Proceedings of
2017 International Conference on Education and Multimedia Technology (ICEMT 2017)

Singapore;
July 9-11, 2017

ISBN: 978-1-4503-5293-2

The Association for Computing Machinery
2 Penn Plaza, Suite 701
New York New York 10121-0701

ACM COPYRIGHT NOTICE. Copyright © 2015 by the Association for Computing Machinery, Inc. Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Publications Dept., ACM, Inc., fax +1 (212) 869-0481, or permissions@acm.org.

For other copying of articles that carry a code at the bottom of the first or last page, copying is permitted provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, +1-978-750-8400, +1-978-750-4470 (fax).

ACM ISBN: ***978-1-4503-5293-2***

Table of Contents

Proceedings of 2017 International Conference on Education and Multimedia Technology (ICEMT 2017)

Preface……………………..……………………………………………………..…. …….…………..…. ……………… **v**

Conference Committees…………………………………………………………………………………………..….. **vi**

Session 1- E-Learning and E-Education

The Effects of Interactive Music and Bubble Feedback using Arduino on Enhancing Physical Activities for Children with Cerebral Palsy 1

Chien-Yu Lin, Wei-Jen Chen, and Chien-Chi Lin

Differences in the Rookie Animation Elements between Taiwan and Japan: A Case Study of College Student Groups with Different Lifestyles.. 8

Cheng-Yong Huang

Speech Interaction of Educational Robot Based on Ekho and Sphinx 14

Zhenyu Li, Xinguo Yu, Bin He, and Rong Hu

Ubiquitous Learning: Information Technology Driving Learning Revolution.. 21

Dexin Hu, Yiwei Wang, and Cheng Chen

Automatic Generation of Plot for Education by Teacher–Student Dialogue Style.. 27

Hironori Ito, Yasuhito Asano, and Masatoshi Yoshikawa

Making an Animation of Overhead Spending to Inspire Undergraduates' Financial Management Concept 33

Ting-sheng WENG, Meng-Hui HSU, Chien-Kuo LI, and Der-Ching YANG

An Exploratory Study on the Memory Performance for Memorizing the English Words through the Apps with Three Different Learning Strategies and Highlights.. 38

Yuan-Bang Cheng and Chuan-Kai Yang

Factors Affecting Student Adoption of E-Learning Systems in Indonesia 43

Hajra Rasmita Ngemba and Syaiful Hendra

Group Collaboration and Effective Tools in Online Education 48

Suhansa Rodchua

Accelerated Learning Method Using Edmodo to Increase Students' Mathematical Connection and Self-Regulated Learning 53

R. Poppy Yaniawati, Rahayu Kariadinata, and Bana G. Kartasasmita

The Implementation of GeoGebra Software-Assited DDFC Instructional Model for Improving Students' Van-Hiele Geometry Thinking Skll 58

Rahayu Kariadinata, R. Poppy Yaniawati, Kanesha Banoraswatii, and Wati Susilawati

Developing an Informal Science Education Activity based on Edmodo 63

Qiusha Min, Guanghui Wu, and Neng Liu

A Comparison of Academic and Non-academic Staffs'Balanced Score Card Based E-Performance Appraisal: A Case Study........ 66

Zeplin Jiwa Husada Tarigan, I Nyoman Sutapa, and Jenny Mochtar

An Online Training Platform Framework for Creative Idea Generation and Development........ 70

Xirong Gao, Jian Yang, and Fei Yang

• *Session 2- E-Commerce and Business Management*

A Study of Barriers to E-Commerce Adoption among Small Medium Enterprises in Indonesia........ 75

Mus Aidah, Hajra Rasmita Ngemba, and Syaiful Hendra

Exploring the Determinants of Viewers' Loyalty toward Beauty YouTubers: A Parasocial Interaction Perspective ...81

Hsiu-Chia Ko and Wen-Ning Wu

The Influence of ERP System to the Company Performance Seen through Innovation Process, Information Quality, and Information Sharing as the Intervening Variables........ 87

Widjojo Suprapto, Zeplin Jiwa Husada Tarigan, and Sautma Ronni Basana

Development of IT Risk Management Framework Using COBIT 4.1, Implementation In IT Governance For Support Business Strategy 92

Jarot S. Suroso and Bayu Rahadi

Preface

This volume contains papers presented at 2017 International Conference on Education and Multimedia Technology (ICEMT 2017), which was held in Singapore during July 9-11, 2017.

ICEMT 2017 provides a scientific platform for both local and international scientists, engineers and technologists who work in all aspects of Education and Multimedia Technology. In addition to the contributed papers, internationally known experts from several countries are also invited to deliver keynote speeches at ICEMT 2017.

The volume includes 18 selected papers which were submitted to the conference from universities, research institutes and industries. Each contributed paper has gone through a rigorous blind peer-review process. They were reviewed by at least two experts who are qualified within this field of E-Business and Internet. The proceeding tends to present to the readers the newest researches results and findings in the related fields.

The chairperson of each session played an important role in guiding the sessions in a timely and efficient manner. To improve the papers and ensure the quality, the reviewers also made great efforts in the given time. Then on behalf of the conference committee, we'd like to express our sincere appreciation to them for their contribution.

We truly believe the participants will find the discussion fruitful, and will enjoy the opportunity for setting up future collaborations.

Best Regards

ICEMT 2017 Organizing Committee

Conference Committees

Conference Chairs

Maode Ma, Nanyang Technological University, Singapore
LIM, Cheolil, Seoul National University, South Korea

Conference Program Chairs

Jason Miin-Hwa Lim, Universiti Malaysia Sabah (UMS), Malaysia
Kazumasa Mori, Bunkyo University, Japan

Conference Technical Committees

CHEE Yam San, Nanyang Technological University (NIE/NTU), Singapore
Zawawi Bin Ismail, University of Malaya, Malaysia
Esther Daniel, University of Malaya, Malaysia
BAEK, Sun-Geun, Seoul National University, South Korea
Vilmante Kumpikaite, Kaunas University of Technology, Lithuania
Chew Fong Peng, University of Malaya, Malaysia
Wen-Chung Shih, Asia University, Taiwan
Sharifah Norul Akmar Binti Syed Zamri, University of Malaya, Malaysia
Cynthia Yolanda Doss, The University of Nottingham Malaysia Campus, Malaysia
Jake Laguador, Lyceum of the Philippines University, Philippines
Aaron Doering, University of Minnesota, USA
Seyithan DEMİRDAĞ, Bulent Ecevit University, Turkey
Kiattichai Saitakham, Rajabhat Rajanagarindra University, Chainhmai
Richard DLC Gonzales, University of Santo Tomas, Philippines
Anabelie V. Valdez, Mindanao State University, Philippines
Khoo Yin Yin, Universiti Pendidikan Sultan Idris, Malaysia
Mariam binti Mohamad, Universiti Sains Malaysia, Malaysia
Malini Ganapathy, Universiti Sains Malaysia, Malaysia
Daisy Jane C. Orcullo, University Utara Malaysia, Malaysia

ICEMT 2017

E-Learning and E-Education

The Effects of Interactive Music and Bubble Feedback using Arduino on Enhancing Physical Activities for Children with Cerebral Palsy

Chien-Yu Lin
Department of special education
National University of Tainan
33, Sec. 2, Shu-Lin St.,
Tainan 700, Taiwan
Tel.: +88662133111 ext 744
linchienyu@mail.nutn.edu.tw

Wei-Jen Chen
Tainan Municipal Yanshuei District
Annei Elementary School
No.96, Xin'annei, Yanshui Dist.,
Tainan City 737, Taiwan

Chien-Chi Lin
Department of Tourism, Food &
Beverage Management
Chang Jung Christian University
No.1,Changda Rd.,Gueiren District,
Tainan City 71101, Taiwan

ABSTRACT

This study uses an interactive music and bubble effect in Arduino to enhance the body strength of children with cerebral palsy. Arduino, using a servo motor and mp3 module function, creates real feedback. This study uses a force-sensitive resistor and laser tripwire circuit sensor transmit as the interactive interface, to enhance the performance and real activity of children with cerebral palsy to perform on physical activities. This study uses a single-case research using an ABAB structure, in which A is the baseline and B is the intervention. The experimental period was 3 months, from March to June 2016. The experimental results demonstrated that the scores for two children with cerebral palsy increased considerably during the intervention phrases. The relative developmental applications of these results are also discussed here.

CCS Concepts

• Human-centered computing →Human computer interaction (HCI) • Interactive systems and tools→User interface toolkits.

Keywords

Cerebral palsy; motivation; single-case research; physical activities

1. INTRODUCTION

1.1 Physical Activity for Cerebral Palsy

Children with cerebral palsy are less physically active compared with their peers with typical development [1]. It has been proven that children with cerebral palsy need less physical activity than non-disabled children. Carlon, Taylor, Dodd, & Shields [2] pointed out people with cerebral palsy are at risk of reduced physical activity and increased sedentary time. The importance of physical activity is not only focused on the effect, but also just as important for enhancing the motivation. Cerebral palsy can affect the ability of children to control the movement of the lower limbs, causing impairment in physical ability and potentially limiting participation in community-based activity [3]. There is evidence suggesting that participating in exercise programs can increase the physical activity of people with CP [4] , and thus our goal is to determine how to increase the motivation for such physical activity.

1.2 Human Computer Interface

Human–computer interaction (HCI) supports an effective and useful communication for individuals [5]. Arduino has changed society, influencing the methods that people use to relate, communicate, work and learn [6], Real-time interactive multimedia is more popular and affordable [7], thus, allowing for the use of technology for people with special needs [8]. However, one of the challenges in HCI is to design systems that are not only usable but also appealing to users [9].

Arduino, as an interactive technology, has attracted an increasing number of specific fields of interest during the last few years. Vorapojpisut [10] presents the concept of rapid prototyping via Arduino for a low-cost gait training for young people with cerebral palsy. DAuria, Persia, & Siciliano [11] discuss HCI becoming popular for patients, for instance during their rehabilitation process, as providing interactive environments can be less boring and also increase motivation.

The main advantages of Arduino technology applications used across different fields have been widely discussed in the literature, such as in museum exhibitions [12] , engineering [13] , logic training [14] , architecture [15] Arduino can also be used in special needs applications, such as the wearable sensing suit in Rogers, Polygerinos, Walsh, & Goldfield [16] , which could make early intervention treatment more accessible for developmentally delayed infants and increase physical ability. A device based on Arduino can lower the technology barrier for students engaging in interactive feedback.

Children with cerebral palsy experience limitations in fine motor control, strength, and range of motion, which can reduce their participation in community and leisure activities [17]. Custom-made alternative devices for children with cerebral palsy are expensive and are not adaptable to different needs [18]. Few leisure pastimes are available for children with cerebral palsy limitations [19].

Recently, many open-source activities have become available, which share their specific technology and programs so users can design and remix the program for their own needs. This study uses

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT '17, July 9–11, 2017, Singapore, Singapore

© 2017 Copyright is held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124117

the Arduino module, which includes hardware and software; their users design open-source hardware and software, via microcontroller-based kits and interactive sensors to control real devices. Arduino can be combined with sensor and kits to design specific interactive feedback: the Arduino website (https://www.arduino.cc/) hosts a free online interactive community, where users can find resources to create what they want to design.

The advantage of this study is that it uses a low-cost, customer interactive product for children with disabilities to train their physical movements and extend their activities.

2. MATERIAL AND METHODS

2.1 Participants

There were two participants in this study, both children with spastic cerebral palsy. Formal parental consent was given at the beginning of the study. This study designed individual physical activities for the children's special needs in order to increase their motion abilities of different body parts and their motivation for physical activity. In this study, we assigned the children with the code names 'Vivian' and 'James'. This two participants has low vision but good at the sounds feedback, and they like music as a stimulate object.

Vivian, the first participant, is an 8-year-old girl with severe spastic cerebral palsy. She cannot talk but can make some sounds to express her feelings. She is unable to stand by herself, but she can stand and lean a wall for a second; all her limbs involuntarily twitch, so she always sits on a customized Kinder chair and uses an H-harness to help her to keep her stable. As she is weak and her limbs move involuntarily, she is always sitting and lacks the motivation to do exercise. Her parents and teachers wanted to train her hand-movement and press abilities, so we gave her two targets: (1) press her index finger on a specific area; (2) use her upper arm to touch a button.

James, our second participant, is a 6-year-old boy with moderate multiple disabilities. He has good upper limb control and poor lower limb control: if he wants to stand, he must use both hands to hold onto the table and pull himself to standing for a few seconds. With lifting lower limb weakness, if he wants to move then he relies on the help of a walker who can walk independently. He can understand oral instructions and give oral feedback and express what he needs. When he sits, he can lift his lower limb, but because traditional training is boring he has no motivation to do that.

In this study, because the two children have different needs, the training parts are different. For Vivian, the body movements are divided into two parts: use the index finger to press a specific area, reach the upper limb for 15 cm to touch a button. For James, the body movement focuses on lifting the lower limbs: starting from a position when the child is sitting upright and the angle between the legs and the floor is at 90 degrees, then lifting one leg to a height of 16.5 cm.

2.2 Apparatus, Material and Setting

In this study we designed an Arduino music bubble device and the participants liked the sound and visual feedback. The interactive feedback was designed using an Arduino microcontroller board, an mp3 module DFPlayer Mini, a Tower Pro SG90 servo motor, laser tripwire circuit and a fan. The apparatus can blow bubbles for a visual stimuli, and play music as an auditory stimuli. The music can be tailored to what the children like, via the microSDHC memory card and mp3 module.

This Arduino microcontroller board could execute the visual and audio feedback using Arduino IDE software. Thanks for Arduino microcontroller board and Arduino IDE software ,they are belong to open source, this study download from http://arduino.cc/en/Main/Sofware, via this study special need to design a real interactive device. Using this Arduino servo motor module, the participants were able to receive real visual and audio feedback. The music balloon device gave the feedback for five seconds and then the bubbles and music paused: if the participant wanted to see more bubbles and listen to their favorite music, they had to execute the specific body movement to switch on the sensor then receive the feedback again. The device's design is similar to an interactive real tool; in this pre-study test, the researcher asked children with developmental disabilities as pilot study, they like to see the real bubble, and they know when they touch the button (sensor), they would receive real feedback. The concept of the study is shown in Figure 1.

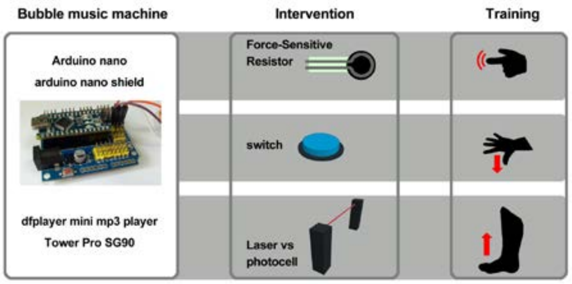


Figure 1. the concept of the study

2.3 General Procedure

Vivian has poor control of her upper and lower limb movements, so this study focused on teaching her how to use her index finger to press something and use her upper limb straighten and press ability. In the index finger press exercise, the researchers pretested to make sure that when the force-sensitive resistor transmitted messages to the Arduino microcontroller with servo motor and mp3 module, the music bubble machine would work for 5 seconds then pause. In the training of her upper limb straighten and press ability, Vivian had to straighten her upper limb and press a real button to get the visual and audio feedback each time. Vivian participated in the experiment on Monday and Wednesday mornings, from March to June 2016. The study design included a ten-minute training process for each session, observed one minute motor performance, then recording the one minute data as a point.

James has poor control lower limb movements, so this study aimed to train him to lift his lower limbs. In the experiments, he sat on an adjustable support chair to make sure he has seat support. The chair had seat belts in a fixed position to avoid body tilt. His feet were to start on the ground and vertical to the ground. The researchers used a laser tripwire circuit to trigger the bubble music machine: the laser light was 16.5 centimeters from the ground, and when James lifted his leg, his foot cut the laser, triggering the Arduino microcontroller with servo motor and mp3 module and the music bubble machine would work for 5 seconds then stop. The researchers selected some music James likes to increase his motivation; if he wanted to see the bubbles and listen to the music, he would lift his leg again. James participated in the experiment on Tuesday mornings, from March to June 2016. His training lasted for ten minutes, then there was an observed one minute motor performance; each training day the researchers recorded the data as a point.

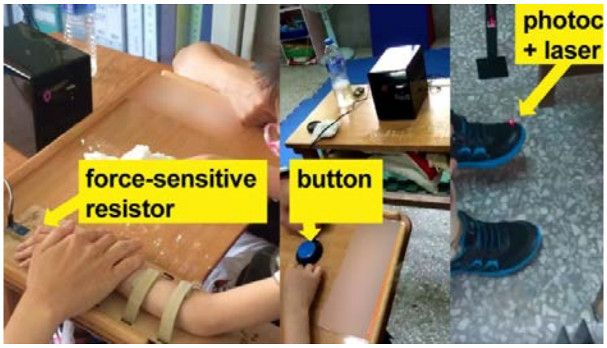


Figure 2. the experimental setup

This study focused on the effect of the Arduino module and the interactive visual and audio feedback on enhancing physical activities for children with cerebral palsy. Because the two children both have poor vision, the music bubble device was placed in front of them. They understood the setup of the device and when they did the correct body movement they could make the music bubble device work. Figure 2 shows the experimental setup.

This study examined how to use Arduino and the extensive module as a switch to let the music bubble device work. With the special visual effect of the bubble flying the air, it made a dynamic real-time feedback effect.The experimental design adopted an ABAB reversal design for single-case research. This is a tool in special education and assistive technology [20][21] , in which A (baseline phase) was followed by B (intervention phase), a return to baseline phase, and then a final intervention phase. The A represented baseline phases while the B represented intervention phases with the Arduino music bubble machine. The experiment was divided into four phases: Baseline 1(A1), Intervention 1(B1), Baseline 2(A2), and Intervention 2(B2). Single-case experiments can be used to assess the efficacy of an intervention or treatment for a single person [22]. Single-case experiments offer experimental control through the systematic manipulation of an instructional strategy [23]. Cohen[24] offered a large (>0.35), medium (0.15–0.35), or small effect size (0.02–0.15): an effect size f^2 for predictive regression equations that could indicate the actual effect.

The data was collected over almost 3 months. Vivian participated two day a week, whereas James participated one day a week. On each experimental day, the training lasted for ten minutes, then there was an observed one minute motor performance, during which we collected the data points.

In the first phase, A1, we collected three data points. In B1, the intervention used an Arduino bubble music machine, from which we collected five data points. In A2, the Arduino module was withdrawn and we collected three data points. In B2, the intervention setup was the same as for B1 and we collected five data points.

3. RESULTS

This study executed a process, including training for 10 minutes then an assessment process for 1 minute then the researcher would record the assessment data as one point. The results of this study are based primarily on descriptive and qualitative analyses of the data. The data collected from all four phases were used to create a graph, in which the x-axis indicated the four different phases and points scored, while the y-axis showed the number of times the participant did the correct movement.

3.1 Vivian's Result (Code Name)

Vivian finds taking and operating items with her upper limb difficult. When she stretched her upper limb or used her index finger, the bubble appeared and the music played for five seconds then stopped. From this interaction, Vivian understood that when she pressed this specific area or reach her upper limb she would receive the feedback, and that when the interactive feedback disappeared, she has to do the physical training again to enjoy the bubble and the music. Figure.3 shows Vivian's data.

After training lasted for ten minutes, there was an observed one minute motor performance, during which we collected the data points. During baseline, an index finger press ability (A1: three sessions) got three points but the mean for each session was low: left index finger, mean score = 0.67, range of 0–1 over 60 seconds; right index finger, mean score = 0.33, range of 0–1 over 60 seconds. The results of Baseline 1 (A1) indicated that Vivian lacked motivation for index finger press activities as she maintained a static position sitting on her customized Kinder chair. When the experiment proceeded to Intervention 1 (B1: five sessions), the left index finger mean score was 2.4, with a range of 1–4 over 60 seconds, the right index finger mean score was 4, with a range of 3–5 over 60 seconds, indicating a different response. Vivian achieved higher scores in B1 than in A1. In B1, Vivian could understand that when she used her index finger to press the specific area, she could receive the feedback; and when five seconds later then bubble and music disappeared, if she used her index finger to press the same area again, she got the bubble and the music back. In Baseline 2 (A2: three session) the intervention was withdrawn, and the mean for A2 reverted to the same as that for A1: the mean score of her left hand for A2 was 0.67, with a range of 0–1 over 60 seconds; the mean score of her right hand for A2 was 1, with a range of 0–2 over 60 seconds. The results from A2 indicated that when the intervention was withdrawn, Vivian again lacked the motivation to do the index finger press activities as there was no attraction to motivate her to perform the physical activities, so she sat immobile on her Kinder chair just as before. In Intervention 2 (B2: five sessions) the study indicated a difference from A2: left index finger, mean score = 2.8, with a range of 2–4 over 60 seconds; right index finger, mean score = 3.8, with a range of 3–5 over 60 seconds. With the interventions materials, Vivian used her index finger to press the specific area and understood that when she performed this action repeatedly she could enjoy the visual and audio feedback, thus representing an attractive motivation for her.

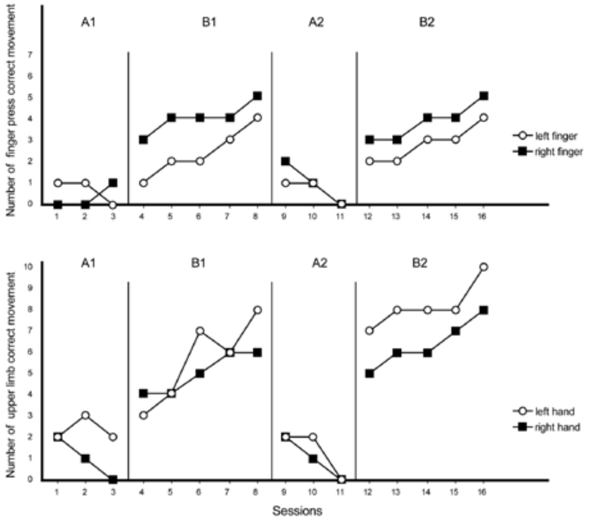


Figure 3. Vivian's data

In the effect of left index finger press measurements, for A1 and B1 the effect size f^2 = 5.1404. For A2 and B2, the effect size f^2 = 3.5707. The intervention phase demonstrated a significantly higher effectiveness than the baseline: the movement from A1 and B1 produced a large effect (5.1404 > .35), as did that from A2 and B2 (3.5707 > .35), with the interventions producing an immediate effect on Vivian's physical activities. In the effect of right index finger press measurement, for A1 and B1 the effect size f^2 =3.6794. For A2 and B2, the effect size f^2 = 12.4870. The intervention phase demonstrated a significantly higher effectiveness than the baseline; The movement from A1 and B1 produced a large effect (3.6794 > .35), as did that from A2 and B2 (12.4870 > .35), with the interventions producing an immediate effect on Vivian's physical activities.

From a visual analysis, for left or right hand the score significantly increased at the B1 phase, and the B2 score results were higher than for A2. The effect sizes were both large. The results demonstrated that the improvement between baseline phases and intervention phases was significant ($p = .00 < .05$); from the Kolmogorov–Smirnov statistical test, the results demonstrated that the improvement between the baseline phases and the intervention phases was significant. Thus, this intervention had a significant effect on Vivian's physical activity.

During baseline, In upper limb reach ability (A1: three sessions) got three points but the mean for each session was low: left upper limb, mean score = 2.33, range of 2-3 over 60 seconds; right upper limb, mean score = 1, range of 0-2 over 60 seconds. The results of Baseline 1 indicated that Vivian lacked motivation for upper limb reach ability as she maintained a static position sitting on her customization Kinder chair. When the experiment proceeded to Intervention 1, the left upper limb , mean score = 5.6, range of 3-8 over 60 seconds; right upper limb, mean score = 5, range of 4-6 over 60 seconds, indicating a different response. Vivian got higher scores in B1 than in A1. In B1, Vivian understood that when she used her upper limb to reach the button she could enjoy the visual and audio feedback, thus representing an attractive motivation for her.

In Baseline 2 (A2: three session) the intervention was withdrawn, and the mean for A2 reverted to the same as that for A1: the mean score of her left upper limb for A2 was 1.33, with a range of 0-2 over 60 seconds; the mean score of her right upper limb for A2 was 1.00, with a range of 0-2 over 60 seconds. The results from A2 indicated that when the intervention was withdrawn, Vivian again lacked the motivation to do the upper limb activities as there was no attraction to motivate her to perform the physical activities, so she sat immobile on her Kinder chair just as before. In Intervention 2 (B2: five sessions) the study indicated a difference from A2: left upper limb, mean score = 8.2, with a range of 7-10 over 60 seconds; right upper limb, mean score = 6.4, with a range of 5-8 over 60 seconds. With the interventions materials, Vivian used her upper limb to reach the specific area and understood that when she performed this action repeatedly she could enjoy the visual and audio feedback, thus showing an attractive response for her.

In the effect of left upper limb reach ability measurements, for A1 and B1 the effect size f^2 = .6929. For A2 and B2, the effect size f^2 = 2.2821. The intervention phase demonstrated a significantly higher effectiveness than the baseline: the movement from A1 and B1 produced a large effect (.6929 > .35), as did that from A2 and B2 (2.2821 > .35), with the interventions producing an immediate effect on Vivian's upper limb reach ability. In the effect of right upper limb reach ability measurement, for A1 and B1 the effect size f^2 =10.6757. For A2 and B2, the effect size f^2 = 16.2292. The intervention phase demonstrated a significantly higher effectiveness than the baseline; The movement from A1 and B1 produced a large effect (10.6757 > .35), as did that from A2 and B2 (16.2292 > .35), with the interventions producing an immediate effect on Vivian's physical activities.

From a visual analysis, for both the left or right upper limb the score significantly increased at the B1 phase, and the B2 score results were higher than for A2. The effect sizes were both large. The results demonstrated that the improvement between baseline phases and intervention phases was significant ($p = .00 < .05$); from the Kolmogorov–Smirnov statistical test, the results demonstrated that the improvement between the baseline phases and the intervention phases was significant. Thus, this intervention had a significant effect on Vivian's upper limb physical activity.

3.2 James' Result (Code Name)

Although James has cerebral palsy and low vision, he could see the bubble and his hearing ability is very good. He sat on the chair with a belt to keep him in a stable position. He had to lift his lower limb over 16.5 cm, so that the laser will be broken and trigger the Arduino microcontroller. Although he has low vision, we found that he could track the bubble motion; he has good hearing ability so the audio feedback was important information. The audio contents were made up of recordings of music that he likes: he told the researcher what songs he likes and the research prepared the mp3 in advance.

After five seconds, the bubble and music pause, motivating him to lift his lower limb reach over 16.5 cm from the ground in order to keep listening. Figure 4 shows James's data. For Baseline 1, the mean for the A1 session was low, with a mean score of 1 over 60 seconds; the right lower performance scores for the A1 session was low, with a mean score of 1.67 and a range of 1–2 over 60 seconds. These results indicated that James lacked the motivation for lifting his both lower limb.

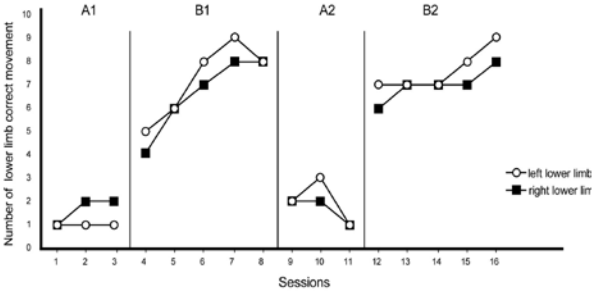


Figure 4. James' data

When the experiment proceeded to Intervention 1 (B1: five sessions): left lower limb, mean score = 7.2, with a range of 5–9 over 60 seconds; right lower limb, mean score = 6.6, with a range of 4–8 over 60 seconds, indicating different stability in B1.

James understood that when he lifted his lower limb to 16.5 cm, he could hear the music and see some bubbles; then, five seconds later, when the visual and audio feedback paused, he had a strong motivation to lift his lower limb as he was expecting to hear more feedback. In Baseline 2 (A2: three sessions), the intervention was withdrawn, and the mean for A2 reverted to that of A1: left lower limb, mean score = 2, with a range of 1–3 over 60 seconds; right lower limb, mean score = 1.67, with a range of 1–2 over 60 seconds. The results of A2 indicated that James also lacked motivation to exercise both his lower limbs. For Intervention 2 (B2: five sessions), there was a difference from A2: left lower limb, mean score = 7.6, with a range of 7–9 over 60 seconds; right lower limb, mean score = 7, with a range of 6–8 over 60 seconds. When James found that he could control the feedback again, he appeared excited and lifted his lower limb to reach the high of 16.5 cm. He understood that when he repeated this action, he could obtain the feedback; although he has low vision, we put the bubble machine near his face so he could follow the bubble flow and enjoy the music. The feedback was a big achievement for him.

In the effect measurement, for James' left lower limb, for A1 and B1, the effect size f^2 =0.5000. for A2 and B3, the effect size f^2 =0.7558；For James' right lower limb, for A1 and B1, the effect size f^2 =0.4839. For A2 and B3, the effect size f^2 =2.3861.

The intervention phase showed significant higher effectiveness than the baseline as there was a big difference between A1 and B1 and A2 and B2. With the interventions producing an immediate effect on both left and right James's lower limbs. No matter left or right, A1 and B1 produced a large effect (0.5000, 0.4839 > 0.35), as did A2 and B2 produced a large effect (0.7558, 2.3861 > 0.35), with the interventions producing an immediate effects on James's lower limbs activities. The intervention phase demonstrated significantly higher effectiveness than the baseline; thus, the interventions produced an immediate effect on James's lower limbs activity. B1 and B2 score results were higher than for A1 and A2. The effect sizes both are both large effect. The results demonstrated that the improvement between baseline phases and intervention phases was significant (p= .00 < .05). From the Kolmogorov–Smirnov statistical test, the results indicated that the improvement between the baseline and intervention was significant,. Therefore, this study suggests that a success intervention could persuade James to engage in lower limb activity training.

4. DISCUSSION

Maker developing more and more, now it is belong to maker era, Arduino provides a simple development environment of hardware and software and many people use open-source Arduino micro-controllers to make products. However, there are always new sensing elements created, so there is continual development, based on the performance of people with special needs, to design the relative trigger method and relative feedback.

In this study, the use of technology from an Arduino module to make a music bubble interactive machine was investigated for two children diagnosed with cerebral palsy. At Baseline 1 and 2, Vivian only sat in her Kinder chair. From the results of Intervention 1 and 2, she trained her index finger press ability and upper limb movement. The research asked her mother what music she liked and then used the relative music as audio feedback. Thanks go to her teacher for suggesting we use the bubble effect as invention, as the results showed that audio and visual invention had a positive reaction, so this study supported her motivation to do finger press and upper limb movement training.

At Baseline 1 and 2, James sat on his chair, or lifted his lower limb to a 16.5 cm height. In this case, the study used real bubbles and audio feedback. If he lifted his feet to the height, it could block the laser and trigger the feedback; James then could hear the music and see the bubble, because the bubble machine was put in front of his face. Sometime the bubble flow touched his skin, which he enjoyed. For interventions 1 and 2 he sat on a chair, and lifted his lower limb. He also showed the cognition that when he did the lower limb activity, he could get the feedback. He also liked to use his low vision eye to follow the bubble flow in different directions. Because he knew the music would pause, he was motivated to do the lower limb training.

While Arduino modules may be suitable for normal people in many different fields, just as robotics, the original design does not suit developmental or physical disabilities; when children with cerebral palsy could not have an opportunity to control the games, the product may not be suitable. Before the study, we observed the children's interests for almost 1 year, got many suggestion from the participants and their teachers then designed the study. The children also liked to see bubbles flying in the air, along irregular routes, like a big canvas that other visual effects could not display. This study used an mp3 module so the music could be tailored to the likes of the participants.

In related research, Shih & Chiu [25] played a participant's favorite video and Lin & Chang [26] used multimedia as a solution to improve motivation and enhance physical activities. This study also focused on different feedback according to which video and audio could attract the participants.

The results showed that the bubble music interaction is significant for children with cerebral palsy. From the research results, this methodology could be applied to custom-made interactive toys. After this study, the researchers designed other physical activities for James to train his other abilities: we asked him to sit down and put the press switch in front of him; he must hold on to the table and let himself stand up and then touch the button and receive the feedback. In the experimental process, we found that using bubbles is not only a visual effect because bubbles will fly in random patterns. Vivian could follow the bubble trajectory and James, although he must sit on the specific chair and his hand speeds were not quick enough to poke the bubble, when some bubble landed on the table he would poke it – also a positive feedback.

In a questionnaire survey, the parents said that this experiment not only improved motivation in the action performance, but also effectively enhanced the action performance for cerebral palsy children, and helped the children’s motor performance to increases smoothly.

Patients with partial paralysis, muscle and nerve damage, paralysis of the brain, spinal cord injury, the elderly, and those who can still move some parts of their limb, could benefit from this methodology, and the results of this study show there could be a flexible design. For them, training is very important for body movements—not only to prevent body movements and functions worsening but to further enhance the individual body movements and functions. It also could be used in their home, which could be a big help for people with cerebral palsy. The same concept can be used but only the contents need to be redesigned, allowing for custom-made designs for developmental disabilities.

5. ACKNOWLEDGMENTS

This work was financially supported by the National Science Council, Taiwan, under the Grant No. 105-2511-S-024 -003 -.

6. REFERENCES

[1] O'Neil, M. E., Fragala-Pinkham, M., Lennon, N., George, A., Forman, J., and Trost, S. G. 2016. Reliability and validity of objective measures of physical activity in youth with cerebral palsy who are ambulatory. *Physical Therapy, 96*(1), 37-45.

[2] Carlon, S. L., Taylor, N. F., Dodd, K. J., and Shields, N. 2013. Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. *Disability and Rehabilitation, 35*(8), 647-655.

[3] Tang, K. T., Richardson, A. M., Maxwell, D., Spence, W. D., and Stansfield, B. W. 2013. Evaluation of an activity monitor for the objective measurement of free-living physical activity in children with cerebral palsy. *Archives of Physical Medicine and Rehabilitation, 94*(12), 2549-2558.

[4] Bania, T. A., Dodd, K. J., Baker, R. J., Graham, H. K., and Taylor, N. F. 2016. The effects of progressive resistance training on daily physical activity in young people with cerebral palsy: a randomised controlled trial. *Disability and Rehabilitation, 38*(7), 620-626.

[5] Oliveira, E., Sousa, G., Magalhães, I., and Tavares, T. 2015, August. The use of multisensory user interfaces for games centered in people with cerebral palsy. *International Conference on Universal Access in Human-Computer Interaction* ,514-524. Springer International Publishing.

[6] Ashhad, B. K., Bristy, I. S., Khatun, H., Kalam, K., and Zahir, E. 2015. Design and Implementation of an Interactive Service Robot. *Journal of Computer and Communications, 3*(11), 121.

[7] Hwang, T. H. T. 2012. Exploring Real-Time Video Interactivity with Scratch. Unpublished undergraduate dissertation, Massachusetts Institute of Technology, USA.

[8] Kagohara, D. M., Sigafoos, J., Achmadi, D., O’Reilly, M., and Lancioni, G. 2012. Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders*, 6, 304–310.

[9] Bonnardel, N., Piolat, A., and Bigot, L.L. 2011. The impact of colour on Website appeal and users’ cognitive processes. *Displays*, 32, 69–80.

[10] Vorapojpisut, S. 2015. Software Development for a Pediatric Gait Trainer: From LabVIEW VI to Arduino Sketch. *International Journal of Engineering and Technology, 7*(6), 508.

[11] DAuria, D., Persia, F., and Siciliano, B.2016, February. Human-Computer interaction in healthcare: How to support patients during their wrist rehabilitation. *Proceedings of the 2016 IEEE Tenth International Conference on Semantic Computing* ,325-328. IEEE.

[12] Schaeffer, J., and Lindell, R. 2015, January. Arduino in museum exhibition: lessons learned when working with design students inexperienced in coding. *Proceedings of the the Ninth International Conference on Tangible, Embedded, and Embodied Interaction* ,715-720. ACM.

[13] Jamieson, P., and Herdtner, J. 2015, October. More missing the Boat—Arduino, Raspberry Pi, and small prototyping boards and engineering education needs them. *Proceedings of the Frontiers in Education Conference* ,1-6. IEEE.

[14] Albayrak, A., Albayrak, M., and Bayir, R. 2015, August. Design of Matlab/Simulink based development board for fuzzy logic education. *Proceedings of the 2015 IEEE International Conference on Fuzzy Systems* ,1-7. IEEE.

[15] Pinar, A., Wijnen, B., Anzalone, G. C., Havens, T. C., Sanders, P. G., and Pearce, J. M. 2015. Low-cost open-source voltage and current monitor for gas metal arc weld 3D printing. *Journal of Sensors*,2015,1-8.

[16] Rogers, E., Polygerinos, P., Walsh, C., and Goldfield, E. 2015. Smart and connected actuated mobile and sensing suit to encourage motion in developmentally delayed infants. *Journal of Medical Devices, 9*(3), 030914.

[17] Chang, Y.J., Chen, S.F., and Huang, J.D. 2011. A Kinect-based system for physical rehabilitation: A pilot study for young adults with motor disabilities. *Research in Developmental Disabilities*, 32, 2566–2570.

[18] Standen, P. J., Camm, C., Battersby, S., Brown, D.J., and Harrison, M. 2011. An evaluation of the Wii Nunchuk as an alternative assistive device for people with intellectual and physical disabilities using switch controlled software. *Computers & Education, 56*(1), 2-10.

[19] Lotan, M., Yalon-Chamovitz, S., and Weiss, P. L. 2009.Lessons learned towards a best practices model of virtual reality intervention for individuals with intellectual and developmental disability. *Virtual Rehabilitation International Conference*, 70 - 77.

[20] Shih, C. T., Shih, C. H., and Luo, C. H. 2013. Assisting people with disabilities in actively performing physical activities by controlling the preferred environmental stimulation with a gyration air mouse. *Research in Developmental Disabilities, 34*(12), 4328-4333.

[21] Neely, L., Rispoli, M., Camargo, S., Davis, H., and Boles, M.2013. The effect of instructional use of an iPad on challenging behavior and academic engagement for two students with autism. *Research in Autism Spectrum Disorders,* 7, 509–516.

[22] Michiels, B., Heyvaert, M., Meulders, A., and Onghena, P. 2016. Confidence intervals for single-case effect size measures based on randomization test inversion. *Behavior Research Methods*, 1-19.

[23] Hagans, K. S., and Powers, K. 2015. Measuring credential candidates' impact on student achievement. *Action in Teacher Education,* 37(4), 355-372.

[24] Cohen, J. 1988. Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

[25] Shih, C. H., and Chiu, Y. C. 2014. Assisting obese students with intellectual disabilities to actively perform the activity of walking in place using a dance pad to control their preferred environmental stimulation. *Research in Developmental Disabilities, 35*(10), 2394-2402.

[26] Lin, C. Y., and Chang, Y. M. 2014. Increase in physical activities in kindergarten children with cerebral palsy by employing MaKey–MaKey-based task systems. *Research in Developmental Disabilities, 35*(9), 1963-1969.

Differences in the Rookie Animation Elements between Taiwan and Japan: A Case Study of College Student Groups with Different Lifestyles

Cheng-Yong Huang
Dep. Arts and Design, NDHU
No. 1, Sec. 2, Da Hsueh Rd.
Shoufeng, Hualien, Taiwan, R.O.C.
+886-3-863-5197
yong@gms.ndhu.edu.tw

ABSTRACT

Using 10 rookie animated works from Taiwan and Japan, this study understands the differences in the rookie animated works from perspective college students in Taiwan who are fond of animation. In terms of lifestyle, this study adopts factory analysis to downsize the components from the original 16 AIO questions into 4 components, including planning, fashion, learning and animation; In addition, this study adopts K-mean clustering to divide the respondents into four groups, including cool boys, indoor boys, bookworm and fashionable boys. The evaluation of animation elements consisted of seven items, including story, style, character, scenario, dynamics, storyboard and sound which are then subjected to multiple-variable statistical analysis. The results tell us that there are statistically significant differences in four items aside from styles, such as story, character, dynamics and storyboard. The statistical results show that respondents with different lifestyles generate a different evaluation of animation elements.

CCS Concepts

• Applied computing → Document management and text processing→ Document preparation→ Multi / mixed media creation • Applied computing→ Arts and humanities→ Media arts.

Keywords

Animation Preference, Life Style, Factor Analysis, K-mean Clustering, ANOVA

1. INTRODUCTION

In 1970s, Taiwan's animation industry played the role as the foundry base for America and Japan and even became the world's largest animation processing center. However, Taiwan’s own animated works have not enjoyed great development since the very beginning [1]. Along with the economic rise of Mainland China and Southeastern Asia, the animation foundry gradually moved to places with cheaper labor and Taiwan’s animation industry has transformed from OEM to private labels.

The development of computer graphics (CG) technology has changed the animation production process, affecting the global animation production line division [2]. Taiwan owns excellent technology and quality but fails in the development of its private-label animated films and television programs. On the contrary, Japan is a pioneer in the global animation industry. For example, the animated works of Miyazaki Hayao and Shinkai Makoto became popular around the world and there are several high quality animated films released every year. Although Taiwan followed the steps of Japan and had set up a large number of multimedia animation departments, it has not created its own animated films and programs with its own characteristics. The common practices are that Taiwan played the role as the foundry base, sold them back abroad and are shown in Taiwan. It is worthy to discuss and explore the difference between the animated works of Japan and Taiwan.

The main purpose of this study is to explore the differences in animation between Taiwan and Japan through rookie animation, which refers to the animation works created by students who have received the necessary animation education and just graduated from school. The Japan CG Animation Contest is a great platform with long history for competition on rookie animation, most of which are non-commercial and original animated works. So far, this platform has found many famous animated directors, such as Shinkai Makoto. By the end of 2014, Japan CG Animation Contest has been promoted in Taiwan along with an exhibition of Taiwan’s rookie animation. This study uses a questionnaire based on the preference of 10 rookie animation groups from Taiwan and Japan through the AIO lifestyle scale. The respondents are college students who are fond of these 10 animated works. This study adopts a multivariate statistical analysis to understand the differences between college students with different lifestyles in terms of evaluating animation elements in Taiwan and Japan for the reference of the Taiwanese animation education industry.

2. LITERATURE REVIEW

2.1 Animation

Based on the human nature of visual temporal rendition, animation is a continuous play of a series of still images. Each image will only stay at one-tenth of a second; the visual dynamic effects are created. The essence of animation lies on drawings that

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.
ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124118

project actions. The nature of animation is to inform the occurrence of events through the feature of continuous images and human beings can respond to the expressed messages through vision. Animation enjoys the advantage of the performance of time and becomes visually attractive to spectators [3].

Lasseter, executive vice president of Pixar Animation Studios, said that successful animated films have three elements: a brilliant storyboard, a realistic animated scene, and moving characters. The three elements of animation are plot, pictures, and sound. Plot is the soul of animation which is critical towards the development of the whole work, the dialogue interaction and the ideas that the works try to express. The pictures are the basic elements of animation, including modeling, background, storyboard, special effects and etc. In the era of audio and video co-existence, the sound plays an indispensable part of the animation [4, 5].

Chen & Hsu (2007) conducted a study on the attractive factors of flash animation by collecting popular flash animations at that time and applied the Evaluation Grid Method (EGM) for in-depth interviews and extracted the attractive factors of flash animation. Afterwards, this study uses focus groups for discussion and further confirmed the attribution relationship among every flash animation feature and attractive factor. Through the questionnaires distributed in the Internet, 80 respondents offered their evaluation of animation preferences and calculated and analyzed the acquired data with the method of quantification theory I. The results show that the main factors of flash animation can be summarized into “story or plot,” “character shaping,” “scene visual style,” “sound,” and “color application”[6].

2.2 Life Style

Lifestyle mainly refers to personal specific life models. The term lifestyle is often discussed among various social groups or social hierarchies. In the late 1960s and 1970s, it has been widely used in the marketing circles, making the market segment more accurate and appropriate. Hawkins, Best & Coney (1986) said that lifestyle is way of life. In simple words, lifestyle is a complex integration of various levels of culture, values, demographic variables, social status, reference groups, family, personality, motivation, cognition, learning, and etc. Lifestyle can impact the decision-making process of individuals through the influence of demands and attitudes [7].

The AIO (Activity Interest Opinion) questionnaire is the most directly related to personal activities, interests, and opinions and is currently the most common measurement method. Lifestyle focuses on the value and behavior of consumer and social culture, from which we can observe their lifestyles, attitudes and opinions [8]. Activity refers to the specific activities, such as watching TV and shopping, which can be studied through observation but their reasons cannot be measured. Interest refers to some affairs that individuals are excited about and paid continuous attention towards them. Opinion refers to the response of individuals to some problems or issues in the external environment. Joseph T. Plummmer (1974) offered a comprehensive description of the above three components and summarized the sub-projects to measure 27 lifestyles[9] as shown in Table 1.

Table 1. The concept and application of lifestyle segmentation

Activities	**Interests**	**Opinions**
Work	Family	Themselves
Hobbies	Home	Social Issues
Social Events	Job	Politics
Vacation	Community	Business
Entertainment	Recreation	Economics
Club Membership	Fashion	Education
Community	Food	Products
Shopping	Media	Future
Sports	Achievements	Culture

3. QUESTIONNAIRE AND METHOD

3.1 Questionnaire Design

The questionnaire is consisted of the animation evaluation and lifestyle. In the animation evaluation, the questionnaire adopts the above animation elements from the literature reviews and evaluates these 10 rookie animation groups from the seven items of story, style, character, scenario, dynamic, storyboard, and sound. Three professors have been consulted to select lifestyle concepts that are appropriate for AIO evaluation. With references of other related lifestyle questionnaires, the experts selected 16 items that are appropriate for the lifestyle questionnaire that will be used in this study. After the item analysis, this study deleted three items whose critical ratios failed to achieve significant difference and the remaining 13 lifestyle items are summarized in Table 2. The whole questionnaire makes use of the seven-order Likert scale method to measure the degree of preference for these items.

Table 2. Items in the Lifestyle Questionnaire

Category	**Concept**	**Questions**
Activities	Hobbies	Q1. I like to watch animations and keep abreast of new animated news.
	Social Events	Q2. I will often discuss social events with friends and family.
	Club Membership	Q2. I will often discuss social events with friends and family.
	Sports	Q4. I will exercise regularly.
Interests	Home	Q5. I attach great importance on family life and will often be reunited with my family.
	Recreation	Q6. I will surf the Internet to understand and gain new knowledge on methods of animation production.
	Fashion	Q7. I like to follow the popular trend.
	Achievements	Q8. I am fond of learning.
Opinions	Themselves	Q9. I think leisure is very important and will take a holiday every year.
	Education	Q10. I often read newspapers and magazines to gain new knowledge.
	Future	Q11. I plan to be involved in animation in the future.
	Future	Q12. I have already planned my own future.
	Culture	Q13. I prefer popularity rather than practicality.

3.2 Analysis Method

In terms of lifestyle items, this study adopts factor analysis to extract the lifestyle factor dimensions and then makes use of the scores of factor dimensions for every respondent to classify them into different groups with K-mean clustering. This study adopts ANOVA to test whether or not there are significant difference in the animation preference of college students with different lifestyles and their acquisition of this preference.

Factor analysis is a statistical technique of dimension downsizing to find a set of smaller number of facets or factors to replace another set of larger number of variables. It is a kind of multivariate statistical analysis method which is related with correlation coefficient among random variables. The main purpose of factor analysis is to find out its structure to interpret a group of variables with mutual correlation through a few factors and to keep most of the information as well. Afterwards, factor analysis will rename these factors to downsize the data and components [10].

The K-mean clustering method is one of the simplest and most common techniques among other clustering methods. The main concept is to assign N data elements to the processing of K groups. The goal is to find whether the elements included in every group are similar and the differences among different groups [11]. Using the SPSS software, the K-mean clustering method can set the number of different groups. In order to achieve an effective distinction and identification, this study conducts a single factor variance analysis to ensure that there are significant differences among the different factor dimensions.

As a very common statistical method used in various studies, this study adopts ANOVA to test the significant difference among the means of three groups (or above). In other words, this study tests whether or not the expectation values of these three interdependent groups (or above) are the same and to compare the differences among all the samples. If there is only one ANOVA for independent variables, it is called as One-Way ANOVA. This study adopts One-Way ANOVA for animation evaluation for statistical analysis to understand the differences in the evaluation of different rookie animation elements among different groups.

4. RESULT

The respondents of this study are college students of 10 rookie animation groups from Taiwan and Japan. They are first invited to answer the lifestyle questionnaire and the animation evaluation after seeing the animated works. Animated works are shown one by one. The whole activity takes about two hours. There are 33 questionnaires returned, four were invalid ones, leaving only 29 valid questionnaires for statistical analysis.

4.1 Lifestyle Analysis

4.1.1 *Factor Analysis*

This study adopts a factor analysis to downsize the factor dimensions of 13 lifestyle questions and keep only four factors whose characteristic values are bigger than 1. The accumulative total variances explained of original variables were 75.391% and the KMO test value was 0.662. The principal component analysis has been conducted by an orthogonal rotation through the Varimax Method and the component matrix. The rotation is shown in Table 3. This study adopts the items whose absolute values of loadings for all elements are bigger than 0.5 to interpret the extracted factor dimensions and rename them accordingly [10], such as planning, learning, fashion and animation. The credibility of all factor dimensions are greater than 0.5 Cronbach's α (Cronbach, 1951), indicating that all factors are correct and reliable [12].

Table 3. Factor analysis matrix

Items	Component			
	Planning	Fashion	Learning	Animation
Q4	.863	.015	.007	.006
Q2	.812	-.093	.172	.307
Q9	.727	.495	.126	-.201
Q5	.584	.195	.349	.237
Q3	.546	.439	.404	-.384
Q13	-.026	.951	.055	.039
Q7	.228	.896	.068	.149
Q11	.021	.569	.303	.498
Q8	.055	-.027	.926	.117
Q10	.193	.216	.704	.112
Q12	.522	.082	.560	.216
Q1	.097	-.068	.182	.834
Q6	.132	.406	.074	.765
Eigenvalue	4.876	1.949	1.815	1.616
CPV%	37.511	52.500	66.471	75.391
Cronbach's α	.825	.834	.710	.616
Note:KMO=.662, CPV=Cumulative Percentage of variance				

4.1.2 *K-mean clustering*

This study makes use of the acquired four life style factor analysis scores as basis and adopts K-mean cluster analysis (Afifi and Clark, 1990) afterwards. First of all, this study has categorized them into three groups and the results found that there are no significant differences between fashion and learning components using the F-test. There are no significant difference between the components of fashion and learning using the F-test. There are significant differences on each component in four groups using the F-test. Consequently, this study divides the college students into four groups and the F-test with K-mean groups are shown in Table 4.

Table 4. K-mean grouping ANOVA analysis

ANOVA	Three Groups		Four Groups	
	F	Sig.	F	Sig.
Planning	35.068	.000*	12.984	.000*
Fashion	3.335	.051	8.951	.000*
Learning	.477	.626	5.306	.006*
Animation	7.104	.003*	4.254	.015*

In order to understand whether or not the clustering effects of K-mean cluster analysis are good and stable, this study analyzes the variances from six lifestyle components for these four groups to understand whether or not there are significant differences among each factor in clusters. The results, shown in Table 5, found that there is a significant difference on all components between these four groups, indicating that the clustering effects are good.

According to the analysis of the tables above, this study deduces the meaning of the groups and renames them accordingly: Group 1 gives more importance on planning and fashion components and has a certain amount of interest and attention on animation components. This study renames it as "Cool Boys." Group 2 lays great emphasis on animation components which are way higher than those of other components. This study renames it as "Indoor Boys." Group 3 gives importance on learning components and they are negative and indifferent towards other components. This study renames it as "Bookworm." Group 4 highly seeks fashion components and they are negative towards other components. This study renames it as "Fashionable Boys."

Table 5. Post-hoc test and renaming of four groups

ANOVA	G1	G2	G3	G4	Post-hoc test
Planning	**.87**	**-1.07**	.23	-.70	(12)(14)(23)(34)
Fashion	**.61**	**-.77**	**-.89**	**.57**	(12)(13)(24)(34)
Learning	-.02	-.57	**1.01**	-.55	(13)(23)(34)
Animation	.36	**.84**	-.41	-.70	(14)(23)(24)
Quantity	10	5	7	7	
Renaming	Cool Boys	In-door Boys	Book worm	Fashionable Boys	

4.2 Analysis of Animation Evaluation

4.2.1 The Differences on the Evaluation of Animation Elements of Rookie Animation between Taiwan and Japan

There are five animation groups each for Taiwan and Japan. This study conducts T-test for independent samples and the results show that among these seven animation elements, the respondents have a higher evaluation on the style of animated works from Japan than Taiwan and Taiwan outperforms Japan in the remaining elements. There are significant differences between these works in terms of story, character, dynamics and storyboard. It is self-evident that the major differences in the animated works between Taiwan and Japan lie in their styles and Taiwan should strive for growth in this respect. The summary of the T-test results for independent samples for the animation elements evaluation of animated works from Japan and Taiwan is shown in Table 6.

Table 6. The summary of t-test results for independent samples between japan and Taiwan

T-test	Taiwan	Japan	F	Post-hoc test
Story	5.26	4.75	8.900*	Taiwan>Japan
Style	5.42	5.63	1.873	Japan>Taiwan
Character	5.59	5.28	4.019*	Taiwan>Japan
Scenario	5.36	5.10	2.880	Taiwan>Japan
Dynamics	5.61	5.16	8.564*	Taiwan>Japan
Storyboard	5.54	5.18	5.725*	Taiwan>Japan
Sound	5.25	5.04	1.821	Taiwan>Japan

4.2.2 The Differences on the Evaluation of Animation Elements of Rookie Animation among Different Groups

According to the results of four groups obtained through the K-mean clustering method, this study conducts a single factor variance analysis for 10 animation groups and the results show that there are significant differences on style, dynamics and storyboard among seven items, in which the evaluation was carried out for 10 elements of animation evaluation. The results showed that there were significant differences between the three styles of animation, dynamic and storyboard. Generally, the evaluation of the animation elements are very high, otaku to the evaluation of all the elements are the lowest, otaku in the lifestyle which showed a strong interest in a moving picture, in the six animation elements inside the story elements they are dissatisfied Highest (lowest score). The single factor analysis of each group in the animation project is shown in Table 7.

Table 6. Summary of ANOVA analysis results of animation elements of rookie animation among different groups

ANOVA	G1	G2	G3	G4	F	Post-hoc test
Story	5.23	4.66	5.06	4.87	1.977	1>2
Style	5.69	5.22	5.74	5.29	3.011*	1>2 1>4 3>2 3>4
Character	5.61	5.20	5.46	5.34	1.227	
Scenario	5.44	4.96	5.27	5.07	1.921	1>2
Dynamics	5.65	5.02	5.47	5.17	3.405*	1>2 1>4
Storyboard	5.81	5.06	5.26	5.04	6.677*	1>2 1>3 1>4
Sound	5.40	4.90	5.14	4.96	2.369	1>2 1>4

4.2.3 The Differences on the Evaluation of Rookie Animation Elements Among Different Groups From Taiwan and Japan

This study distinguishes the animated works from Taiwan and Japan based on the groups with different lifestyles and then conducts two-factor variance analysis. The results of the analysis found that there are no significant interaction and mutual influences among the animation elements in different groups from Taiwan and Japan. The comparison in data found that there are differences on the evaluation of style and characters. The summary of the means of different groups in terms of styles and characters are shown in Table 7. Fashionable boys tend to have higher evaluation on style of animated works from Taiwan than Japan, which is different from the evaluation of other groups as shown in Figure 1. Cool boys tend to have greater evaluation on characters in animated works from Japan rather than Taiwan as shown in Figure 2.

Table 7. The summary of cross means of styles and characters based on ethnical groups and nationalities

Elements	Groups	Taiwan	Japan	Comparison
Style	G1	5.440	5.940	Japan>Taiwan
	G2	5.040	5.400	Japan>Taiwan
	G3	5.714	5.771	Japan>Taiwan
	G4	5.371	5.200	Taiwan>Japan
Character	G1	5.580	5.640	Japan>Taiwan
	G2	5.480	4.920	Taiwan>Japan
	G3	5.743	5.171	Taiwan>Japan
	G4	5.543	5.143	Taiwan>Japan

5. CONCLUSIONS AND SUGGESTIONS

The results of statistical analysis show that there are differences in the evaluation of animation elements from different college groups with different lifestyles. Overall, the strengths of Taiwanese rookie animations are in the aspects of story, character, dynamics and storyboard. However, among the seven evaluation items, the respondents had lower evaluation on style in animated works from Taiwan than Japan and the Taiwanese animation education needs to strengthen this part. Among the different groups, cool boys often attach higher evaluation on all components of animated works while indoor boys are on the opposite, attaching the lowest evaluation. The study of variance mean between animation groups from Taiwan and Japan found that cool boys, different from other groups, attach higher evaluation on Taiwan than Japan. However, cool boys attach higher evaluation on character in animated works from Japan than Taiwan. Therefore, based on the above results, this study offers the following suggestions for Taiwan' s animation education industry.

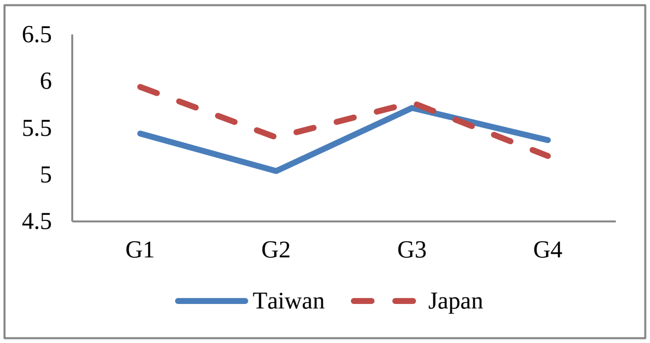


Figure 1. Style Preference Differential Line Chart from Different Groups

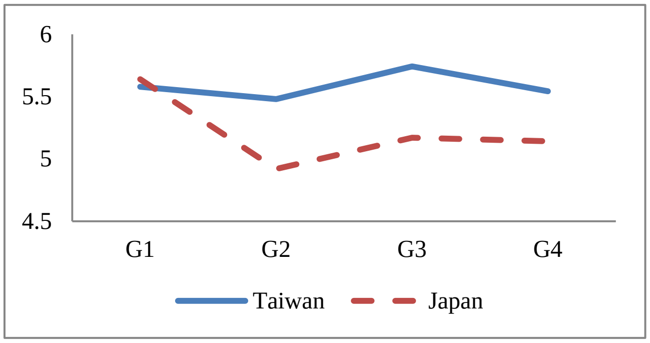


Figure 2. Character Preference Differential Line Chart from Different Groups

1. Taiwan animation producers have long been OEMs for the U.S.-based animation company Disney. The training for animation instructors has been geared towards the technical aspect and growing even faster than its Japanese counterparts. However, Taiwan's style is less distinctive and special than those of Japanese animated works. Taiwan's animation education should strive to encourage students to be experimental, have innovative styles, and find out their own unique styles. Furthermore, in terms of style settling, this study suggests that cool boys can offer more constructive opinions because they are quite different from other groups.

2. Among the different groups, cool boys often attach higher evaluation on all animation elements. On the contrary, indoor boys give the lowest evaluation. From the lifestyle aspect, we can conclude that a certain group is fond of animation and it expects higher requirements on animation. However, among the other six animation elements, the lifestyle groups are dissatisfied mostly on story. In fact, screenwriters must be involved in another professional field. The animation education in Taiwan probably needs to integrate good screenwriters or ready-made stories to produce animation. In addition, indoor boys can be consulted about the story development and give suggestions on the scripts during the animation production.

3. Cool boys give higher evaluation on characters in animated works from Japan than other groups. Based on the lifestyle of cool boys, they give greater emphasis on fashion and image and enjoy unique insights on character design. They are different from other groups in terms of character acuity, especially for characters in animated works. Therefore, the characters need to fit with the story to gain the attention of spectators, which needs to be strengthened in future animation education.

Finally, based on lifestyles, this study has explored the preference of different groups of college students on animated works from Taiwan and Japan. This study aims to find out the differences among the different groups for the reference of animation designers and practitioners. The limitations of this study are as follows: the 10 rookie animation groups are selected where the types and quality of each team are quite different from each other. In addition, college students in Taiwan probably encounter cultural shocks from Japan and there are gaps in understanding of animation. In terms of related animation preferences in the future, this study suggests that more diversified and typical animated works should be included, the sampling of the mother group of respondents should be stricter, the scope should be expanded, and the evaluation items should be added to ensure that the subsequent studies can be distributed widely. The major contribution of this study is to explore the differences between preferences in animated works from Taiwan and Japan as a future reference for animation education and industry.

6. REFERENCES

[1] Shiau, H.-C. 2002. The Production and Consumption of Animation in Taiwan- the Interplay of Global Political and Economic Force. Temple University, Philadelphia, PA.

[2] Day, W. W. 2005. Being Part of Digital Hollywood: Taiwan's Online Gaming & 3D Animation Industry under the New International Division of Cultural Labor. Int. J. Comic Arts, 7, 1 (Spring. 2005), 449-461.

[3] Bloomer, C. M. 1989. Principles of Visual Perception (2nd ed.). New York Design Press, New York, NY.

[4] Minato, M. 2004. Success of Japanese animation films inspires would-be cartoonists. Knight Ridder Tribune Business News (Aug 12. 2004), Washington, DC.

[5] Field, S. 1994. Screenplay: The Foundations of Screenwriting, Bantam Doubleday Dell, New York, NY.

[6] Chen, H.- Y. and Hsu. Y.- L. 2007. Decomposing the Attractive Factors of Flash Animation (Chinese).J. Kao Yuan University, 13, 307-326.

[7] Hawkins, D. J., Best, R. J., and Kenneth A. C. 1995. Consumer behavior: implication for marketing strategy (6th ed.) Richard D. Irwin, Boston, MA.

[8] Wells, W. and Tigert, D. 1971. Activities, Interests and Opinions. J. Advertising Research, 11, 27-35.

[9] Plummer, J. 1974. The Concept and Application of Life Style Segmentation. J. Marketing, 38, 1 (Jan. 1974), 33-37. http://dx.doi.org/10.2307/1250164

[10] Kaiser, H. F. 1958. The Varimax Criterion for Analytic Rotation in Factor Analysis. Psychometrika, 23 (Sep. 1958), 187-200.

[11] Afifi, A., May, S. and Virginia, A. C. 2003. Computer-Aided Multivariate Analysis (4th ed.). Chapman & Hall/CRC, Washington, DC.

[12] Guieford, J. P. 1965. Fundamental Statistics in Psychology and Education (4th ed.). McGram-Hill. New York, NY.

Speech Interaction of Educational Robot Based on Ekho and Sphinx

Zhenyu Li
National Engineering
Research Center for ELearning, Central China
Normal University
Wuhan, China.
+8613026327301
lizhenyu@mails.ccnu.edu.cn

Bin He
National Engineering
Research Center for ELearning, Central China
Normal University
Wuhan, China.
+8618163325459
hebin@mail.ccnu.edu.cn

Xinguo Yu
National Engineering
Research Center for ELearning, Central China
Normal University
Wuhan, China.
+86-27-67867572
xgyu@mail.ccnu.edu.cn

Rong Hu
National Engineering
Research Center for ELearning, Central China
Normal University
Wuhan, China.
+8613554146949
hurong_hr@foxmail.com

ABSTRACT

Speech interaction is a prominent interaction technology in educational robot, and educational robot with speech interaction can have a more harmonic and natural way of interaction. In some specific application scenarios such as education, the performance of speech recognition is not satisfactory due to the wide range of vocabularies and poor network. This paper trains the language model with professional vocabulary in the specific subject and establishes the corresponding phonetic dictionary in speech recognition based on Sphinx, and combines with speech synthesis based on Ekho to implement the speech interaction of educational robot in the offline state, and designs the relevant application of speech interaction about the teaching scenario of Chinese ancient poetry. The experiment demonstrates that the system designed and implemented can meet the demand of practical application of speech interaction in specific subject, and achieve the purpose of enhancing the student's learning experience and improving the learning effect.

CCS Concepts

• **Applied computing→ Education**

Keywords

Speech recognition; Speech synthesis; Teaching application

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124119

1. INTRODUCTION

Nowadays, Computer-Based Education has become one of the main technical means of modern educational technology, resulting in enormous economic and social benefits. The development of robot technology is fast and has been applied in many aspects of life [1, 2], however, the connection between robot technology and modern educational technology is limited, which is far less than the impact of computer technology in the field of education. Educational robot is developed by adopting the robot technology, which applies the robot to teaching process, plays practical operation and demonstration function of the robot, and can interact with student in time to adapt the demand of individual student adaptively. There are many ways of interaction between human and robot, and speech is the most natural modality to convey meanings and intentions among humans, in human-robot interaction [3]. At the same time, applying speech to robot teaching can greatly enrich the teaching form, and stimulate learning interest of the learners and help them to study better.

In robot assistant instruction, the dialogue between robot and student is crucial [4], which involves speech interaction technology. However, speech interaction technology has developed to the present stage, and there are still problems such as the training workload and the recognition speed of large vocabulary continuous speech recognition. Therefore, this paper focuses on professional vocabulary speech recognition of specific teaching scenarios.

2. RELATED WORK

Educational robot with speech interaction have the ability to listen and speak, which involves speech recognition and speech synthesis. Speech synthesis, whose main problem is how to translate text information into audible sound information, is also known as text-to-speech technology. The method of parametric synthesis was used early in speech synthesis, but the sound quality of synthetic speech was difficult to meet the practical requirements of the text-to-speech system. In [5] Thai speech synthesis with emotional tone based on Formant synthesis was presented that promotes the nature of speech. Then PSOLA

(Pitch-Synchronous Overlap-Add)[6] was presented that promotes the tone quality and the nature of speech greatly. In recent years, the method of HMM (Hidden Markov Model) [7] and DNN (Deep Neural Network) [8] were proposed to improve the quality of synthetic speech. With the application of machine learning algorithm in speech synthesis system, the performance of speech synthesis has been improved greatly. In addition to improving one algorithm individually, researchers choose the fusion of methods such as combining HMM-based speech synthesis and unit selection synthesis [9].

Speech Recognition is the process of converting a speech signal to a sequence of words, by means of an algorithm implemented as a computer program, which is also known as Automatic Speech Recognition[10]. Acoustic model, phonetic dictionary and language model were used during translations [11]. In the acoustic model, HMM[12] and DNN[13] were used to map the most likely phones. In the language model, Viterbi algorithm [14] was used to produce the templates that best match the uttered phones, and Pruning algorithm[15] was used to reduce the number of possible outcomes and speed up the translation time. With the advancement of speech recognition technology, the accuracy of speech recognition is improved. Microsoft Research used convolution and LSTM neural networks, and combined with a novel spatial smoothing method and lattice-free MMI acoustic training, so that its word error rate of English speech recognition is 5.9%, which has been basically close to human performance [16]. Baidu Research applied deep convolution neural network technology to acoustic modeling of speech recognition, combined with the end-to-end speech recognition technology based on LSTM and CTC, so that the error rate of the utterances recognition of Deep Speech 2 is reduced to 3.7%, which means that the best Mandarin Chinese speech system transcribes short voice-query like utterances is better than a typical Mandarin Chinese speaker [17].

At present, many domestic and international companies and research institutes launched human-robot interaction system with speech interaction, which brings great convenience to life. In [1] HTK and Festival speech tools were used to study the speech interaction among older adults with Alzheimer’s disease and robot called ED in terms of speech recognition and difficulty with dialogue, which provides caregiving assistance to a growing number of older adults in the near future. In [2] Microsoft SDK 11 and BaldiSync speech tools were used to study the speech interaction among autistic children and robot called LILI so as to observe the mental state of children. JiaJia was developed by University of Science and Technology of China, and used the speech platform interface of iFLYTEK so as to interact with people cordially. With the development of speech technology and robot technology, robots of various types are developed and applied in different fields, and serve people in different levels. However, robots used in the field of education still need to be popularized, especially teaching robot used for teaching tasks and answering related learning problems for students. In addition, the realization of speech interaction of educational robot requires the support of speech technology. In the case of poor network, if the online speech platform interface provided by some companies such as Baidu and iFLYTEK is used, the speed of speech recognition can be limited and affect user experience. Although domestic companies provides offline speech kits, the cost is too huge, and not suitable for general developers to do research.

In order to solve the above-mentioned problems, this paper selects the teaching scenarios of Chinese ancient poetry, and realizes the reliable recognition of vocabularies like ancient poetry by training language model and establishing phonetic dictionary, then combines with speech synthesis, and integrates the speech interaction system into educational robot platform, so that the robot can provide teaching services in the offline state.

3. DESIGN OF CHINESE SPEECH INTERACTION

3.1 Speech Interaction Model of Educational Robot

The speech interaction system in this paper is developed on embedded device based on Raspberry Pi, and understands user’s intent through speech recognition technology and speech synthesis technology. Figure 1 shows the speech interaction model of educational robot, which is composed of speech recognition module, speech synthesis module and interaction management module, and can interact with users in real time.

Speech recognition module, which is composed of speech acquisition device and speech recognition, is the input of the speech interaction model. The speech acquisition device adopts miniature omni-directional microphone array that can form directional pickup beam by detecting the speaker and suppresses the noise other than the beam to improve the audio quality. Speech recognition completes the recognition processing of speech signal. In order to realize accurate recognition of the words in the specific teaching domain, this paper establishes a dedicated knowledge base that is used to store the professional words or phrases of various subjects, with which the language model is trained.

Speech synthesis module, which is composed of speech playback device and speech synthesis, is the output of the speech interaction model. The speech playback device uses the speaker to convert electrical signal into acoustic signal to achieve the playback of the text. Speech synthesis translates sequences of words into phonological sequences.

Interaction management module, which is composed of speech interaction rules, manages speech recognition module and speech synthesis module. Because the recognition result given by the speech recognition module may be correct or wrong and may not recognize the speech，the recognition result needs to be matched with the rules stored in the interaction management module to determine user's answer, and selects the corresponding text according to different kinds of answers, and the text selected is played through speech synthesis module.

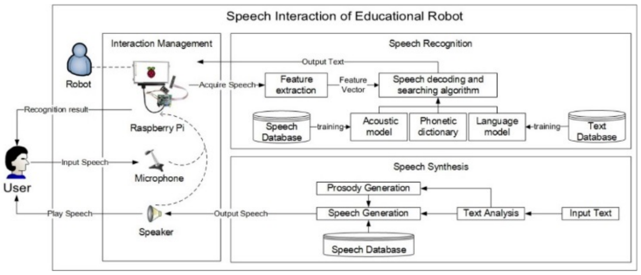


Figure 1. Speech interaction model of educational robot

3.2 Chinese Speech Synthesis

Figure 2 shows the process of speech synthesis. Firstly, the pronunciation of single Chinese character is syncopated from natural speech as a basic pronunciation unit, with which a pronunciation corpus is established. Then, the pronunciation units corresponding to input text are extracted from corpus, and adjusted and controlled in prosody. Finally, different pronunciation units are spliced together to realize the function of speech output.

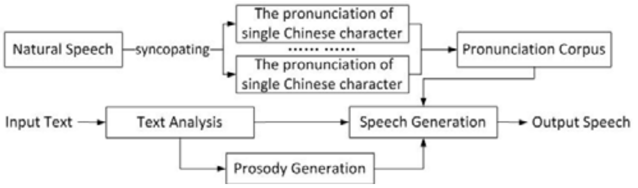


Figure 2. Flow chart of speech synthesis

Ekho is a free, open source and multilingual text-to-speech software[18]. It is based on the principle of speech synthesis in Figure 2, and supports Cantonese, Mandarin, Tibetan and some other languages. Ekho has more than 2000 audios in its own Mandarin pronunciation corpus, each of which corresponds to the different tones of Chinese characters. After configuring and installing ekho-5.6 in Raspberry Pie, inputting "*ekho '123'* " on Ubuntu terminal, the installation is successful when a sound played. The synthetic speech can be changed by replacing Ekho's original audios with following methods.

1) Collecting audio: There are several ways to obtain audio, such as using a professional recording device to record the pronunciation of a single character, or using the speech synthesis tool to synthesize the pronunciation of different Chinese characters, or obtaining the pronunciation of some special roles on different Chinese characters from a variety of video-audio websites.

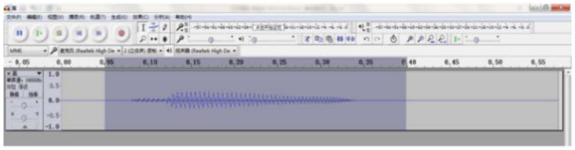
2) Processing audio: The collected audio does not replace the original audio directly, and needs to be processed using the Audacity audio processing software, such as cutting off the blank area before and after audio to reduce the sense of pause in synthesis.

3) Converting audio format: Most of the processed audio are mp3 or wav format, should be converted into gsm format.

The method used in this paper (Figure 3) is to convert the audios that are synthesized by the synthetic tool and processed with Audacity into gsm format, and then replace the original audios with those GSM format audios. In this method, different voices are synthesized for different users to enhance the user experience.

嘉.mp3
嘉
按钮
ekho-5.6
ekho-data
pinyin
a1.gsm
a2.gsm
a3.gsm
a4.gsm
a5.gsm
a6.gsm

a) The audios that are synthesized by the synthetic tool b) Ekho's original audios



c) Processing of the audios

Figure 3. Method of replacing the Ekho audios

3.3 Chinese Speech Recognition

Figure 4 shows the process of speech recognition, which can be divided into three parts. The first part is the pre-processing of speech input to complete the feature extraction of speech signal. The second part is linguistic preparation, including the training of acoustic model and language model and the establishment of phonetic dictionary. The third part is the decoding of speech recognition, which is a process of searching and matching the model and the training model.

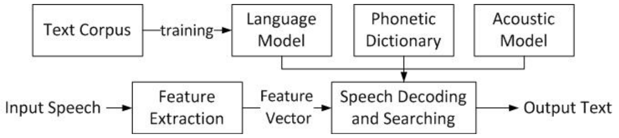


Figure 4. Flow chart of speech recognition

Sphinx is a continuous speech recognition system based on HMM with large vocabulary and speaker independence[19], which can be used to train acoustic model and language model besides the speech recognition. Sphinx has evolved to multiple versions of the speech recognition engine, including Sphinx1, Sphinx2, PocketSphinx, Sphinx3 and Sphinx4. PocketSphinx is a tool that is oriented to embedded system development, and it is the fastest in recognition speed among those versions above through making corresponding optimizations and improvements in memory, machine and algorithm level[20]. Considering the hardware condition of the robot system, if the computation of algorithms are too large, the robot will consume most of the resources in speech recognition, which makes it difficult to run other applications. Therefore, using PocketSphinx to decode is a method of satisfying the speech recognition demand of robot with low occupancy.

In this paper, after configuring and installing sphinxbase-0.8 and pocketsphinx-0.8 in Raspberry Pie, inputting "*pocketsphinx_ continuous*" on Ubuntu terminal, if "*READY…*" is displayed, the installation is successful. In actual test, the specific range acoustic model is trained by using the sphinxtrain tool, but the acquisition of speech corpus is not sufficient, and the basic requirement of training a high quality acoustic model can not be satisfied, so that the acoustic model obtained by training is not as good as PocketSphinx's own acoustic model. Therefore, this paper uses PocketSphinx's own acoustic model, the default Chinese acoustic model of which is *zh_broadcastnews_ptm256_8000*, and trains the language model with professional vocabulary in the specific subject and establishes the corresponding phonetic dictionary.

3.3.1 Training of language model

Language model is a model that describes the transfer relationship between phoneme, syllable and word. Although the acoustic model can well record the speech feature parameter of each word, there are still some co-articulation, assimilation and homophones while decoding, making the result less reliable, so we need to restrict the grammar. Sphinx adopts the statistical language model based on N-gram, the conditional probability of the current word is related to the previous *n-1* words, regardless of the word sequence and the position of the current word in the word sequence. $P(W)$ is the probability of word sequence $W = \omega_1\omega_2 \dots \omega_m$.

$$P(W) = P(\omega_1^m) = \prod_{i=1}^{m} P\left(\omega_i \middle| \omega_1^{i-1}\right) \approx \prod_{i=1}^{m} P\left(\omega_i \middle| \omega_{i-n+1}^{i-1}\right) \quad (1)$$

The next step is to estimate the conditional probability of each word $P(\omega_i|\omega_{i-n+1}^{i-1})$ in (1). When n is too large, the parameter space becomes very large, and the training data required is quite large, so the assumption is that the current word only depends on a limited number of previous words. Generally, n ranges from 1 to 7. Sphinx adopts the statistical language model based on Bigram and Trigram, which is to determine the probability of the current word by the previous one word or two words. The probability estimation method is to calculate the conditional probability by maximum likelihood estimation (MLE). For the Trigram, the probability of the current word is expressed by the equation (2).

$$P(\omega_m|\omega_{m-2}\omega_{m-1}) = \frac{P(\omega_{m-2}\omega_{m-1}\omega_m)}{P(\omega_{m-2}\omega_{m-1})} \qquad (2)$$

Because $P(\omega_{m-2}\omega_{m-1}\omega_m)$ and $P(\omega_{m-2}\omega_{m-1})$ is not known, the number of $\omega_{m-2}\omega_{m-1}\omega_m$ and $\omega_{m-2}\omega_{m-1}$ needs to be counted from the corpus, and denoted as $C(\omega_{m-2}\omega_{m-1}\omega_m)$, $C(\omega_{m-2}\omega_{m-1})$ respectively. $P(\omega_{m-2}\omega_{m-1}\omega_m)$ can be expressed by the equation (3) according to the rule of maximum likelihood estimation.

$$P(\omega_{m-2}\omega_{m-1}\omega_m) = \frac{C(\omega_{m-2}\omega_{m-1}\omega_m)}{\sum_{(\omega_{m-2}\omega_{m-1}\omega_m)} C(\omega_{m-2}\omega_{m-1}\omega_m)} \qquad (3)$$

The equation (3) indicates the ratio of $C(\omega_{m-2}\omega_{m-1}\omega_m)$ and the number of Trigram, and the probability of arbitrary model based on N-gram can be calculated according to (3). If the number of words contained in the corpus is L, the number of Trigram should be $L-2$, and the number of Bigram should be $L-1$, When L is large enough, $L-1 \approx L-2$. Thus,

$$P(\omega_m|\omega_{m-2}\omega_{m-1}) = \frac{C(\omega_{m-2}\omega_{m-1}\omega_m)/L-2}{C(\omega_{m-2}\omega_{m-1})/L-1} \approx \frac{C(\omega_{m-2}\omega_{m-1}\omega_m)}{C(\omega_{m-2}\omega_{m-1})} \qquad (4)$$

But such an estimation will have a serious problem. If $C(\omega_{m-2}\omega_{m-1}\omega_m)$ is zero, $P(\omega_m|\omega_{m-2}\omega_{m-1})$ will be zero and the word sequence W will never be considered as a transcription, regardless of how unambiguous the acoustic signal is, so that the probability of the whole sentence is zero, resulting in data sparseness problem. To address this problem in the language model, the smoothing technique is used to for adjusting the maximum likelihood estimate of probabilities (as in (3)) to produce more accurate probabilities. Sphinx adopts Good-Turning method [21].

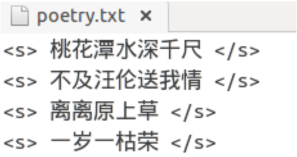
The performance of statistical language model is highly dependent on the training data, and the model's performance will decrease when the domain for identification is changed. For example, the recognition rate is very low when using the Sphinx's own language model to test ancient poetry. Because the Sphinx's own language model is trained based on a large number of everyday language, however, the collocation of words in ancient poetry is not consistent with everyday language, the probability of poetic sentences appearing in Sphinx's own language model is very low. Therefore, this paper establishes a corpus of professional vocabulary in specific teaching domain, and combines the knowledge of Chinese grammar and semantics, then language modeling is used to improve the recognition performance of speech recognition system in a specific domain, which can effectively reduce the search scope.

In this paper, establishing a corpus or thesaurus that stores target vocabulary to be recognized by the system, the format of the corpus is txt. Taking ancient poetry teaching as an example, the corpus (Figure 5) is organized as following.

1) Each phrase or sentence in a line.

2) Each line begins with <s>, ends with </s>, and leaves a space between the sentence and tag *s*.

3) Last line should not contain any linefeeds.



```
<s> 桃花潭水深千尺 </s>
<s> 不及汪伦送我情 </s>
<s> 离离原上草 </s>
<s> 一岁一枯荣 </s>
```

Figure 5. Corpus

Tag *s* indicates mute, which is used to separate the sentences. If the tag is missing, the language model after training will generate errors when it is loaded by the system. After corpus is established, cmuclmtk-0.7 tool is used to train the language model, which has 5 steps, each output file of which is the input file of the next step. The concrete steps are as follows.

1) Count the number of words or phrases appear in the text.

```
text2wfreq <poetry.txt> poetry.wfreq
```

2) List words or phrases appeared in the text.

```
wfreq2vocab <poem.wfreq> poetry.vocab
```

3) List n-gram grammar related to words or phrases.

```
text2idngram -vocab poetry.vocab -idngram poetry.idngram <poetry.txt
```

4) Output language model file.

```
idngram2lm -vocab_type 0-idngram poetry.idngram -vocab poetry.vocab-arpa poetry.arpa
```

5) Convert language model format.

```
sphinx_lm_convert -i poetry.arpa -o poetry.lm.DMP
```

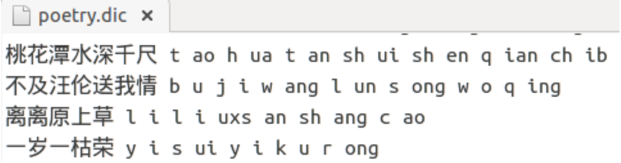
3.3.2 *Establishment of phonetic dictionary*

The connection between language model and acoustic model is accomplished by the phonetic dictionary, the text part of phonetic dictionary is associated with the language model, and the pronunciation of corresponding words in the text is used to match the corresponding words in the acoustic model. The phonetic dictionary marks the pronunciation of the text that needs to be trained. According to the phonetic dictionary provided by CMU Sphinx, adding phonetic annotation to the training text, and their pronunciation rule differ from the daily Pinyin (shown in Table 1). So it is not feasible to use daily Pinyin to do test.

Table 1. Comparison of phonetic dictionary and Pinyin

Example	Phonetic dictionary annotation	Pinyin annotation
原	uxs an	y uan
诗	sh ib	sh i
思	s if	s i

In this paper, taking ancient poetry teaching as an example, putting poetry in the corpus into phonetic dictionary, the format of phonetic dictionary is dic, phonetic dictionary (Figure 6) is organized as following.



```
桃花潭水深千尺 t ao h ua t an sh ui sh en q ian ch ib
不及汪伦送我情 b u j i w ang l un s ong w o q ing
离离原上草 l i l i uxs an sh ang c ao
一岁一枯荣 y i s ui y i k u r ong
```

Figure 6. Phonetic Dictionary

1) Each sentence and its phonetic annotation are in a line.

2) Leaving a space between each sentence and phonetic annotation as well as the different phonemes.

3) Last line should not contain any linefeeds.

3.4 Interaction Management

In the teaching environment, when students communicate with educational robot for specific subject, the robot needs to understand the student's intentions. Considering the instability of speech recognition module, this paper designs some speech interaction rules to determine the student's intentions and gives reasonable responses. An example of interaction rules [22] is designed as follows.

```
<rule>
<question>离离原上草的下一句是什么</question>
<answer> 一岁一枯荣 </ answer >
</rule>
```

In this paper, the content of a rule is placed between <rule> and </rule>, which includes question and answer. The question between <question> and </question> is what the last sentence or the next sentence of a poetic sentence is. The answer between <answer> and </answer> is the answer to the poetic sentence questioned.

The latest dialogue is memorized in the interaction management module, by which can avoid repetitions of the same questions raised by system and determine the execution flow of speech interaction system. For example, when the result of speech recognition is correct, the system will prompt the answer is correct and continue to raise questions. Therefore, the latest question raised by the speech interaction system is placed between <before> and </before>, which are added to the rules. The following is rules with labels <before> and</before>.

```
<rule>
<question> 一岁一枯荣 </question>
<before> 离离原上草的下一句是什么 </before>
<answer> 回答正确，你真棒，我们继续吧 </ answer >
</rule>
```

4. IMPLEMENTATION OF SPEECH INTERACTION OF EDUCATIONAL ROBOT

4.1 Educational Robot Platform

The speech interaction system in this paper is based on the robot in Figure 7. This robot platform consists of three layers. Speech interaction runs on the development layer based on Raspberry Pi that integrates the microphone array and the speaker. Raspberry Pi is an ARM-based micro-computer mainboard with USB interface and network port, which has the basic functions of a computer. In this paper, the model of Raspberry Pi is Pi 3 Model B (1GB RAM, 1.2GHz Quad-core CPU), and the system is Ubuntu 14.04. The programming language is C.

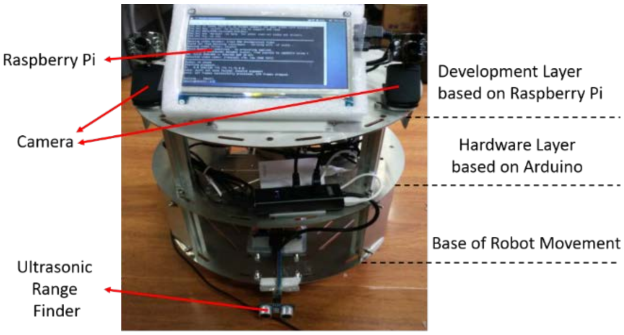

Raspberry Pi
Camera
Ultrasonic Range Finder
Development Layer based on Raspberry Pi
Hardware Layer based on Arduino
Base of Robot Movement

Figure 7. Educational robot platform

This paper relies on the platform of educational robot, and in order to reflect the features of education, an example of speech interaction between student and robot is designed in the Raspberry Pi, which can be applied in a specific teaching scenario.

4.2 Implementation of Chinese Ancient Poetry Interaction

Ancient poetry is indispensable teaching materials in Chinese language classroom, which is the carrier of initial awareness and understanding of Chinese culture as a child, and helps to improve their cultural taste and language literacy comprehensively. Learning ancient poetry can help children in the enlightenment stage identify Chinese characters and their pronunciation. Reciting poetry can also help students deepen understanding of ancient poetry and enhance their ability to remember.

This paper designs an example of question answering with ancient poetry between student and robot. The procedure of ancient poetry program is shown in Figure 8.

The process of ancient poetry program is divided into four steps. Firstly, the robot initiates speech interaction program. Secondly, the robot converts the text of the program into speech through the processing of the speech synthesis module, and raises question which is what the last sentence or the next sentence of a random poetic sentence is. Thirdly, the student answers the question raised by robot through microphone, and the robot recognizes the acquired speech through the processing of the speech recognition module. Finally, according to the interaction rules of the interaction management module, the recognition result is judged, and the execution flow of speech interaction system is determined.

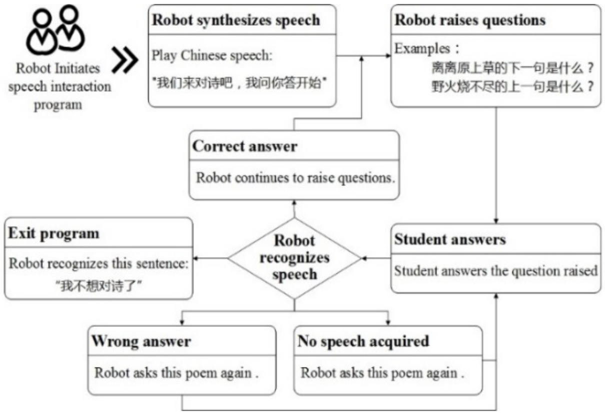
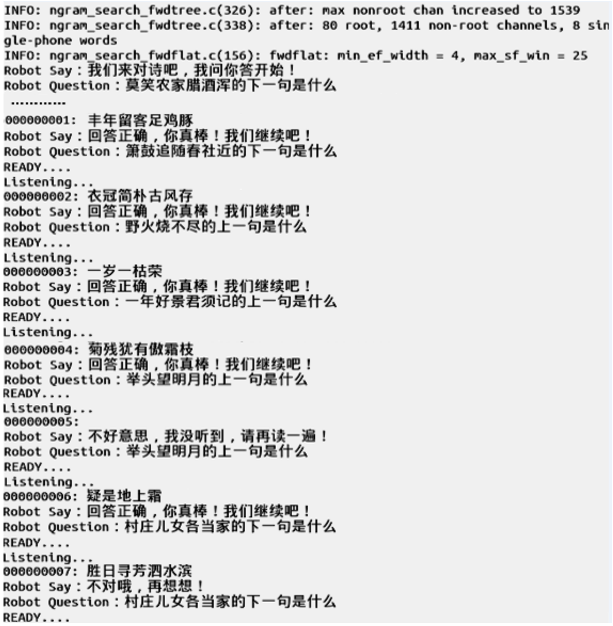

Robot Initiates speech interaction program
Robot synthesizes speech
Play Chinese speech:
"我们来对诗吧，我问你答开始"
Robot raises questions
Examples：
离离原上草的下一句是什么？
野火烧不尽的上一句是什么？
Correct answer
Robot continues to raise questions.
Exit program
Robot recognizes this sentence:
"我不想对诗了"
Robot recognizes speech
Student answers
Student answers the question raised
Wrong answer
Robot asks this poem again .
No speech acquired
Robot asks this poem again .

Figure 8. Flow chart of ancient poetry program



```
INFO: ngram_search_fwdtree.c(326): after: max nonroot chan increased to 1539
INFO: ngram_search_fwdtree.c(338): after: 80 root, 1411 non-root channels, 8 sin
gle-phone words
INFO: ngram_search_fwdflat.c(156): fwdflat: min_ef_width = 4, max_sf_win = 25
Robot Say：我们来对诗吧，我问你答开始！
Robot Question：莫笑农家腊酒浑的下一句是什么
 …………
000000001: 丰年留客足鸡豚
Robot Say：回答正确，你真棒！我们继续吧！
Robot Question：箫鼓追随春社近的下一句是什么
READY....
Listening...
000000002: 衣冠简朴古风存
Robot Say：回答正确，你真棒！我们继续吧！
Robot Question：野火烧不尽的上一句是什么
READY....
Listening...
000000003: 一岁一枯荣
Robot Say：回答正确，你真棒！我们继续吧！
Robot Question：一年好景君须记的上一句是什么
READY....
Listening...
000000004: 菊残犹有傲霜枝
Robot Say：回答正确，你真棒！我们继续吧！
Robot Question：举头望明月的上一句是什么
READY....
Listening...
000000005:
Robot Say：不好意思，我没听到，请再读一遍！
Robot Question：举头望明月的上一句是什么
READY....
Listening...
000000006: 疑是地上霜
Robot Say：回答正确，你真棒！我们继续吧！
Robot Question：村庄儿女各当家的下一句是什么
READY....
Listening...
000000007: 胜日寻芳泗水滨
Robot Say：不对哦，再想想！
Robot Question：村庄儿女各当家的下一句是什么
READY....
```

Figure 9. Display of ancient poetry program in Raspberry Pi

In the example of ancient poetry, according to the method described in Section 3, this paper establishes a corpus that contains 30 poems (a total of 128 poetic sentences) [23] in the first grade and fourth grade, which is used to train the language model and establish a phonetic dictionary. 128 poetic sentences are recognized and tested in the educational robot. The test is conducted five times, and recognize 100 sentences every time. In the case of minimal noise, more than 90 sentences are accurately recognized every time, which shows that the recognition performance basically meets the demand of ancient poetry teaching. After the program is run, the display of Raspberry Pi screen is shown in Figure 9. Students can answer the question raised by robot through speech or the text displayed in the screen. Realizing question answering with ancient poetry between student and robot can detect students' mastery of ancient poetry and enhance students' interest in learning ancient poetry.

5. CONCLUSION

According to the demand of speech interaction application of robot in the field of education, this paper designs the speech interaction model and interaction method for the specific subject and teaching scenarios, and realizes speech interaction based on Ekho and Sphinx on the educational robot platform, which is applied to the teaching environment of the Chinese ancient poetry. The experiment shows that the system designed and implemented basically satisfies the requirements of speech interaction of educational robot in practical application. Instead of relying on network, the method of speech interaction of educational robot selected in this paper makes students interact with robot more conveniently in a specific teaching scenario, so as to help students learn better. This is a meaningful attempt to use speech interaction technology in the educational robot, while excavating potential new applications and new directions in the teaching environment is also very promising.

Compared with human performance in speech, the speech interaction system implemented in this paper still has many deficiencies in the aspects of semantic understanding, speech recognition accuracy and nature of speech synthesis. Determining how to optimize the application of speech interaction in education robot, and build an intelligent speech interaction system is still a huge challenge we face.

6. ACKNOWLEDGMENTS

This work is supported by the specific funding for education science research by self-determined research funds of CCNU from the colleges' basic research and operation of MOE (No.ccnu16JYKX005).

7. REFERENCES

[1] Rudzicz, F., Wang, R., Begum, M., et al. 2015. Speech Interaction with Personal Assistive Robots Supporting Aging at Home for Individuals with Alzheimer's Disease. *Acm Transactions on Accessible Computing*, 7(2), 1-22.

[2] Chuah, M. C., Coombe, D., Garman, C., et al. 2014. Lehigh Instrument for Learning Interaction (LILI): An Interactive Robot to Aid Development of Social Skills for Autistic Children[C]. *IEEE, International Conference on Mobile Ad Hoc and Sensor Systems*. IEEE, 731-736.

[3] Deng, L., Wang, K., and Wu, C. 2005. Speech technology and systems in human-machine communication [from the Guest Editors]. *IEEE Signal Processing Magazine*, 22(5), 12-14.

[4] Burbules, N. C. 2000. Dialogue in Teaching: Theory and Practice, *Journal of Curriculum Studies*, 32(6), 878-881.

[5] Khorinphan, C., Phansamdaeng, S., and Saiyod, S. 2014. Thai speech synthesis with emotional tone: Based on Formant synthesis for Home Robot. *Third ICT International Student Project Conference (ICT-ISPC), I. IEEE*, 111-114.

[6] Moulines, E. and Charpentier, F.. 1990. Pitch-synchronous waveform processing techniques for text-to-speech synthesis using diphones. *Speech Communication*, 9(5-6), 453-467.

[7] Tokuda, K., Nankaku, Y., Toda, T., et al. 2013.Speech Synthesis Based on Hidden Markov Models. *Proceedings of the IEEE*, 101(5), 1234-1252.

[8] Ze, H., Senior, A., and Schuster, M. 2013. Statistical parametric speech synthesis using deep neural networks. *IEEE International Conference on Acoustics, Speech and Signal Processing*. IEEE, 7962-7966.

[9] Takamichi, S., Toda, T., Shiga, Y., et al. 2014. Parameter Generation Methods with Rich Context Models for High-Quality and Flexible Text-To-Speech Synthesis. *IEEE Journal of Selected Topics in Signal Processing*, 239-250.

[10] Anusuya, M. A. and Katti, S. K. 2009. Speech Recognition by Machine: A Review. *International Journal of Computer Science and Information Security*, 64(4), 501-531.

[11] Hjulström, R. 2015. Evaluation of a speech recognition system Pocketsphinx. Umeå University, Sweden. http://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-108293

[12] Gales, M. and Young, S. 2008. The application of hidden Markov models in speech recognition. *Foundations and Trends® in Signal Processing*, 1(3), 195-304.

[13] Hinton, G., Deng, L., Yu, D., et al. 2012. Deep Neural Networks for Acoustic Modeling in Speech Recognition: The Shared Views of Four Research Groups. *IEEE Signal Processing Magazine*, 29(6), 82-97.

[14] Lou, H. L. 1995. Implementing the Viterbi algorithm. *Signal Processing Magazine*, IEEE, 12(5), 42-52.

[15] Liu, W. and Han, W. 2010. Improved Viterbi algorithm in continuous speech recognition. *International Conference on Computer Application and System Modeling.* IEEE, V7-207-V7-209.

[16] Xiong, W., Droppo, J., Huang, X., et al. 2016. Achieving Human Parity in Conversational Speech Recognition. arXiv:1610.05
256v1 [cs.CL] 17 Oct 2016.

[17] Amodei, D., Anubhai, R., Battenberg, E., et al. 2015. Deep Speech 2: End-to-End Speech Recognition in English and Mandarin. Computer Science.

[18] “How to Install Ekho (for Linux and Raspberry Pi)”, http://www.eguidedog.net/cn/ekho_cn.php.

[19] KAI-FU LEE, Hon, H. W., R REDDY. 1990. An Overview of the SPHINX Speech Recognition System. *IEEE Transactions on Acoustics Speech, and Signal Processing*. 38(1), 35-45.

[20] Huggins-Daines, D., Kumar, M., Chan, A., et al. 2006. Pocketsphinx: A Free, Real-Time Continuous Speech Recognition System for Hand-Held Devices. *IEEE International Conference on Acoustics, Speech and Signal Processing*, 2006. ICASSP 2006 Proceedings. IEEE, I-I.

[21] Chen, Stanley, F., Goodman, et al. 1999. An empirical study of smoothing techniques for language modeling. Computer Speech and Language, 13(4), 359-393.

[22] Ma, R., Yue, H., Gao, Q., et al. 2007. Research on Intelligent-Robot-Oriented Speech Interactive Technology and Module. *IEEE International Conference on Control and Automation*. IEEE, 1263-1267.

[23] Online reading of "Ancient Poems of primary school ", http://www.gushiwen.org/gushi/xiaoxue.aspx.

Ubiquitous Learning: Information Technology Driving Learning Revolution

Dexin Hu
Institute of Education
Tsinghua University
Beijing, China
+86-18813127199
hdx15@mails.tsinghua.edu.cn

Yiwei Wang
Institute of Education
Tsinghua University
Beijing, China
+86-15210517342
wangyiwei20060113@163.com

Cheng Chen
Institute of Education
Tsinghua University
Beijing, China
+86-18810661123
changjin23@163.com

ABSTRACT

As one of the ideal models of lifelong learning in the future, ubiquitous learning can provide learners with an ideal environment for obtaining information, promoting communication and learning at anytime, anywhere, any device, anyway. Ubiquitous learning is a new way of learning in the era of technological changing education. Therefore, how to give impetus to the application of ubiquitous learning has become an important problem in the current study and popularization. Based on summarizing the theory and characteristics of ubiquitous learning, this study explores the typical models of ubiquitous learning. Finally, the study puts forward the focus of the future research on ubiquitous learning in China, expecting to arouse the attention of researchers, and stimulating the rethink of the future education reform.

CCS Concepts

•Applied computing → Education → E-learning

Keywords

Ubiquitous learning; information technology; learning style; typical model.

1. INTRODUCTION

In recent years, the rapid development of computer technology, network technology and communication technology has brought far-reaching influence to the field of education. In the era of Web 1.0, the number of high-quality learning resources is very few, which makes the access to adequate learning resources sometimes become difficult for learners, so the learning resources' digitization and the construction of numerous databases has become the focus of the research [1]. With the advent of the era of Web 2.0, the number of learning resources has increased exponentially. These resources cover all aspects of the people's life and learning, and learning resources' digitization is not the main problems. Since then people has begun to pay attention to whether the resources can promote effective learning [2].

With the emergence of the new learning theory such as constructivism learning theory, cognitive learning theory, and new learning methods, people could have a new understanding of the nature of learning. With the maturity of cloud computing, pervasive computing and Internet of things, it is possible to build a seamless learning space [3]. Seamless learning space is the basic supporting environment of ubiquitous learning, and learning resources are the important foundation of constructing seamless learning space. At present, the technology related to learning resources, which is based on the learning objects, is only concerned with the learning content and content sharing in the closed structure, and can't meet the needs of constructing an ideal seamless learning space. Therefore, the future development direction of human learning is ubiquitous learning in an open structure.

Ubiquitous learning use information technology to create a learning environment for learners in which learners can use their digital devices or tools to carry out various learning activities at anytime and anywhere [4]. As a new way of learning, ubiquitous learning is considered to have a unique advantage in the creation of personalized learning environment, sharing of learning resources, learning methods and the reform of educational model. Ubiquitous learning has become one of the most important means to promote educational equity, improve the quality of education and promote the construction and formation of a learning society.

2. THEORY AND CHARACTERISTICS

2.1 Theoretical Basis

With the rapid development of computing and communication technology, especially the popularization of micro, intelligent computing

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124120

equipment and network interconnection, the computing mode has been pushed into the era of ubiquitous computing. Ubiquitous learning is derived from ubiquitous computing. With the rapid development of computing technology, the theory of learning is changing greatly. Specifically, under the guidance of behaviorism learning theory, cognitive learning theory and constructivist learning theory, ubiquitous learning has been developed rapidly.

2.1.1 Behaviorist learning theory

Behaviorism considers individual learning behavior is a process of "stimulus-response" that adapts to the external environment, which holds that learning behavior and outcomes can be controlled and predicted as long as we control the stimulation. Under the guidance of this theory, ubiquitous learning uses a kind of information transmission model from the learning equipment to the learner. It can make use of pervasive computing devices to ask a question (stimulus), and then to propose solutions by the learner (response), and even to strengthen the process by the system feedback [5].

2.1.2 Cognitive learning theory

Cognitiveism emphasizes that students are not passive recipients of external stimuli, but the active main body of selecting and processing information. Cognitive learning theory focuses on the analysis of learning content and learner characteristics, the design of learning environment, teaching strategy, and organizational form. The concentrated embodiment of the cognitive learning theory in the application of ubiquitous learning is to emphasize the individual learning, that is to say, the small-scale learning.

2.1.3 Constructivist learning theory

Constructivism holds that knowledge is not taught by teachers, but taught by the cognitive structure of learners. The calculation and information management function of ubiquitous equipment can be used as a construction tool to support, guide and expand the learner's cognitive structure or thinking mode, which will promote the construction of knowledge and problem solving of learners. Therefore, ubiquitous learning is the best place for the application of constructivist learning theory. At the same time, constructivism has an important guiding significance for the development of ubiquitous learning, and it can well meet the construction of student-oriented learning environment.

2.2 Basic Characteristics

2.2.1 Persistence

The learner can remain in the state of study unless he or she cancels the learning requirements; the learning process is continuous and seamless.

2.2.2 Accessibility

The form of learning materials that learners can obtain is diverse, including text, pictures, video, audio, etc.

2.2.3 Immediacy

Learners can get information directly from the server or from the peer-to-peer network wherever they are, and the information is usually timely, such as clicking on an online video.

2.2.4 Interaction

Learners can communicate with other learners in a synchronous or asynchronous way to realize information exchange and interaction.

2.2.5 Initiative

When a user has been detected to enter the specific area, the server will automatically send the service content for the user to choose, and forwardly provide services.

2.2.6 Circumstances of teaching activities

Learning can be integrated into the daily life of learners. The information and knowledge required by the learner can be presented in a natural and effective way.

3. THE TYPICAL MODELS

Learning mode is the way to make learners achieve the best learning state. The factors affecting learning include learners, teachers, learning environment, learning objectives, learning content, learning media, learning process, learning style, learning evaluation, learning time, etc., and different combinations of these factors will form different learning modes. Formal learning is a kind of learning activity carried out in the form of curriculum and specific project, which is provided by a special educational institution. Informal learning is a completely personalized learning activity that includes the form of conferences, books, websites, etc.

There are a lot of typical models in ubiquitous learning, and it is necessary to conduct a comprehensive and in-depth study. In this study, the typical models of ubiquitous learning are divided into three according to the learning methods and the resources, that is, informal learning, quasi-formal learning and formal learning [6].

3.1 Informal Learning

Informal learning refers to learning that completely relies on digital learning resources. The general learning process is: according to self-learning needs, learners find the right learning resources and use learning resources to learn; through learning, learners may write some experience, reflection, and even create some new resource after thinking, analysis and summary, which facilitates the formation of generative shared resources. The available resources can be diverse such as text, picture, video, courseware, or complete curriculum etc. The goal, the behavior, the process and the effect of the study are decided by themselves, without restrictions from external factors.

3.2 Quasi-Formal Learning

Quasi-formal learning is a learning model based on learning resources and teachers, between formal learning and informal learning. Quasi-formal learning is usually based on the theme, refers to the study of certain aspects of social life or phenomena, such as the knowledge and skills needed for a certain occupation, the learning of a certain kind of sports, literature and art, etc. Based on the common needs of the subject of learning, the educational institutions determine the theme of the training project, provide a ubiquitous learning environment and resources, design learning process, and provide teachers’ guidance and counseling in the learning process. Based on their own needs, learners find and select the appropriate training programs, and use compiled resources for learning and interaction in accordance with the environment, conditions. In quasi-formal learning, the objectives, behaviors, processes, resources of learning will be restricted by educational institutions. However, there is no strict and mandatory norm for the evaluation of learners’ learning.

3.3 Formal Learning

Formal learning refers to curriculum learning that is based on learning resources and teachers, such as a professional course study or a certificate course. In formal learning, professional education institutions (Professional education institutions generally refers to schools, research institutions, etc.) should set up curriculum, prepare teaching syllabus, provide a wide range of learning resources, arrange teaching activities, carry out learning evaluation, and constantly improve the whole process. Learners should choose the course of study, clear learning goal, choose the way of learning, and participate in learning activities and learning evaluation. At the end of the study, the learners should meet the eligibility criteria of evaluation. Although the teaching activities of teachers and the study activities of learners are in the state of quasi-separation, but the two are inseparable. Figure 1 shows the relationship between teachers' teaching and students' learning in the process of ubiquitous learning.

3.4 Comparison of Three Learning Models

We can make a systematic comparison among the three modes from the aspects of learning goal, resources, process, evaluation, etc., in order to better analyze their similarities and differences. Specific conditions are shown in table 1.

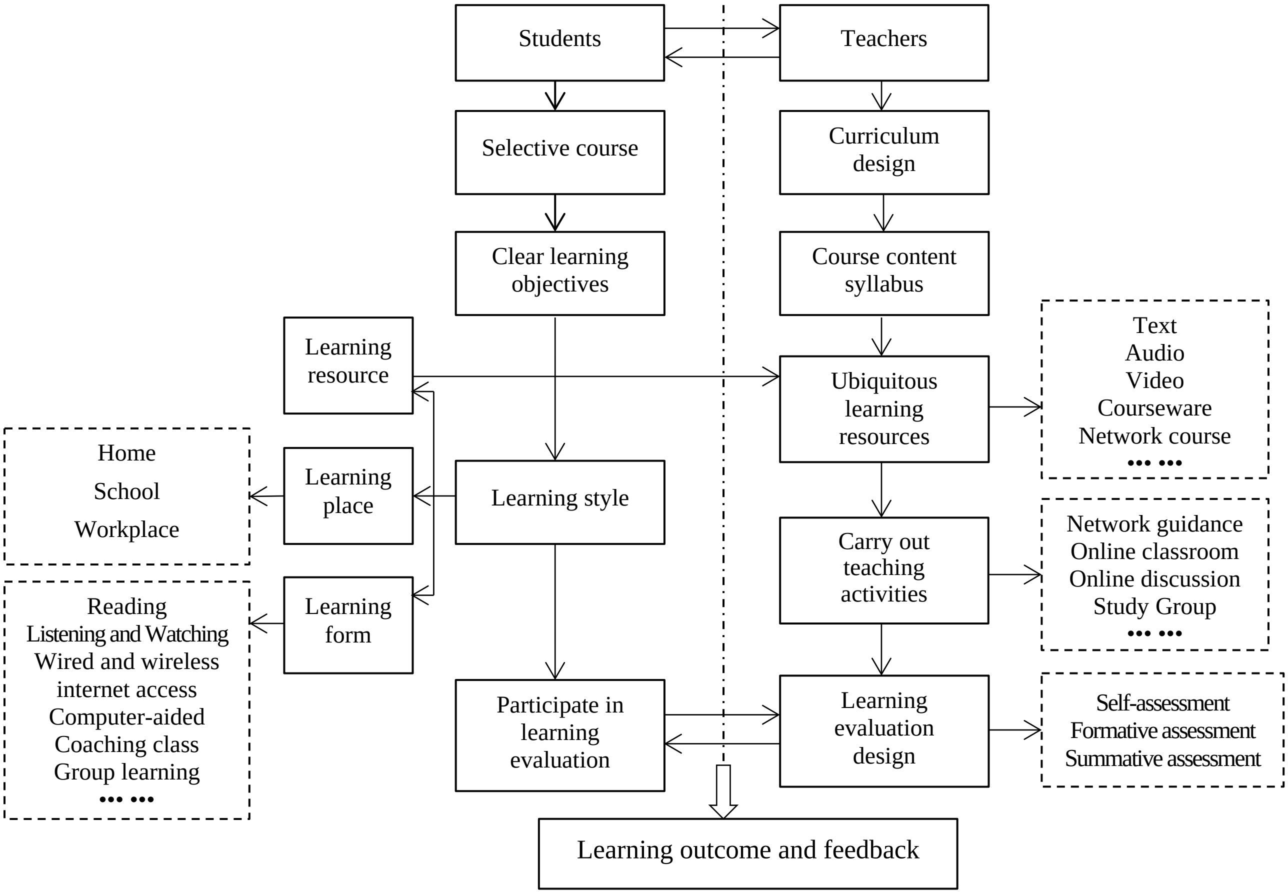

Students
Teachers
Selective course
Curriculum design
Clear learning objectives
Course content syllabus
Learning resource
Ubiquitous learning resources
Text
Audio
Video
Courseware
Network course
••• •••
Home
School
Workplace
Learning place
Learning style
Carry out teaching activities
Network guidance
Online classroom
Online discussion
Study Group
••• •••
Reading
Listening and Watching
Wired and wireless internet access
Computer-aided
Coaching class
Group learning
••• •••
Learning form
Participate in learning evaluation
Learning evaluation design
Self-assessment
Formative assessment
Summative assessment
Learning outcome and feedback

Figure 1. The whole process of ubiquitous learning in formal curriculum learning

Table 1. Comparison of three learning models

Learning model	**Learning goal**	**Learning resources**	**Learning process**	**Learning evaluation**
Informal learning	Self - discovery and definition	Any public resources	Completely autonomous learning	Self-evaluation
Quasi-formal learning	Goal is defined by educational institutions, and needed to be accepted by learners	Educational institutions provide learning resources, and learners choose resources suited to their requirements	Educational institutions design the learning process, individuals learn according to their own situation	The combination of self-evaluation and other-evaluation; give priority to self-evaluation
Formal learning	Goal is Basically defined by educational institutions	Learning resources provided by educational institutions, with a certain mandatory	Educational institutions design the learning process, and learners learn according to the requirements of the organization	The combination of self-evaluation and other-evaluation; give priority to other-evaluation (School evaluation or teacher evaluation)

4. THE FOCUS OF THE FUTURE RESEARCH IN CHINA

4.1 Theoretical Research

Theoretical research is the basis for the development of ubiquitous learning. Only the mature theory research can indicate the correct direction for the practice development, and the combination of the theory research and the practice development is the most important method for perfecting theory [7]. In view of the current development in the ubiquitous learning, theoretical research is weak, making it difficult to play a guiding role in practice. Therefore, in the future research, we should strengthen the theoretical research of ubiquitous learning, including the general definition, the unified theoretical basis, the mature ubiquitous learning model, the operational development strategy, etc. At the same time, Chinese researchers should communicate with the relevant foreign researchers, in order to strengthen understanding of foreign related research results, which can not only avoid low-level, repetitive studies, but also promote the introduction of high level research achievements abroad.

4.2 Technology Development Research

As the basis and key factors of the development of ubiquitous learning, the technology needs to be paid more attention by researchers. With the continuous progress of science and technology, new technologies will continue to emerge time after time. Therefore, how to effectively use technology to achieve seamless learning, and how to make learners at any place, at any time to obtain any information needed is an important point of technology development research. Foreign technology is far more mature than China, so researchers need to learn from the introduction of foreign advanced technology, and carry out development and innovation combined with the characteristics of China. At the same time, the development of technology requires the support of government, enterprises, universities and research institutions, etc. It should be noted that the emergence of technology is good, but it can't be optionally applied to the ubiquitous learning. Therefore, we have to choose the appropriate technology for organic combination, which is conducive to a wider range of applications, and the realization of seamless learning.

4.3 Research on Resource Construction

Resource construction is an important part of ubiquitous learning, and it is an important prerequisite for the application of the whole system. An excellent model and resource construction system can integrate multiple factors, which makes the system more perfect and more effective. Only in this way, the system can be recognized by educators and learners [8]. At present, most of the research results are still in the theoretical stage. Although some of the research results described by the researchers can be achieved, it needs practical verification whether it has a high application value. For the study of resource construction in ubiquitous learning, researchers need to focus on the practical use, such as the construction of learning resources, the construction of teaching resources, etc. At the same time, the resource construction requires researchers to go deep into the classroom to understand the needs of students and teachers. Only by fully understanding the needs of the society, researchers can effectively promote the healthy development of ubiquitous learning.

4.4 Research on Related Standards

Ubiquitous learning is a complex system. In order to avoid the interference of negative factors in the research and development of ubiquitous learning, it is necessary to formulate the corresponding standards to regulate and constrain. The direct effect of the standardization is to make the research results become more unified and interrelated, which will greatly improve the utilization efficiency of resources. On the other hand, standardization provides support for the widespread application of ubiquitous learning. In terms of the present research situation, China's research on the related standards of ubiquitous learning is still relatively weak, existing many problems. Therefore, research on related standards is far from meet the requirements both in depth and intensity, and the researchers still need to continue to vigorously promote the standardization process of ubiquitous learning.

5. EPILOGUE

Throughout the current theory and practice of ubiquitous learning, theoretical research is not yet mature, and many practical problems need to be solved. Although some practices have achieved some functions of ubiquitous learning, it does not meet the requirements of learning at anytime, anywhere, anydevice and anyway. Therefore, in order to achieve a real sense of ubiquitous learning, we need not only to promote the continuous development of technology and continuous updating of computing device or terminal, but also to further improve and perfect the basic theory and functional design of ubiquitous learning in future research. In general, there is a long way to go in the full realization of the ubiquitous learning, which requires us to continue to explore and practice.

6. REFERENCES

[1] Evans, C. 2008.The effectiveness of M-Learning in the form of podcast revision lectures in higher education. *Computers & Education*, (50), 491-498.

[2] Yu, S. Q., and Chen, M. 2011. The characteristics and the trend of ubiquitous learning resources construction. *Modern Distance Education Research*, (4), 14-22.

[3] Duan, C. Y., and Cai, J. D. 2016. Knowledge map research in the field of international ubiquitous learning. *Modern Distance Education Research*, (1), 85-94.

[4] Luo, J. 2014. Information technology drives learning change. *China Educational Technology*, (1), 15-21.

[5] Yu, S. Q. 2007. From the knowledge transmission, cognitive construction to situational cognition: the development and prospect of the three generation mobile learning. *China Educational Technology*, (6), 7-18.

[6] Yang, X. T. 2011. Ubiquitous learning: theory, models and resources. *Distance Education in China*, (6), 69-73.

[7] Xia, Y., and Li, S. C. 2012. U- Learning in China from 2003 to 2011: a literature review. *Distance Education in China*, (5), 36-40.

[8] Ding, J. J. 2016. Challenges faced by ubiquitous learning and its future research focuses. *China Medical Education Technology*, 30(2), 146-149.

Automatic Generation of Plot for Education by Teacher–Student Dialogue Style

Hironori Ito
Kyoto University
Yoshidahonmachi Sakyoku, Kyoto, Japan 606-8501.
h-ito@db.soc.i.kyoto-u.ac.jp

Yasuhito Asano
Kyoto University
Yoshidahonmachi Sakyoku, Kyoto, Japan 606-8501.
asano@i.kyoto-u.ac.jp

Masatoshi Yoshikawa
Kyoto University
Yoshidahonmachi Sakyoku, Kyoto, Japan 606-8501.
yoshikawa@i.kyoto-u.ac.jp

ABSTRACT

As described in this paper, we propose a method to generate plots automatically for educational Manga by teacher–student dialogue style using XML documents, such as PowerPoint^{TM} documents and Web pages, as input. Educational Manga explain knowledge in various fields using expression of Manga. It is recognized that it has high learning effects because of the strength of its impressions, including people to enjoy learning, and so on. However, it is generally difficult to create educational Manga. Therefore, as a support for educational Manga creation, we propose a method to generate plots corresponding to XML documents. Additionally, we adopt teacher–student dialogue style because it is commonly used in educational Manga for ease of understanding and remembering, and for other reasons.

CCS Concepts

• Applied Computing→Education • Information Systems → Information Retrieval→Retrieval tsks and goals→Question answering.

Keywords

Education, Blended learning, Educational manga, Leaning Support

1. INTRODUCTION

Educational Manga explain knowledge in various fields using the expressive medium of Manga. The medium is recognized as having a high learning effect because of the strength of its impression, including people to enjoy learning, and so on. Kogo et al. [1] demonstrated that presentation of learning contents using Manga increases learners' interest in learning content and deepens their understanding.

However, creating educational Manga requires not only profound knowledge related to learning contents; it also requires techniques for presenting them effectively. Few people can do both. Therefore, people cannot use it for education if they want to use its high learning effect. Additionally, it requires a plot for the basis of its creation. This plot must present knowledge in an easy-to-understand manner, but it is difficult for people who have not experienced creating Manga. Therefore, we propose a method to generate plots automatically for educational Manga using XML documents such as PowerPoint^{TM} and Web Pages as input that people can be accustomed to using when creating explanatory materials.

In educational Manga that are actually on the market, a teacher–student dialogue style is often used as a method of presenting knowledge because it is easy to understand and remember. This style has two characteristics: a teacher who has detailed information about a certain field and can teach about it, and a student who does not know about the field. It deepens a reader's understanding through teacher role explanations and student role responses and questions. Therefore, a question- and-answer is the core of teacher-student dialogue style and we focused on it as an utterance pattern of the dialogue style in our method. In addition to educational Manga, it is often used in media such as reference books [2] and educational programs, and TV-shopping is also an example of it. For the above reasons, we adopted this style for our method with an aim to increase learning effect.

First, we defined question-and-answer and dialogue patterns which is the core of teacher-student dialogue style based on their frequency patterns in educational Manga. Then we constructed a classifier for classifying XML documents into these patterns based on their frequent structures. This classifier uses the information of their sentence structure and syntax structure such as 5W1H information. After classification, a plot is generated from question-and-answer exchanges and dialogues that are generated using the sentence structure of input and the language resources based on classification results.

An evaluation experiment was conducted using XML documents of four courses. Six people evaluated the understandability and naturalness of each utterance in the generated plots. Results show comprehensively that high scores were obtained for every evaluation item.

The structure of this paper is the following. First, we describe related work in Section 2. In Section 3, our proposed method of educational plot generation is explained. In Section 4, we explain the evaluation experiment. Conclusions are presented in Section 5.

2. RELATED WORK

We introduce research related to our own. Nadamoto et al. assessed a method to generate dialogues automatically from web news [3]. They specifically examined the Topic Structure [4], which consists of subject words and content words that indicate

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.
ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124121

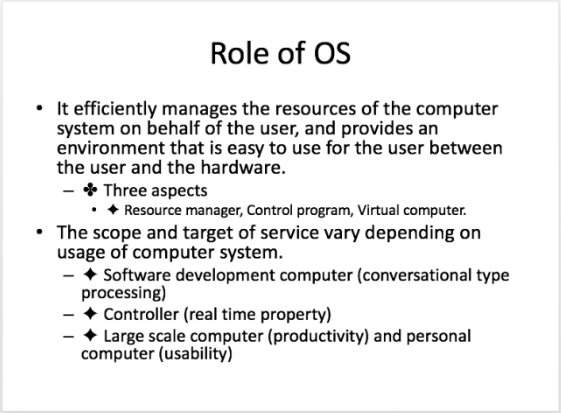
the topic structure, and generated dialogues of comic style using Topic Structure to divide long sentences, generate question-and-answers by two people, and paraphrase web contents into more familiar ones. With Nadamoto method, exaggeration, back-channeling question-and-answers and paraphrasing are used for generating dialogue. In addition, the question-and- answer is generated using the subject word and the content word, but its pattern is only "What is ~? ".

In Nadamoto method, the plots are generated using all of the input. This is not problem when the input is few sentences like news. However, when the input is a XML document which often have many sentences, a very long plot is made and the impression on the content will be weak. Additionally, it is important to ask questions in order to present the important points of the sentence impressively and understandable, but the pattern of questions in their research is only one. Therefore, it is a problem that questions become monotonous. Then, we extract important sentences from XML documents by TextRank [5] in our method. In addition, we propose a method to generate various question-and-answers according to 5W1H information.

3. EDUCATIONAL PLOT GENERATION

First, we explain the teacher–student dialogue style that is actually generated using the proposed method. As an example, Fig. 2 presents the generated dialogs that correspond to Fig. 1 when we use a XML document about the role of operating system (OS) including the page presented in Fig. 1 as input.

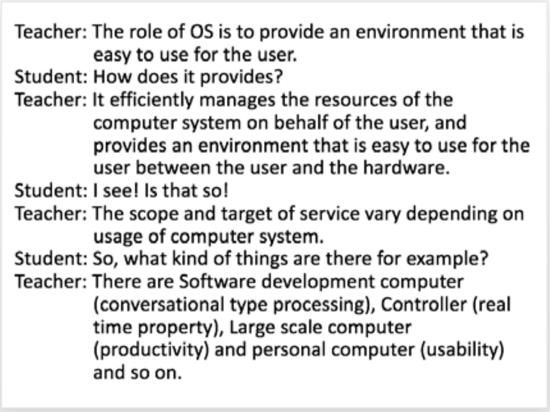
The characters in the plot are a teacher and a student. The teacher fundamentally describes knowledge in the input. The student responds to the explanation such as questions and reactions. In the proposed method, the generated plot comprises combination of dialogues and questions-and-answers. The dialogue is an utterance pair consisting mainly of the teacher's explanation and the student's response. The question-and-answer is an utterance pair of a question from the teacher or the student and an answer of it.



Role of OS

- It efficiently manages the resources of the computer system on behalf of the user, and provides an environment that is easy to use for the user between the user and the hardware.
  - ✤ Three aspects
    - ✦ Resource manager, Control program, Virtual computer.
- The scope and target of service vary depending on usage of computer system.
  - ✦ Software development computer (conversational type processing)
  - ✦ Controller (real time property)
  - ✦ Large scale computer (productivity) and personal computer (usability)

Figure 1. Example of an input.



Teacher: The role of OS is to provide an environment that is easy to use for the user.
Student: How does it provides?
Teacher: It efficiently manages the resources of the computer system on behalf of the user, and provides an environment that is easy to use for the user between the user and the hardware.
Student: I see! Is that so!
Teacher: The scope and target of service vary depending on usage of computer system.
Student: So, what kind of things are there for example?
Teacher: There are Software development computer (conversational type processing), Controller (real time property), Large scale computer (productivity) and personal computer (usability) and so on.

Figure 2. Example of an output.

The processing flow of the proposed method is the following: (1). Estimation of important sentences, (2). Estimation of 5W1H information of important sentences, (3). Classification of important sentences (4). Generation of dialogues and question-and-answers. In the proposed method, inputs are one or more sheets of XML satisfying the constraints shown in Subsection 3.1. Output is a plot written in the teacher−student dialogue style similar to the example presented above. In this section, we first define the constraint conditions of an input. Then we explain the part of our method following the processing flow above.

3.1. Input Condition

This section presents a definition of the constraint conditions of an input XML document. For the proposed method, we adopted a XML document as the input format because it is often used to explain various knowledge including advanced contents and it is easy to handle for users. Input document must satisfy ISO/IEC 29500 prescribing the XML structure such as PowerPoint^{TM} because it is indispensable that the role of each tag in the XML structure be defined clearly to extract information such as texts, images, and emphasis information accurately. An input must include sentences more than 10 because they are used for generating dialogues and question-and-answers. However, if they include too many sentences, then there are many parts of input knowledge that are not used in the plot. The intelligibility of the knowledge is lost. Therefore, as an input condition, this method limits the number of sentences in an input XML document empirically to 10 sentences or more and 100 sentences or less.

3.2. Estimation of Important Sentences

It is important to present input knowledge in an impressive and easy-to-understand manner for generating educational Manga plots. Therefore, we regard important sentences in input as sentences including important knowledges. We use them for generating an educational Manga plot to present the knowledge in that manner. Then, we use TextRank [5] and emphasis information of sentences such as colors, fonts, underline, and bold etc. to extract important sentences from the input.

First, we describe the TextRank algorithm. TextRank proposed by Mihalcea et al. is an application of PageRank [6] for measuring the importance of sentences. TextRank uses a graph structure (G) in which sentences are vertices and weights of edges between vertices are similarities between sentences. The weight W_{ij}^S of an edge between vertex S_i and vertex S_j is calculated using the following formula.

$$W_{ij}^{S} = Simirarity(S_i, S_j) = \frac{|\{\omega_k | \omega_k \in S_i \cap \omega_k \in S_j\}|}{\log(|S_i|) + \log(|S_j|)} \quad (1)$$

Therein, ω_k stands for a word in the sentence, and $|S_i|$ signifies the number of words in the sentence S_i. The importance of the sentence S_i is presented by TR(S_i). It is calculated using the following formula.

$$TR(S_i) = (1 - d) + d * \sum_{S_j \in In(S_i)} \frac{W_{ij}^{S}}{\sum_{S_k \in Out(S_j)} W_{jk}^{S}} TR(S_j) \quad (2)$$

In the equations above, $In(S_i)$ is a set of sentences adjacent to the sentence S_i . $Out(S_j)$ is a set of sentences reachable from the sentence S_j by traversing edges. Then, d is a constant value between 0 and 1, which is assumed here to be 0.85. This is the same value as that used by Brin. The calculation of Eq. (2) is repeated until convergence.

Next, we describe weighting of the importance of sentences obtained from TextRank. The weighting is based on emphasis information accompanying each sentence. It is done by doubling the importance based on the experimentally obtained result in Yagi's research related to emphasis on letters and sentences [7]. The judgment of whether a sentence is emphasized or not is made by comparison with sentences in the same page. In this comparison, the following items are criteria of judgement: the literal color differs from other sentences, the only sentence is underlined. The number of fonts is larger than the others.

Based on results of the estimated importance of each sentence, sentences that fall into the top 20% in the ranking of importance are regarded as sentences for generating question-and-answer. Sentences that are in the top 20%--50% are regarded as sentences for generating dialogues because we recognize sentences with higher importance as central topics. We aim to intensify their impression by converting them into question-and-answers.

3.3. Estimation of 5W1H information of important sentences

This section presents an explanation of the estimation of 5W1H information of important sentences. The 5W1H information is basic information of sentences. There are many questions asking about it generally. Therefore, it is necessary to generate natural questions. For this estimation, we use existing methods by Otake’s research [8]. Additionally, we use MeCab [9] and CaboCha [10] for Japanese parsing and Stanford Core NLP [11] for English parsing, which is necessary for Otake’s method. Simultaneously, we estimate how many sentences divisible by the content.

3.4. Classification of Important Sentences

This section explains the classification of important sentences extracted from an input. In our method, the important sentences extracted in the process of Subsection 3.3 are classified into dialogue patterns using the 5W1H information obtained from the process in Subsection 3.4, the sentence structure of the XML document including the important sentences, and the divisible number of the important sentences, as estimated in Subsection 3.4. Then, criteria for classification are defined based on patterns of sentence structures and syntactic structures which are common in actual XML documents. Patterns into which important sentences are classified are constructed from patterns of dialogue and question-and- answer that appear frequently in educational Manga. Correspondence between the classification results and the utterance patterns of the output are based on similarity between the pattern of how to explain (question, example, or detailed description, etc.), as estimated from the classification result and the pattern of each utterance in educational Manga. Next, we explain the classification patterns and the classification criteria.

3.4.1. Output Pattern of Classification

(a)Dialogues on Figures

This pattern consists of commentary on the figures, with supplementary explanation of the figures and responses to them. This is done while presenting the figures. Hereinafter, an example of dialogues on figures is shown. They are generated from important sentences included in a page that is occupied to great degree by a figure, similar to Fig. 3.

Teacher: "As the figure shows, all programs are executed by the CPU, but it is the role of the OS to control the functions provided by the hardware."
Student: "Yeah, I see, I see!"

(b)Question of 5W and Answer

This pattern consists of questions about What, Who, When, Where or Why and the responses to those questions. Hereinafter, an example generated in the case of a sentence is shown: "The user program manages and controls shared hardware resources at the time of execution." In this example, the information (subject: user program, What: shared hardware resource, When: runtime, predicate: manages and control) is extracted from the sentence and the question about `What` is generated.

Student: "What does the user program manage and control?"
Teacher: "The user program manages and controls shared hardware resources at runtime."

(c)Question of How and Answer

This pattern consists of a question asking for details or examples, and its answer. Hereinafter, an example is shown where the first sentence in Fig. 1 is supplemented with the title as the subject.: "OS is between the user and the hardware, efficiently manages the resources of the computer system on behalf of the user and provides an easy-to-use environment for the user."

Teacher: "The OS role is to provide an easy-to-use environment for the user."
Student: "How does it provide?"
Teacher: "Between the user and the hardware, it efficiently manages the resources of the computer system on behalf of the user and provide an easy-to-use environment for the user."

(d)Question about the Meaning of a Word and Answer

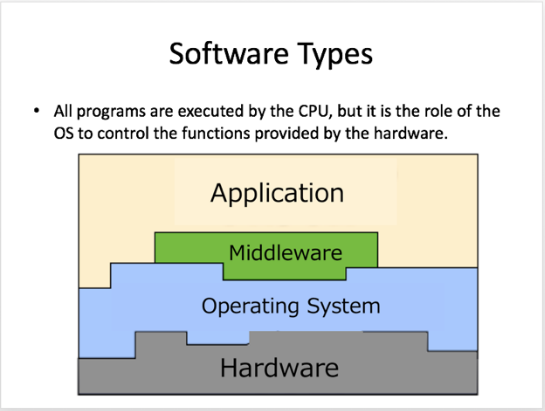
This pattern consists of a question asking for means or details of a certain word and its answer. An example generated for the sentence in the nested structure of Fig. 4 is presented below.

Student: "What is resources on computer system?"
Teacher: "It means hardware resources such as CPU, memory, and disk and software resources such as programs and data."

(e)Question about Complementary Information and Answer

This pattern consists of a question asking for complementary information such as an example and its answer. An example generated for the sentence in the second nested structure of Fig. 1 is shown below.

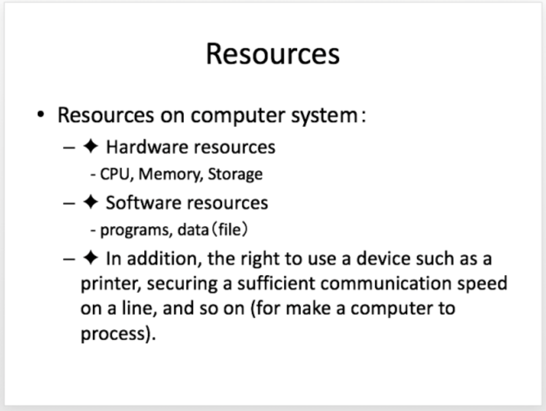
Teacher: "The scope and target of service vary depending on the usage of the computer system."
Student: "What kind of thing is that, for example?"
Teacher: "Software development computer (conversational type processing), control device (real time property), large scale computer (productivity) and personal computer (usability)."



Software Types

- All programs are executed by the CPU, but it is the role of the OS to control the functions provided by the hardware.

Figure 3. Example of figure main page.



Resources

- Resources on computer system：
  - ✦ Hardware resources
    - CPU, Memory, Storage
  - ✦ Software resources
    - programs, data（file）
  - ✦ In addition, the right to use a device such as a printer, securing a sufficient communication speed on a line, and so on (for make a computer to process).

Figure 4. Example of page including nested structure.

3.4.2. Classification Method

(1) To judge whether the inputted important sentence is a sentence that corresponds to the explanation of the image, one must check whether the page including the sentence is a page centering on the image. If applicable, classify this important sentence into the pattern of dialogues on figures. If not applicable, proceed to (2). Here, the page centering on the image is defined as a page with area of the image occupying more than half the entire area.

(2) To judge what explanatory sentence the inputted important sentence is in, it is checked what kind of structure the important sentence is located in the page containing the inputted important sentence. Here, the basic structure by which important sentences are located is divided into two structures found in many slides in reality and others. The first basic structure is that the input sentence is written in a simple list structure. Figure 1 shows that the second is one in which the input sentence is written in the itemized structure using nesting. If it matches the former structure, then proceed to (3). If it matches the latter, then proceed to (5). If neither of the above applies, then it is terminated without outputting.

(3) To judge whether or not supplementation of a subject is necessary for the inputted important sentence in terms of the 5W1H information of the important sentence, it is checked whether the subject relating to the modification subject exists in this. If it exists, then do nothing and proceed to (4). If it does not exist, then take a noun or subject as the subject of the important sentence from the title of the page containing it and proceed to (4).

(4) For generation of more natural questions, one must decide whether the syntax structure of the input important sentence is simple and describing one content, or complicated and describing plural contents. Therefore, it is checked based on the divisible number estimated in Subsection 3.3. If the divisible number is 1, then the important sentence can uniquely identify 5W1H information and can generate a question by missing them. Therefore, it is classified into the pattern of question of 5W and answer. If the divisible number is 2 or more, then the important sentence has plural contents in one sentence and can generate questions related to divided contents. It is classified into a pattern of question of how and answer. If the divisible number is also 0, then it is difficult to convert the sentence. Therefore, it ends without outputting. The example of a sentence that this is 0 is a list of nouns, and so on.

(5) For an important sentence in an itemized structure using nesting, judging what kind of explanatory form the nested structure is from the sentence at the top of the nested structure, a sentence at the top of the nested structure is checked to ascertain whether it is a complete sentence or an incomplete sentence. Here, a complete sentence is defined as one including a subject and a predicate. An incomplete sentence is defined as a sentence lacking a predicate, or any other fragment from the definition above. If the sentence at the top of the nested structure is a complete sentence, then the sentence in the nested structure below that sentence is judged as supplementing the top sentence by example. The important sentence is classified into the pattern of a question about a complementary information and answer. If the sentence at the top of the nested structure is an incomplete sentence, then the sentence in the nested structure below that sentence is judged to provide commentary and a detailed explanation of the top sentence. Important sentences are classified into patterns of question related to meaning of words and answers.

4. EVALUATION

We conducted the experiment to confirm the naturalness and comprehensibility of the utterance in the plot generated using the proposed method.

4.1. Experiment Outline

We conducted the following experiment. First, six people read the four plots generated using the proposed method and inputted XML documents. Then, they answered a questionnaire by three degrees. The XML documents used as input were materials distributed in Kyoto University courses. Each plot produced here had about 30 sentences. The questionnaire asked questions from six questions according to each utterance of the plots, the questions are presented in Table 1. In addition, the types of utterances are classified into explanations of four types, question, response, and agreement. The questions made in each type are presented in Table 2.

Table 3 presents the experimentally obtained results. In response to the questions, evaluation value “1” means "I don’t think so." Then, “2” means "I don’t feel strongly either way." Here, “3” means "I think so." The following were found from this experiment.

Table 1. Question List

Q1	Is the utterance colloquial?
Q2	Can you understand the meaning of the utterance?
Q3	Is the utterance natural as a response?
Q4	Is the question actually being done?
Q5	Is the utterance appropriate as an answer to the question?
Q6	Is the question content important in the slide document?

Table 2. Correspondence of utterance type and question

Type	Question
Explanation	Q1, Q2
Question	Q1, Q2, Q4, Q6
Response	Q1, Q2, Q3, Q5
Agreement	Q1, Q2, Q3

Table 3. Result of evaluation (Average Value)

	Q1	Q2	Q3	Q4	Q5	Q6
Explanation	2.47	2.46	--	--	--	--
Question	2.79	2.76	--	2.38	--	2.78
Response	2.71	2.87	2.52	--	2.41	--
Agreement	2.96	2.97	2.63	--	--	--

(1) The evaluation value for colloquialty in the explanation is somewhat lower than for the other utterances.

(2) The evaluation value for the reality of question is somewhat lower than for the other questions.

(3) The average evaluation value is high for all evaluation items of each utterance.

The main reason for (1) above is failure to complement the subject from the title for the explanation. This evaluation is low when the title is a combination of two nouns connected by a symbol, when it is supplemented as a subject without being divided, or when the title and the contents aren’t coincident. This solution shows the importance not only of complementing the subject of the sentence from the title but also confirming whether the subject coincides with the contents of the sentence using information such as that from web. If not, it is necessary to complement the subject that is appropriate from web information.

The cause of (2) is the failure of elimination of extra information and of interrogative insertion at the time of generating a question because of the failure of estimation of 5W1H information. In the utterance for which the evaluation to this question was low, there were utterances for which word the deletion and interrogative insertion were not performed well. Therefore, we consider that it is necessary to improve the estimation accuracy of 5W1H information, which is the source of generating question sentences.

Regarding (3), some items have a low average evaluation value when mutually comparing evaluation items. However, fundamentally, all the evaluation items of each utterance received good evaluations in general. Results suggest that the generation of plots using the proposed method is useful.

5. CONCLUSION

As described in this paper, we aim to generate plots of educational Manga automatically based on XML documents related to certain knowledge. We proposed a method to generate dialogues and question-and- answer from classified patterns and to generate a plot of teacher − student dialogue style automatically. The evaluation experiment was conducted using plots generated using the proposed method. People evaluated it mainly from the viewpoint of the naturalness and impression of the utterances. The evaluation results underscored the usefulness of the proposed system. As a future task, we will consider about a method of plot generation which deepens understanding more, and also consider automatic generation of educational Manga from the plot.

6. REFERENCES

[1] Tomoko Kogo, and Chiharu Kogo. (1998). The Effects of Comic-based Presentation of Instructional Materials on Comprehension and Retention. *Journal of Japan Educational Technology*, 22(2), 87–94.

[2] Gritzman, P. and Brandenberg, R. 2005. *Das Geheimnis des kurzesten Weges*. Springer.: Publisher.

[3] Nadamoto, A., and Tanaka, K., Complementing your TV-viewing by web content automatically-transformed into TV-program-type content. In: *Proceedings 13th Annual ACM International Conference on Multimedia*, pp. 41–50. ACM Press, New York (2005).

[4] Nadamoto, A., Qiang, M., and Tanaka, K. 2003, December. Concurrent browsing of bilingual Web sites by content-synchronization and difference-detection. In *Web Information Systems Engineering*, 2003. WISE 2003. Proceedings of the Fourth International Conference on (pp. 189-199). IEEE.

[5] Mihalcea, R., and Tarau, P. 2004, July. TextRank: Bringing order into texts.

[6] Page, L., Brin, S., Motwani, R., and Winograd, T. 1999. The PageRank citation ranking: Bringing order to the web. Stanford InfoLab.

[7] Yagi, D., Hoshino, H., and Matsumoto K. 2015, March. Analyzing the effect of sentence emphasis using gaze method. In SIG-KSN-015-03.

[8] Otake, Y., and Hagiwara M. 2012. A dialogue system for the elderly considering utterance intention. *Transactions of Japan Society of Kansei Engineering*, vol. 11 (2012), no. 2 Special Issue P 207-214.

[9] MeCab: Yet another part of speech and morphological analyzer. http://mecab.sourceforge.net/

[10] CaboCha: Japanese dependency structure analyzer. http://chasen.org/taku/software/cabocha/

[11] Stanford CoreNLP – Core natural language software. https://stanfordnlp.github.io/CoreNLP/

Making an Animation of Overhead Spending to Inspire Undergraduates' Financial Management Concept

Ting-sheng WENG
Department of Business Administration, National Chiayi University, No.580, Sinmin Rd, Chiayi City 600,Taiwan, R.O.C.
politeweng@mail.ncyu.edu.tw

Chien-Kuo LI
Department of Information Technology and Management, Shih Chien University, No.70, Dazhi St., Zhongshan Dist., Taipei City 104, Taiwan, R.O.C.
ckli@mail.usc.edu.tw

Meng-Hui HSU
Department of Mechanical Engineering, Kun Shan University, No.195, Kunda Rd., Yongkang Dist., Tainan City 710, Taiwan, R.O.C.
mhhsu@mail.ksu.edu.tw

Der-Ching YANG
Graduate Institute of Mathematics and Science Education, National Chiayi University, 621 No.85, Yamunan, Minxiong
Township, Chiayi County 621, Taiwan, R.O.C.
dcyang@mail.ncyu.edu.tw

ABSTRACT

The average undergraduate does not specifically calculate the total tuition or miscellaneous fees spent during their four-year study at university. Besides tuition and miscellaneous fees, few undergraduates record their basic living expenses or additional expenses, resulting in some unnecessary expenses. Using multimedia animation about expenditures during the four-year study at university, this study employed an interesting and creative way to allow undergraduates to learn their total expenditures and recall additional expenses during a four-year study program at university, understand financial management in daily life, perceive the hardship that their parents have endured to pay their tuition and living expenses, and learn to cherish their hard-earned money. Wealth management and mathematical thinking have multiplied effects. When learning to apply mathematical thinking to one's financial management, the learner can accumulate more wealth faster. The students finished their animation homework regarding their expenditures during the four-year study program at university, and observed those of other groups. Many students reflected upon the hardship of their parents, learned of conflicts between income and expenditures, and stressed rational and emotional life expenses. This study guided students to learn more multimedia animation technologies, and directly educated the students to understand and appreciate the devotion of their parents in order to develop the correct concepts for planning and improving management abilities of personal financial management.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124122

CCS Concepts

• **Applied computing→Education→E-learning.**

Keywords

Expense; mathematical thinking; multimedia; animation

1. INTRODUCTION

With the vigorous development of the Taiwanese economy, the living standard of the public is enhanced, and daily life patterns are westernized and refined [1]. In the face of changing social conditions, such as leisure consumption and popular consumption in line with the trends of the era, undergraduates have additional expenditures.

2. RESEARCH MOTIVES AND PURPOSES

Our lives and money are inextricably linked. Each person spends money on different things every day. Thus, the total expenditures during a four-year study program at university will vary. Do undergraduates know how much money is enough for a four-year study program at university? This author asks students to think about and discuss this question. The students started to reflect how they spent their money, calculated and estimated how much they would spent for their four-year study, and discussed the expenses of relevant items with each other.

The students are assigned to produce multimedia animation homework regarding their expenses, where they were expected to estimate the items and their corresponding expenses during a four-year study program at university, calculate and summarize a list of expenses, and adopt multimedia animation to produce images and videos on the "expenditures of undergraduates". By sharing their animations regarding the "expenditures of undergraduates" on the Internet, this study intends that other undergraduates could consider their daily-life expenses, and identify any improper expenses or waste, in order to conduct appropriate financial planning and reduce the expenses for themselves and their families.

Through this teaching and learning process, this study intends that students could become thrifty, make every penny count, reduce popular consumption, increase their income, and reduce their expenditures, in order to save as much as possible, reduce the burden on their parents, and gain the greatest benefits with the least money.

3. LITERATURE REVIEW

3.1 Expenditure Other Than Tuition and Miscellaneous Fees at University

Nowadays, in addition to basic tuition and miscellaneous fees, undergraduates pay extra expenses, such as volunteer education expenses, expenses for extracurricular cram schools, expenses for art classes, extracurricular books, etc. [2]. From the perspective of social interaction, the pursuit of popular goods is an action with social purposes rather than blindly following. Besides the goal of self-realization, the pursuit of popular goods has the meanings of belonging to a group and competition [3], and additional expenses are varied in terms of male and female undergraduates. Females tend to express their concern about others via shopping. In contrast, males consume for the purpose of self-realization or attracting the attention of females. This is the "instrumental" consumption model [4]. The current consumption model in Taiwan pursues emotional and social goals, rather than meeting basic needs.

3.2 Education of Financial Management in Life

The right knowledge of good ability in financial management serves as the basis for economic development, and reflects the quality of citizens. Financial management knowledge could help people establish a correct financial management attitude, and develop the abilities and habits of financial management, in order to make the right decisions regarding financial management, and thus, lay a vital foundation for themselves and their families [5, 6]. "Financial management education" is a process that deepens the understanding of students regarding financial management concepts and commodities [7]. Through the step by step teaching of courses, people could develop financial management decision-making skills and confidence in line with their personal demands. Through such education, people could learn to perceive the risks and opportunities of financial management, hold an appropriate attitude toward money management, and learn to shoulder the responsibility of their decisions regarding financial management. Chang [8] argued that "financial management education" is designated to cultivate proper ideas and concepts of money and wealth, form scientific financial management methods, and cultivate the senses of devotion and responsibility in students.

Ouyang and Yang [9] showed that primary school students were the subjects, and financial management education was defined a s: During the progressive teaching process, teaching scenarios were designed to teach through lively activities. They hoped that, through such systematic courses, students could learn proper concepts of financial management, manage their money appropriately, and develop the senses of devotion and responsibility. The ultimate goal of such education is to make people affluent in body, mind, and spirit.

This study conducts education of financial management for life within the scope of the expenditures of undergraduates, and teaches students to produce animation of their expenditures. It is intended that students could gain the abilities to analyze, manage, and exchange personal financial conditions, in terms of their management and use of money.

3.3 Integration of the Animation with Living Expenses

In the application of animation elements in TV programs, Animation elements serve as a significant carrier to popularize financial and economic knowledge via radio and TV programs [10]. Lee, Wu, Hou, and Lo [11] deemed that multimedia computer-aided teaching could enhance the academic performances of primary school students with mental disorders, with the effects of promptness, maintenance, and analogy, thus, their study had good social validity.

This study introduces the expenditures animation to undergraduates in order to raise their acuity and emphasis on expenditures.

3.4 Mathematical Thinking

Huang [12] argued that the history of mathematics originated from the desire to solve various computational problems in daily life, and a variety of mathematical problems emerged in an endless stream to promote the development of mathematics. The entire process of identifying a problem—solving the problem—finding another problem, is mathematical thinking adapted to the changes of the objective world and Cheng [13] demand of rigorous and logical thinking of mathematics. Chu etc. [14] mentioned the trajectory of human activities, and advocated that the teaching of mathematics should be close to the real-life of students. The connection between mathematics in life and textbooks should be deepened, in order to integrate life and mathematics. According to the research [14], it was conducive for financial management to learn mathematics.

During this course, the students are asked to make good use of rapid mathematical calculation. In fact, the mathematical knowledge involved in financial management is not as complicated or difficult as imagined, provided that people are willing to spend the time, they could truly "participate in" their planning of financial management [15]. Most skills of financial management are derived from practice, and students are expected to constantly apply "addition", "subtraction", "multiplication", and "division" to financial management. The concept of "addition" in financial management refers to "accumulation". The concept of "subtraction" in financial management refers to the "reduction of expenditures and debts". The concept of "multiplication" in financial management requires us to utilize the ideas of financial management. "Multiplication" refers to the time and money consumed through periodic and repeated accumulation. "Division" implies that we should eliminate our consumption habits without limits and the idea of "spending all we have earned". Similar habits affect the appreciation of our wealth. Moreover, "division" could be used to filter necessary items, and we should compare the same goods sold by different stores in order to select the most suitable products. "Division" is used to select the product portfolio most suitable for ourselves. As we go forward with our burdens discarded, we would become acutely aware of our expenses, manage our wealth more easily, and achieve the desired effects of financial management.

The question of this study asked how much money would be spent for a four-year study program at university, which triggered the students to reflect on their expenditures, solve their problems in real-life, constantly apply mathematics in their lives, make decisions to control expenditures, and analyze problems from different perspectives.

Animation Production Steps

Figure 1 shows the steps to produce an animation about the expenditures of undergraduates. First, this author discusses with the undergraduates the expenses, items, and amounts students recorded during their past four-year study. Then, according to the average amount spent on the assumptions of classification, we calculated the expense of each item, and then, the fixed item expenses during the four years are multiplied by four. This study conducts statistical analysis of the items of expense during the junior and senior years, as based on the memory of the students, and the amounts. Then, the above figures are summed up to obtain the total expenditures.

Discussions with the students show that, when they started to classify their expenses, they understood that they had not realized the influence of such classification. After sharing data among the groups, the students conducted in-depth study of the expenses of the sub-items in each major category. Some students engaged in quiet reflection, while some spoke eloquently. As each person has different lifestyles and values regarding their expenses, they realized they spend different amounts of money on one item, and because their understanding was different, it was sometimes difficult for them to obtain an average value.

As their teacher, the author hoped to guide them to calculate their expenses more clearly. Thus, the students were asked to think carefully about each of their expenses, as well as their estimation method for each amount. However, due to different habits, different students spent different amounts of money on the same item. Through discussions, we determined a solution for each student to record their own account book, and then, the average value of each three students was calculated. They also referred to the standard data regarding the expenses of a general person from the Internet. Through such estimation, they reached an amount for each item, which was accepted by all three persons of one group.

Multimedia animation is lively, interesting, and attracting.

Due to advanced technologies, many applications can make animations or turn photos into animated characters. The author taught the students how to use MomentCam, a photo software, which can modify face shape, hairstyle, and background. The author also provided the steps to use the software for their simulation and reference; the software can be used to remove unwanted background, crop the desired size of a photo, and store the photo into a new image file in the Q edition style.

Powtoon is an online software for animation production and modification, which has a clear interface, and is convenient, free, and easy. After the figures in the Q edition style were made, they were imported to Powtoon to add transition effects and text to form animation.

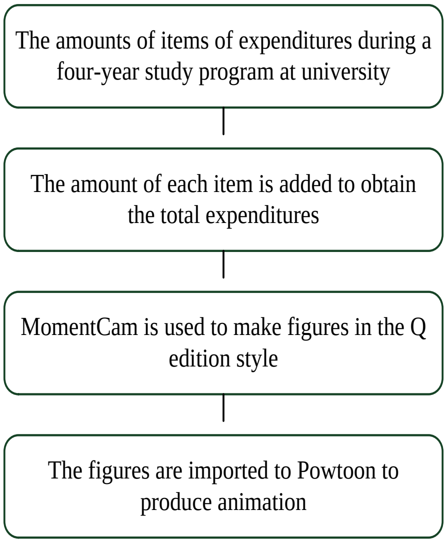

The amounts of items of expenditures during a four-year study program at university
The amount of each item is added to obtain the total expenditures
MomentCam is used to make figures in the Q edition style
The figures are imported to Powtoon to produce animation

Figure 1. Flowchart of the steps to produce animation regarding the expenditures of undergraduates

This animation is designated to allow more students to understand the amount of their expenditures during a four-year study program at university, which triggered them to consider how to better plan their expenditures, save each penny, and use their money more efficiently, in order to gain the best benefits from the money spent during a four-year study program at university. Figures 2 to 5 display the screenshots of animations completed by one group of students. Figure 5 shows the estimations of the total expenditures of a student of the Business Management Department during their four-year study program at university.

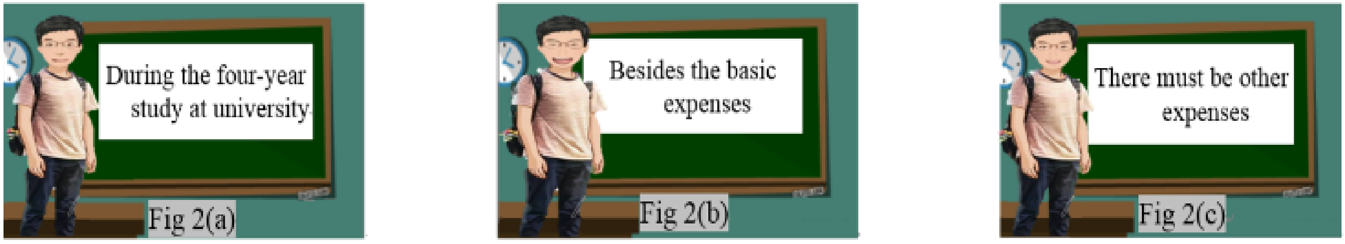

During the four-year study at university
Fig 2(a)
Besides the basic expenses
Fig 2(b)
There must be other expenses
Fig 2(c)

Figure 2. A student is thinking about his expenditures in the animation

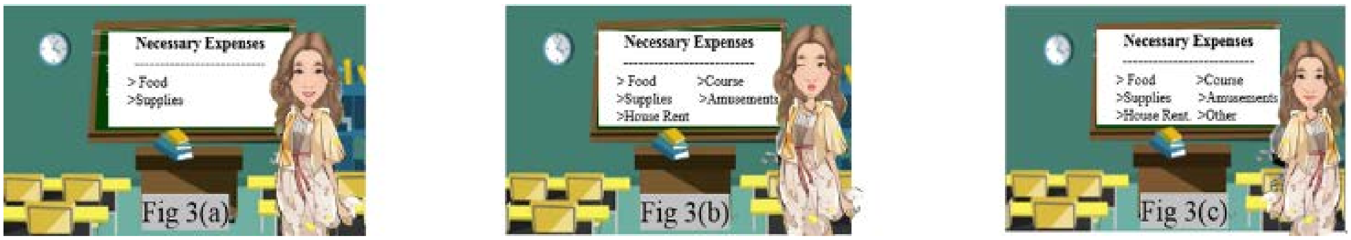
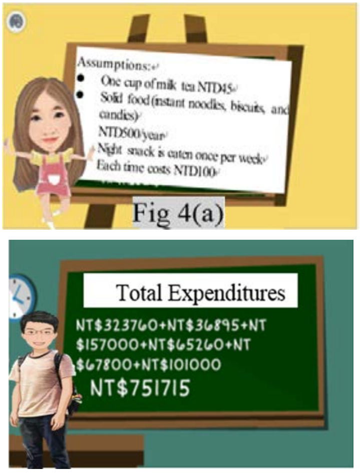

Necessary Expenses
>Food
>Supplies
Fig 3(a)
Necessary Expenses
> Food
>Supplies
>House Rent
>Course
>Amusements
Fig 3(b)
Necessary Expenses
> Food
>Supplies
>House Rent
>Course
>Amusements
>Other
Fig 3(c)

Figure 3. A list of the "items of necessary expenses and other additional items of expenses" in the animation



Assumptions:

- One cup of milk tea NTD45
- Solid food (instant noodles, biscuits, and candies)

NTD500/year

Night snack is eaten once per week

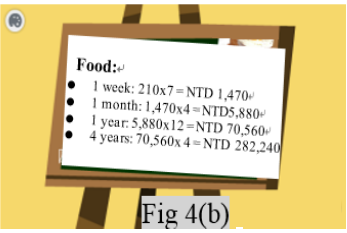
Each time costs NTD100

Total Expenditures

NT$323760+NT$36895+NT $157000+NT$65260+NT $67800+NT$101000

NT$751715

Figure 4. Expenditures and the amount accumulated in the animation



Food:

- 1 week: 210x7 = NTD 1,470
- 1 month: 1,470x4 = NTD5,880
- 1 year: 5,880x12 = NTD 70,560
- 4 years: 70,560x 4 = NTD 282,240

Figure 5. Total expenditures of a student in four years at university

4. CONCLUSION

This study introduced the calculation of the living expenditures of undergraduates to import their real-life patterns, converted such expenditures for easy learning, and cultivated their acute mathematical thinking ability, as based on their own experiences of living expenditures. The students were eager to discuss this topic, not only because it was closely related to their lives, but also because they learned how much their parents paid for their four-year study program, and realized the opposite numbers of income and expenses. They clearly understood the item, usage, and value of each penny spent, and wanted to work hard to thank their parents for their love and care.

Mathematics is a tool to calculate all kinds of life matters, including many financial management skills. Financial management is a science, which requires effort and mathematical skills in life. The guidance of this study *program* in mathematical thinking deepened the students' understanding of *their* knowledge of financial management, which allowed them to cultivate correct concepts and planning of financial management, enhance their abilities in management and decision-making related to money, and realize the goal of independent and sound management throughout their life in the face of changing environments and various financial situations.

The animation and figures in the Q edition style added joy and attraction to the exploration of living expenses. The students completed their own animations and observed the outcomes of other groups. After reflection and careful calculation, some students found that there were many "rational expenses" and "emotional expenses". Some thought that the final figure might not cover all the items, as some items might be missing, and they would be more surprised if the amounts of the missing items were added.

How much is spent for a four-year study program at university? At present, in light of the 2017 statistics of Taiwan, among the total of 217 colleges and universities, 58 were public were 159 were private [16]). Those that studied at a private school spent more than those at a public school. The living expenses, tuition, and miscellaneous fees, as provided by each family to their children, are different. This study can serve as a reference for other undergraduates and their parents.

5. ACKNOWLEDGMENTS

The authors thank the Ministry of Science and Technology for providing funding MOST 105-2511-S-415-002 to assist in the completion of this study. The authors also thank to the project assistants Ju-Ting Chen, Ming-Hsun Chang, and Mei-Yun Cho for assisting in making animations

6. REFERENCES

[1] Cheng, F. L., Hsu, Y. J., and Huang H. J. 2016. *An Experimental Study on the Healthy Diet Program for Elementary Student's Nutritional Cognition, Dietary and Consumption Behavior*. Humanities and Social Sciences: Education, 10(3), 27-48.

[2] Chou, C. Y. 2005. *High Tuition Fee vs. Low Tuition Fee—Survey on the Living Expenses of Undergraduates in Taiwan*. Collection of Papers of Seminar on the Reform and Development of Higher Education of Mainland China and Taiwan, 128-140.

[3] Wu, M. Y., and Hsu, S. C. 2014. *I Suffered Therefore I Buy: Family and Peer Effects on Fashion Consumption among College Students*. Formosa Journal of Mental Health, 27(3), 379-408.

[4] Wong, Y. T., Osman, S., Said, A., and Paim, L. 2014. *Moderating Effect of Gender in Repatronage Behavioral Intention: The Role of Personal Characteristics*. Asian Social Science, 10(1), 106-116.

[5] Grable, J. E., and Joo, S. 1998. *Does Financial Education Affect Knowledge, Attitudes, and Behavior? An Empirical Analysis*. Personal Finances and Worker Productivity, 2(2), 213-220.

[6] Martin, A., Oliva, J. C. 2001. *Teaching Children about Money: Applications of Social Learning and Cognitive Learning Developmental Theories*. Journal of Family and Consumer Sciences, 93(2), 26-29.

[7] Huang, M. Y. 2008. *The Imperative of Integrating Financial Education into Elementary and Secondary School Curricula: Analyzed According to Its Importance and Curriculum Content*. Bulletin of Civic and Moral Education, No.19, 25-54.

[8] Chang, L. L. 2010. *Teach Your Children to Manage Money in Advance.* Taipei: Red Ants Books.

[9] Ouyang, H., Yang, L. L. 2013. *A Study on Teaching Effectiveness of Financial Education—An Example of Third-Graders in Elementary School*. 2013 Seminar on Internationalization of Service Industry, 1-31.

[10] Fang, H., Sung, L. C. 2013. *Dictionary of Finance and Economics: Animation Drives away Boredom*. Broadcasting Realm, No.1, 116-117.

[11] Lee, L. Y., Wu, C. L., Hou, C. T., Lo, J. S. 2013. *The Effects of Multimedia Computer Assisted Instruction on the Performance of Financial Education for Elementary Children with Intellectual Disabilities*. Journal of Research in Special Education and Assistive Technology, No.6, 23-43.

[12] Huang G. R. 2003. *Problem-chain Method and Mathematic Thinking*. Journal of Mathematics Education, 12(2), 35-37.

[13] Cheng, Y. H. 2004. *Mathematical Thinking and Education of Mathematics in Primary School*. Curriculum, Teaching Material and Method, 24(1), 28-32.

[14] Chu, P. C., and Chu, P. C. 2006. *Financial Quotient (FQ) Training—66 Tips on Financial Management*. FQ Training, Hong Kong: Wan Li Book.

[15] Morton D. D. 2001. *The Math of Money-Making Mathematical Sense of Your Personal Finances.* New York: Springer-Verlag New York Inc.

[16] Ministry of Education 2016. *List of Colleges and Universities in 2016*.

An Exploratory Study on the Memory Performance for Memorizing the English Words through the Apps with Three Different Learning Strategies and Highlights

Yuan-Bang Cheng
Department of Information Management
National Taiwan University of Science and Technology
Taipei, Taiwan
+886-2-27333141 ext. 7905
davinban@gmail.com

Chuan-Kai Yang
Department of Information Management
National Taiwan University of Science and Technology
Taipei, Taiwan
+886-2-27376756
ckyang@cs.ntust.edu.tw

ABSTRACT

This study conducts the experiment by the Apps with three different learning strategies and highlights on Taiwanese students. The goal is to investigate the differences in memory performance for memorizing new English words and to provide suggestions for developing Apps. There are 103 students participating in the experiment to use the Apps under three conditions. 1) In condition A, students try to remember every new English word without any highlight. 2) In condition B, students try to remember every new English word with the existing highlight. 3) In condition C, students make the highlight on every new English word and try to remember that. Our results show in terms of average accuracy, condition A is the most, followed by condition B and C. In summary, we think the function of making highlights can just help the students quickly look up where they should focus on. Hence, in the Apps, for memorizing the English words, we suggest that the function of making highlights by fingers should not be activated, and the English words should have no highlight on them.

CCS Concepts

• Applied computing→Education→E-learning. • Software and its engineering→Software creation and management→Designing software→Software design tradeoffs.

Keywords

English learning; highlight; memory performance; signal detection theory.

1. INTRODUCTION

Nowadays, English is the most important international language that we have to learn, and especially English is slightly difficult to EFL (English as a Foreign Language) students, e.g. Taiwanese students. One of the most basic steps of English learning is vocabulary memorization. The most common way to memorize a new word is rote rehearsal because it is convenient and fast [1], and it just requires encoding and rehearsing on these new words repeatedly for memorizing them [2]. Some evidences showed that the memory performance following rote rehearsal is modulated by repeated encoding and physical aids on the text like highlights. Hence, this study probes into the memory performance for memorizing new English words when students adopt two types of highlights. The behavior of making highlights on key contents is an interesting issue to be discussed, especially in Taiwan where the cram schools are so popular, and it is very common that students are taught about how and where to make highlights. Most students in Taiwan used to highlight the key contents using underlines or marks by their hands. However, as there are so many underlines and marks, how is the memory performance? Recently, there have already been a lot of researches on these studies in note-taking and annotation. In this study, we mainly focus on discussing the effect of highlighting (marking) for Taiwanese students when to use the Apps to memorize new English words.

2. HIGHLIGHTS ON THE VOCABULARY FOR LEARNING AND MEMORY

It is common that students used to make highlights on new English words which they are probably unfamiliar with, so the modality of highlights for the English words is significant to students, and the highlights were proved to be helpful [3]. Moreover, some researchers had used technology-enhanced and multimedia annotations in order to help the EFL students learn and memorize new English words [4-8]. Regardless of using the traditional or technology-enhanced and multimedia highlights on the words, the use of highlights is still an issue to be worth to discuss how effective the EFL students learn and memorize these new English words through different highlights and modalities. For multimedia highlights, we can adopt the voice coupled with highlight or without highlight for the study of the learning and memorization for these new English words over the Apps.

3. THE ROLE OF KINESTHETIC CODE

In our daily life, we often use the red underlines or yellow marks to highlight key words while reading a book (Figure 1). During the learning process, in terms of human memory, there are four main code types: acoustic, visual, semantic and physical/kinesthetic code [9]. So, highlighting can be considered one of the encoding behavior like the kinesthetic code.

Kinesthetic code denotes to memorize materials or information through the postures or movements of one's body parts, and it is also important to the blinds [10], athletes [11] and dancers. Moreover, according to the relation between kinesthetic code and learning, Fleming categorized learning styles into the VARK model (i.e., visual, auditory, reading-writing preference and kinesthetic learners) [12]. We can know that one of the properties

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124123

of kinesthetic learners is to learn and memorize something through moving, doing and touching. As a result, kinesthetic code is an issue that the cognitive psychologists or educational technologists are enthusiastic to do further explorations [13-15].

Based on the kinesthetic code, students themselves need to highlight some key contents by their hands to increase the received stimuli in order to achieve better memory performance; however, when these key contents had already been highlighted for the students, is there any difference in the memory performance?

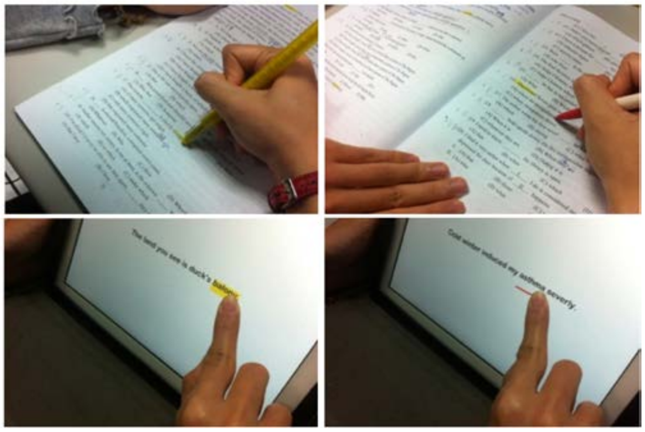


Figure 1. A student highlights two words using the yellow mark (top-left) and red underline (top-right) when reading a book. Likewise, a subject is making the yellow mark (bottom-left) and red underline (bottom-right) through the Apps in this experiment.

4. SIGNAL DETECTION THEORY

In a recognition memory test, the signal detection theory (SDT) is widely used to measure the memory performance. SDT includes four possible response categories i.e. Hit, False Alarm (FA), Correct Rejection (CR) and Miss [16]. Moreover, Tulving introduced that *Remember* is different from *Know* [17]. Remember is defined as a true state of conscious recollection, whereas Know is defined as feelings of familiarity that arise in the absence of recollection [18]. Hence, the Remember and Know procedure is commonly used to differentiate between recollection and familiarity-based recognition memory [19]. In this study, we adopt the SDT, R-K-N and the accuracy rate for evaluating the memory performance for every participant. N means the English word is new for a student, or the student had never seen it. K means the student has the feelings of familiarity with the word, and R means the student had seen and remembered the English word. Also, the accuracy rate is derived from *[(Hit count + CR count) / (Hit count + CR count + FA count + Miss count)] × 100 percent.*

5. METHOD

5.1 Objectives

This study is to understand students using three different learning strategies (highlights) as follows. Firstly, students do not use their hands to make highlights while the highlights on learning materials are not provided (condition A). Secondly, students do not use their hands to make highlights while the highlights (namely, red underlines or yellow marks) on learning materials are already provided (condition B). Thirdly, students have to use their hands to make highlights using red underline or yellow mark (condition C). For three kinds of learning strategies over the Apps, we discuss the diversity of memory performances in terms of the accuracy rates for memorizing new English words.

Based on human memory, reinforcing attention and kinesthetic codes, we assume that highlighted words in the sentences would be remembered better (namely, B should be better than A, and C should be better than A), and we also assume that making highlights using red underline or yellow mark by oneself (using kinesthetic code) should provide better performance in comparison with the case where these materials had been highlighted already (namely, C should be better than B). We explore these hypotheses and probe into their answers in this experiment.

5.2 Procedure

We conducted a within-subject design involving the dependent samples. There were totally three conditions, and then we remixed experimental orders for the counterbalance. So they included S-ABC (namely, this serial at first is condition A, then condition B, at last condition C), S-BCA and S-CAB, and these corresponding learning strategies over the Apps were also developed. Three orders were cyclically assigned to students and were conducted in an individual and quiet environment. Finally, we had 35 students for S-ABC, 34 students for S-BCA and 34 students for S-CAB. The procedure design of this study is showed in Figure 2.

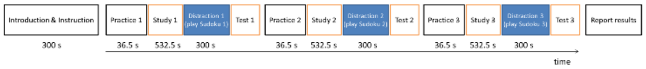


Figure 2. The procedure design of this study.

Firstly, an introduction & instruction for 300 seconds was held before to start the experiment, and finally the results were reported and stored into the iPad for further analyses. For every condition, the students had ten seconds for learning and memorizing every new English word and one second for every time interval. The purpose of time interval was to remind the students to get ready for the next new word. On the time interval pages, the Apps were showing a cross sign on the center of the screen before showing the next new word. In every condition, between the study and test phases, a numeric puzzle game (we used the Sudoku game) was provided for students in order to occupy their working memory. For example, in terms of the experimental order, one student encountered an experimental order S-CAB as illustrated in Figure 3, so App condition C was met at first, App condition A was the second and App condition B was the last. The final result of three test phases was output on the screen page at the end of the experiment (in detail, see http://cgm.cs.ntust.edu.tw/Aban/ACM_ICEMT2017_supplement.pdf).

5.3 Design and Material

In the study phase, the tasks a student needed to do were the following.

- In condition A: to remember every new English word in every sentence without any highlight.
- In condition B: to remember every new English word in every sentence with the existing highlight of red underline or yellow mark (in turn).
- In condition C: to make the highlight of red underline or yellow mark (in turn, and cannot freely select the red underline or yellow mark) on every new English word in every sentence and to remember that.

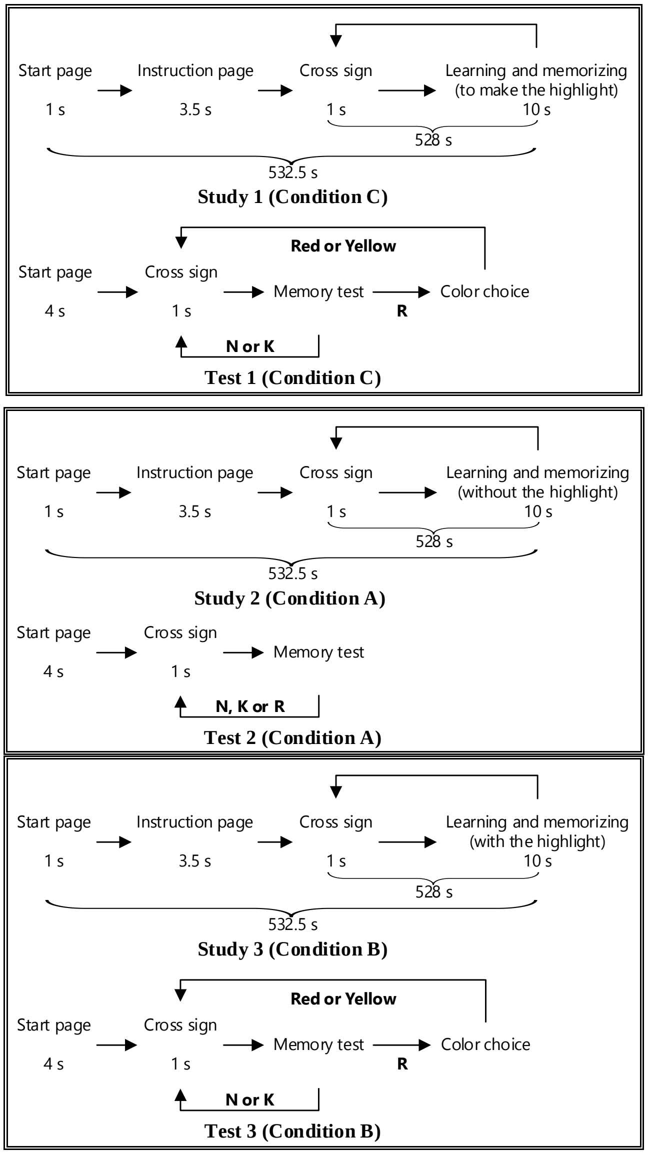

Start page
1 s
Instruction page
3.5 s
Cross sign
1 s
Learning and memorizing
(to make the highlight)
10 s
528 s
532.5 s
Study 1 (Condition C)
Red or Yellow
Start page
4 s
Cross sign
1 s
Memory test
Color choice
R
N or K
Test 1 (Condition C)
Start page
1 s
Instruction page
3.5 s
Cross sign
1 s
Learning and memorizing
(without the highlight)
10 s
528 s
532.5 s
Study 2 (Condition A)
Start page
4 s
Cross sign
1 s
Memory test
N, K or R
Test 2 (Condition A)
Start page
1 s
Instruction page
3.5 s
Cross sign
1 s
Learning and memorizing
(with the highlight)
10 s
528 s
532.5 s
Study 3 (Condition B)
Red or Yellow
Start page
4 s
Cross sign
1 s
Memory test
Color choice
R
N or K
Test 3 (Condition B)

Figure 3. An experimental order S-CAB for this study.

In every condition, the new word's pronunciation and its spelling sound, both sounds in every study phase to have two times circularly were presented to a student while showing the new word and its sentence on the iPad. For example, "fender" and "f-e-n-d-e-r", twice. Between the study and test phases, we asked each student to complete the Sudoku game correctly with limited 5 minutes, and totally we provided three different Sudoku games for the student. In the test phase, the Apps displayed these English words one by one on the center of screen page for the student without any highlight, pronunciation and sound, and the appearances of these words that included the singular/plural and uppercase/lowercase forms were all the same as they were in the study phase. In addition, we used the R-K-N method. If it was in condition B or C, there were two buttons on the screen page (including "Red" or "Yellow") after R button was being touched, and the student needed to respond one color. In order to have a fair probability distribution, two colors of highlights were allocated to 50 percent probability, respectively.

By the means of reading, we can use the relationship between words to give one meaning for the strange word [20]. That is helpful to memorize a new word, even though we do not know its meaning in the beginning. Therefore, we used some simple words which were with very high-frequency to be incorporated together with a new word (namely, stimulus, it was low-frequent word). Hence, every student had to remember these low-frequent new English words that appeared one by one in the Apps using the current or past simple tense sentence. We picked 225 low-frequent words that the ratios were lower than 28.36/million from The Corpus of Contemporary American English [21]. These new words were all nouns with 6 alphabets in length. We had done a preview of these materials by another 9 students from graduate school of computer science to ensure that these 225 English words were not only low-frequency but were all new words to the students, and these sentences were also confirmed that they were reasonable to be understood by the students based on their responding comments.

In every study phase, it included 48 trial sentences which each sentence was individually involved with a new English word. In every test phase, it included 48 English words to allow the student to do recognition one by one, in which 24 English words had been shown in the study phase and the other 24 English words were just for lures. However, students did not know the number of shown English words and lures allocated, so totally we used 72 lures in all conditions. Moreover, before every study phase started, there were three practicing sentences in every condition (totally, 9 practicing sentences) for the students to understand the condition and task.

5.4 Participants

All students participated in this study had approved to sign the consent documents for this experiment. A total of 103 students (students in the preview have been excluded) attended at this study, in which there were 54 females and 49 males. Their ages ranged from 23 to 26 years old and majors were graduate school of computer science in the first or second year from two universities in northern Taiwan. These students were to learn English as a foreign language. They had already attended to the test of TOEIC lately during one month before to start this experiment. For 103 students' English levels, the mean of correctly answering questions was 62.75 and standard deviation was 2.48 in their TOEIC tests. For students' TOEIC scores, in the three experimental orders they were not significantly different from individual two orders [$F(2, 100) = .585$, $p = .559>.05$].

6. RESULTS

6.1 Descriptive Data

A demographic table is listed in Table 1. Moreover, for the colors of contexts, we also calculated the students' source hits. The total of the source hits denoted that the students had correctly responded to the targets' colors in condition B and C. In the three conditions, for the values of Hit, the internal-consistency reliability (Cronbach α) was .77. For the values of FA, Cronbach α was .88, and for the values of Hit and FA, it was .80. So, the results reveal our methods and the values have good consistency.

Table 1. Means (M) and standard deviations (SD) for Hit, FA, Accuracy and Source Hit.

Items	**Hit (%)**		**FA (%)**		**Accuracy (%)**		**Source Hit (%)**	
Group (n=103)	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Condition A	77.95	15.45	42.19	22.65	67.88	12.52	-	-
Condition B	74.66	15.73	40.57	20.93	67.04	11.80	57.18	18.87
Condition C	70.06	13.53	38.95	22.60	65.55	10.59	45.86	17.79
Total	74.22	15.23	40.57	22.04	66.82	11.67		

6.2 The Accuracy Rates Are not Significantly Different from Different Conditions

The accuracy rate is analyzed using a repeated-measure one-way ANOVA among three conditions. The within-subjects effects reveal no significant difference [F = 2.282, p = .105], so all accuracy rates of students are not significantly different among three conditions. However, in terms of the means of accuracy rates, condition A (M = 67.88) is the most, followed by conditions B (M = 67.05), and the fewest is condition C (M = 65.55).

6.3 The Students Cannot Answer Correctly These Highlights (Modalities) more in Condition C

For the source hits, a dependent sample T-test is conducted for testing the effect of source hits between condition B and C. The modalities for the highlights that included the red underline and yellow mark were answered correctly fewer in condition C than that in condition B, and there is a significant difference between both [$t(102)$ = 4.206, p = .000<.001]. So, these students can answer correctly with these highlights (modalities) in condition B significantly more than in condition C.

7. DISCUSSIONS

In our results, condition A (no highlight and no kinesthetic code) is slightly better than condition B (highlight and no kinesthetic code), and condition A is slightly better than condition C (highlight and kinesthetic code). Also, in terms of the kinesthetic code, condition C is slightly worse. Moreover, students correctly answering these highlights (modalities) are significantly fewer in condition C.

The activity of making highlights shows no reinforcement to the students for memorizing the new words; however, there is no significant evidence to answer that. In terms of the means of accuracy rates, making highlights is worse. Our discussion is as follows. Because making highlights will lead to distractions, students need to consume more their working memory resources [22]. Perhaps, the activity of making highlights cannot be associated with these new words and/or the highlights (modalities) which the students need to remember, but just quickly provides the indexing locations.

We assumed that making highlights by the kinesthetic code was helpful for students; however it is not totally correct as we commonly used to think. In the result, the students can answer with the yellow marks or red underlines remarkably more correctly in condition B than that in condition C. Because of the kinesthetic code, the students were probably elicited to pay attention to the energy-consuming activity of making highlights, rather than on the colors, modalities, or these new words.

Moreover, the duration of rehearsal time should be considered as well, because it can also seriously affect the memory performance. Recent studies have also confirmed that the rehearsal is important for learning and memorizing new English words [23, 24] and what rehearsal strategies are used by students e.g. [25-27], are also important to EFL students, because both rehearsal time and rehearsal strategies are positively significantly related to the consolidation of human memory on the learning materials.

In addition, since the region of a yellow mark was bigger than a red underline, a yellow mark could lead to higher attention/impression, so the students preferred a yellow mark to a red underline. As a result, in condition B the yellow marks could draw the attention/impression more than the red underlines [n_{yellow}=658, n_{red}=603, p>.05], and in condition C the yellow marks could as well [n_{yellow}=600, n_{red}=578, p>.05], although there were not significant differences between the yellow and red. For this reason, what kind of colors can stimulate the students more, and probably it is not due to the colors, but the modalities of highlights, including the underline and mark. So, in terms of these bigger regions of highlights for memorizing new English words, we can do more experiments to test the effect of the big/small region of highlights in the future.

8. LIMITATIONS AND IMPLICATIONS

Two colors and modalities of highlights probably had different stimulating effect for the students; however, we did not allow them to choose colors and modalities, and that might limit their abilities. Moreover, the students might need more time than this study provided, so that they could tightly memorize these new English words.

We do not encourage students to make the highlights while they are memorizing, and we do not suggest that students to highlight the contents too much. According to the results, we think the function of making highlights is mostly to help index the locations, which can just help the students quickly look up where they should focus on. In this experiment, there is no significant evidence to confirm that highlights or making highlighting can effectively help the students on memorizing new English words. We can suggest that the highlights made must be very obvious and clear, and make sure that it can help the students index the contents quickly, which is just the most important thing for the highlighting.

In this exploratory study, we report the results for our developing App (called Easy E-words REM) which is built to help Taiwanese students memorize the English words by a specific better learning strategy. So, in terms of such an App, we suggest the design policies for the future App as follows. 1) During the memorizing process for the new word, provide the word's pronunciation and its spelling sounds for the student. 2) The App should be developed with the function that the student can freely adjust the rehearsal time before switching to next one for the individual difference. 3) On the page for memorizing, the function of making highlights by the finger should not be activated. 4) Those English words which the students need to memorize should have no highlight on them. 5) The App can just activate the function of making highlights after the memorizing process, so that the student can mark one word on a sentence by a yellow mark (it should be obvious and clear) for indexing the content later.

9. REFERENCES

[1] G. F. Meunier, D. Ritz, and J. A. Meunier, "Rehearsal of individual items in short-term memory," Journal of Experimental Psychology, vol. 95, no. 2, pp. 465-467, 1972.

[2] E. B. Goldstein, Cognitive Psychology: Connecting Mind, Research, and Everyday Experience (2rd ed.), p.^pp. 139, Belmont, CA: Wadsworth, 2007.

[3] K. A. Kiewra et al., "Providing study notes: Comparison of three types of notes for review," Journal of Educational Psychology, vol. 80, no. 4, pp. 595-597, 1988.

[4] K. Al-Seghayer, "The Effect of Multimedia Annotation Modes on L2 Vocabulary Acquisition: A Comparative Study," Language Learning & Technology, vol. 5, no. 1, pp. 202-232, 2001.

[5] Z. Chen, “The effects of multimedia annotations on L2 vocabulary immediate recall and reading comprehension: A comparative study of textpicture and audio-picture annotations under incidental and intentional learning conditions,” University of South Florida, 2006.

[6] D. M. Chun, and J. L. Plass, “Effects of Multimedia Annotations on Vocabulary Acquisition,” The Modern Language Journal, vol. 80, no. 2, pp. 183-198, 1996.

[7] J. Gasigijtamrong, “Effects of Multimedia Annotations on Thai EFL Readers' Words and Text Recall,” English Language Teaching, vol. 6, no. 12, pp. 48-57, 2013.

[8] Y. Yeh, and C.-w. Wang, “Effects of Multimedia Vocabulary Annotations and Learning Styles on Vocabulary Learning,” CALICO Journal, vol. 21, no. 1, pp. 131-144, 2003.

[9] S. K. Card, T. P. Moran, and A. Newell. "The Psychology of Human-Computer Interaction," http://www-personal.umich.edu/~itm/688/wk7/CMN-ch2.PDF.

[10] M. I. Posner, “Characteristics of Visual and Kinesthetic Memory Codes,” Journal of Experimental Psychology, vol. 75, no. 1, pp. 103-107, 1967.

[11] A. Ille, and M. Cadopi, “Memory for movement sequences in gymnastics: Effects of age and skill level,” Journal of Motor Behavior, vol. 31, no. 3, pp. 290-300, 1999.

[12] N. D. Fleming, Teaching and learning styles: VARK strategies: Christchurch , New Zealand, 2001.

[13] L. J. Adams, “Movement and Memory,” Master of Arts in Education, California State University, Stanislaus., 2013.

[14] D. Edge, K.-Y. Cheng, and M. Whitney, “SpatialEase: learning language through body motion,” in CHI 2013, Paris, France, 2013.

[15] T. F. Hawk, and A. J. Shah, “Using Learning Style Instruments to Enhance Student Learning,” Decision Sciences Journal of Innovative Education, vol. 5, no. 1, pp. 1-19, 2007.

[16] D. M. Green, and J. A. Swets, Signal detection theory and psychophysics: New YorkWiley, 1966.

[17] E. Tulving, “Memory and consciousness,” Canadian Psychology/Psychologie canadienne, vol. 26, no. 1, pp. 1-12, 1985.

[18] J. l. Hicks, and R. l. Marsh, “Remember-know judgments can depend on how memory is tested,” Psychonomic Bulletin & Review, vol. 6, no. 1, pp. 117-122, 1999.

[19] N. M. Dudukovic, and B. J. Knowlton, “Remember-Know judgments and retrieval of contextual details,” Acta Psychologica, vol. 122, pp. 160-173, 2006.

[20] S. A. Stahl, "Words Are Learned Incrementally Over Multiple Exposures," Essential Readings on Vocabulary Instruction, M. F. Graves, ed., International Reading Association, 2009, pp. 69-71.

[21] M. Davies. "The Corpus of Contemporary American English: 450 million words, 1990-present. Available online at http://corpus.byu.edu/coca/.".

[22] M. K. Rai et al., “Effects of Stress and Working Memory Capacity on Foreign Language Readers' Inferential Processing During Comprehension,” Language Learning, vol. 61, no. 1, pp. 187-218, 2011.

[23] K. Dahlen, and C. Caldwell-Harris, “Rehearsal and Aptitude in Foreign Vocabulary Learning,” Modern Language Journal, vol. 97, no. 4, pp. 902-916, 2013.

[24] H. Erik, “Rehearsal Significantly Improves Immediate and Delayed Recall on the Rey Auditory Verbal Learning Test,” Applied Neuropsychology, vol. 18, no. 4, pp. 263-268, 2011.

[25] F. I. M. Craik, and M. J. Watkins, “The role of rehearsal in short-term memory,” Journal of Verbal Learning and Verbal Behavior, vol. 12, no. 6, pp. 599-607, 1973.

[26] M. Kaushanskaya, and J. Yoo, “Rehearsal effects in adult word learning,” Language and Cognitive Processes, vol. 26, no. 1, pp. 121-148, 2011.

[27] J. L. Harris, and C. D. Qualls, “The association of elaborative or maintenance rehearsal with age, reading comprehension, and verbal working memory performance,” Aphasiology, vol. 14, no. 5-6, pp. 515-526, 2000.

Factors Affecting Student Adoption of E-Learning Systems in Indonesia

Hajra Rasmita Ngemba
Department of Information System
STMIK Adhi Guna
Palu, Central Sulawesi, Indonesia
+62 811 4536 968
hajra.rasmita@gmail.com

Syaiful Hendra
Department of Informatics Engineering
STMIK Adhi Guna
Palu, Central Sulawesi, Indonesia
+62 811 4538 853
syaiful.hendra.garuda@gmail.com

ABSTRACT

This study discusses the factors that influence the successful adoption of e-learning system in Indonesia. This study analyzed eight independent variables (system quality, information quality, service quality, organizational structure, organizational environment, user experiance, computer self efficay, social influance), two intervening variables that user satisfaction and intention to use, and one variable dependent is net benefit. This study uses a model-FIT HOT modified and adapted to the circumstances of adoption of e-learning in Indonesia. Based on the findings of the hypothesis that there are six strong influence on the adoption of e-learning.

CCS Concepts

Social and professional topics → Information systems education.

Keywords

Adoption; E-learning in Indonesia; HOT-FIT model.

1. INTRODUCTION

E-learning in higher education was born as a new paradigm of modern education and lead to drastic changes in educational practice. E-learning is considered by many as a significant breakthrough process effectively in the learning process [1] [2]. E-learning became priorities for higher education after the widespread use of the internet. Implementation of E-learning is expected to improve teaching, learning, information and knowledge of learners, skills or other performance. The availability of online resources is a key condition to support it [3]. An information system is successful when it is able to meet all the needs of users and to assess the success of information systems necessary to do an evaluation. The evaluation process always contains a judgment (assessment / determination) that was based on certain criteria. The criteria can be determined by the evaluator himself or of the assignor [4].

Some research on the evaluation of e-learning as done by [5] [6] [7] [8] [9] [10]. From research conducted using the sharing of models. This study will use HOT-Fit modified model. E-learning research in Indonesia quite a lot but that using HOT-Fit Model to evaluate e-learning is still very little.

The results of this study are expected to provide input for the Indonesian government about the factors that influence the adoption of E-learning and also for universities. Furthermore, the remainder of this study is organized as follows. Section 2 describes the theoretical framework for this research acceptance of E-learning. Section 3 presents the research methodology. Section 4 presents the analysis. Section 5 discusses the results of the study. Section 6 presents the conclutions and Section 7 recommendations provided which closes this article.

2. BASIC THEORY

2.1 E-Learning in Indonesia

E-learning is a learning process that uses an electronic device or computer that is structured [11], while according to Horton [12], E-learning is a learning system using internet and web technologies. From both definitions, we can conclude that E-learning is a learning system using computer and internet media. Horton [12] categorize e-learning into five types, among others: a) Learner-led e-learning or self-directed e-learning; b) Instructor-led e-learning; c) Facilitated E-learning; d) Embedded E-learning; e) telementoring and e-Coaching.

According Wahono [13], the components that make e-learning is a) E-learning System, a system virtualization software that makes conventional teaching and learning process; b) E-learning Content, the content and teaching materials available on the E-learning system; c) E-learning Infrastructure ie E-learning infrastructure or equipment used in the E-learning..

Cross [14] mentions several trends E-learning models that are widely used by educational institutions, among others, a) Blended Learning; b) Learning Content Management Systems (LCMSs); c) Learning Object and Web Collaboration or Live E-learning, E-Learning Circumstances in Indonesia

In Indonesia, the implementation of E-learning is growing in line with the development of ICT infrastructure. Some programs ICT development, especially infrastructure in Indonesia, for example the Internet network (Jarnet), Network Information School (JIS), (Wide Area Network City (WAN City), Information and Communication Technology Center (ICT Center), Indonesia Higher Education Network (Inherent), National Education Network (Jardiknas) and the Southeast Asian Education Network (SEA Edunet).

Along with the development of the ICT infrastructure of the many educational institutions begin to develop e-learning. At the level of Higher Education (PT), some PT developed the E-learning

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124125

platform itself, including UGM, Unisula, AMIKOM and others. Several other universities using MOODLE platform, including ITB, UNPAR, GUNADARMA, ITS, UB, Unitomo, IST AKPRIND, and more.

According to Gani [15] facing some problems occurred in Indonesia, the use of ICT is an appropriate alternative solution to some problems of education in Indonesia, especially those related to: (a) geographic constraints, time and social economical; (B) Digital divide (ICT development and use was dropping) of the developed world; (C) Contributions technology. Utilization of E-learning is expected to improve the quality of education in Indonesia, with a focus on the development of E-learning for (1) Support the 9-Year Compulsory Basic Education launched by the Government; (2) Support program Distance Education (ODL); (3) Providing solutions to the problems of education because of the constraints of access to information and communication. (4) Equity in learning opportunities; (5) Improving the quality of education; (6) Improving the quality of human resources.

2.2 HOT-Fit Model

Human-Organization-Technology (HOT) Fit Model. According to Yusof [16] This model puts an important component in the information system of Human, Organization and Technology, and suitability relationships. Within the framework of HOT-Fit, the evaluation include: (1) Organizational factors and dimensions: the structure and the environment; (2) Fit between technological factors, human and organization; (3) Two-way relationship between these dimensions: quality of information and the use of the system, information quality and user satisfaction, the structure and the environment, structure and net benefits, and net environmental benefits. Human component assesses the information system of the use of the system in the frequency and extent of functions and investigation information systems. System use is also associated with anyone who uses (who use it), its level (level of user), training, knowledge, hope, and acceptance (acceptance) or reject (resistance) system.

This component also assess the system from the aspect of user satisfaction Yusof [16]. Organizations component of the system assesses the organizational structure and environmental aspects of the organization. Consist type of organizational structure, culture, politics, hierarchy, planning and control systems, strategy, management, and communication. Leadership, support from top management or top management and support staff is an important part in measuring the success of the system. While the organization's environment consists of sources of financing, government, politics, competition, interorganizational relations and communications Yusof [16]. Component technology consists of system quality, information quality, and service quality.

Quality of system concerns the linkage system features in the system include system performance and user interface. Ease of use (ease of use), easy to learn (ease of learning), response time, usefulness, availability, flexibility, and security is a variable or a factor that can be judged by the quality of the system. The quality of information focused on information produced by the information system. The criteria that can be used to assess the quality of information include the completeness, accuracy, timeliness, availability, relevance, consistency, and data entry. While the overall quality of services focused on the support received by service providers or technology istem. Service quality can be judged by the speed of response, assurance, empathy, and follow-up services.

The purpose of this study was to identify the factors that influence the adoption of E-learning in higher education. This study reviewed several international studies and models that might apply to the situation in Indonesia.

3. RESEARCH METHOD

3.1 Research Model

In this study, the authors integrate multiple models acceptance of information systems that have been done in previous research. Research model development can be seen in Table 1.

Table 1. Variables adoption

Variable	[16]	[17]	[18]	[19]	[20]	[21]
SQ	√	√				
IQ	√	√				
SV	√	√				
OS	√					
OE	√					
UE						√
CS			√		√	
SI			√			
US	√	√				
IT		√		√		
NB	√	√				

SQ=Service Quality; IQ=Information Quality; SV=Service Quality; OS=Organizational Structure; OE=Organizational Environment; UE=User Experiance; CS=Computer Self Efficacy; SI=Social Influence; US=User Satisfaction; IT=Intention To Use; NB=Net Benefit

According to the Table 1 formation factors acceptance of information systems, the authors make modifications to take some construct that will be used in this research model. The latent variables used in the model receipt of the information system of E-Learning in Indonesia can be seen in Figure 1.

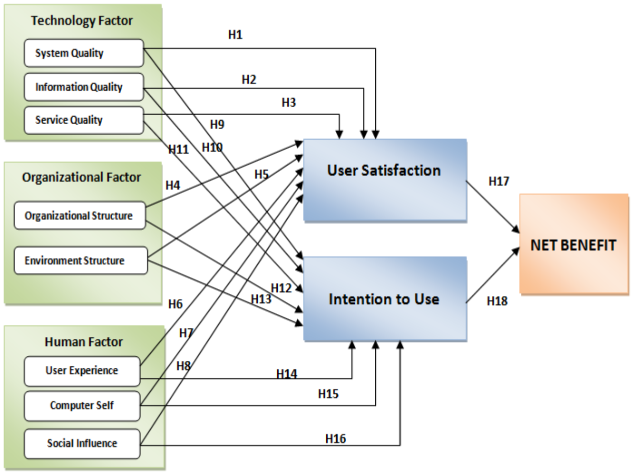


Figure 1. Research model

The population for this study is the Indonesian students in the Province of Central Sulawesi who actively use e-learning. This data collected by 2016 from October to December. Choosing a sample of students with non-probability sampling method, which uses purposive sampling technique. Students sampled are students who have been using E-learning at least 3 times and actively use e-learning. Collecting data using questionnaires. The questionnaire was designed is divided into two parts. The first part contains the data on the respondents, including: department, semester, age, income / allowance, duration and frequency of use of E-learning. In the second part contains statements related to the research constructs.

As for the measurement technique on this questionnaire using likert scale between 1-5. The lowest value until the Count highest value of the mean Likert scale (1) strongly disagree, (2) do not agree, (3) neutral, (4) agrees and (5) strongly disagree. Data processing techniques used in the analysis and discussion of the data that has been collected is assisted by SPSS data processing software. To measure the correlation using a number of interpretations. According Sugiono [25] interpretation of the correlation numbers are as follows:

0 to 0.199	: Very weak
0.20 to 0.399	: Weak
0.40 to 0.599	: Medium
0.60 to 0.799	: Strong
0.80 to 1.0	: Very strong

3.2 Variable Measurement

In general indicators on research variables as follows:

Table 2. Variables and indicators

Variable	Indicators	Adoption From
System Quality	Ease of use,System flexibility Response time, System reliabilty, Sophistication, System features.	[16];[17];[22];[23]
Information Quality	Accuracy,Timeliness, Completeness, Format,Reliability Usefulness.	[16];[17];[24]
Service Quality	Tangible,Service reliability, Responsiveness,Assurance, Empathy.	[16];[17]
Organizational Structure	Support,Involvement, Commitment.	[26]; [16]
Organizational Environment	Sharing,Communication, Teamwork.	[16]
User Experience	Usability,Content Pleasure,Classic Aesthetics Expressive Aesthetics.	[21]
Computer Self Efficacy	Independently, to help others, leisure time facilities, aid.	[27]
Sosial Influence	Trend in the organization, people are important and influential, Friends and Family Support, Instruction Leadership.	[18]
User Satisfaction	Effectiveness,Enjoyment System satisfaction,Proudnes Overall satisfaction.	[16];[17]
Intention To Use	Frequency of use, Intention to (re)use,Dependence.	[28]
Net Benefits	Individual productivity, Job effectiveness, Cost reduction, Improved outcomes/outputs, Competitive advantage, Quality improvement,Costumer satisfaction.	[16];[17]

4. ANALYSIS

4.1 Validity and Reliability Tests

Validity and reliability tests performed on the items the question to see the correlation between the questions of the questionnaire and see the consistency of the questionnaire. Test the validity of using the correlation formula Pearson Product Moment confidence level used is 95% (α = 0.05). Testing the validity (correlation) is done by comparing the value of r count r table = 0.1543. The test results are all values of r count is greater than r table, thus indicators declared invalid. According to Table III, all the sub-variables with the total of the questions (items) as much as 53 grains, has a Cronbach's Alpha above 0.6. In fact, there are five variables with Cronbach's Alpha value of more than 0.8 which indicates that variable has a good reliability. So we can conclude measurement tool in this research has been reliable. Based on calculations in mind that the calculation of multicollinearity among variables meet the prescribed criteria, ie Variance Inflation Factor (VIF) <10. It can be concluded that all the variables have been eligible for further study.

Table 3. Reability

Variable	(n)	Cronbach's Alpha	Reliability
System Quality	6	0.730	Accepted
Information Quality	6	0.841	Good
Service Quality	5	0.872	Good
Organizational Structure	3	0.789	Accepted
Organizational Environment	3	0.790	Accepted
User Experience	5	0.835	Good
Computer Self Efficacy	4	0.773	Accepted
Social Influence	4	0.690	Accepted
User Satisfaction	5	0.882	Good
Intention To Use	3	0.729	Accepted
Net Benefit	7	0.874	Good

Note: (n) number of questions in the questionnaire

4.2 Respondent Demographics

This section presents an overview of research data obtained from the respondents. Questionnaires distributed 200 questionnaires were returned as many as 162 so that a response rate of 81%. Based on the data analysis users of e-learning mostly from department of information system with the amount of 67.3% is consistent with the fact the field that is most active users are students majoring in information systems. While based on the semester of the most active use of e-learning is half of 3 and 5 with a frequency of 118 people. For sex most widely used e-learning is a male 89 people with an average age of most users are less than 21 years, this is because users of e-learning at no more than half of the level 3 and 5. Minority respondents had revenues / allowance of less than Rp. 500,000 some 78 people. As for the frequency of use of e-learning in the week the average user to use 2 times a week with duration of use for an average of 1 hour in each time access.

5. RESULT AND DISCUSSION

The results of analysis of 18 hypothesis tested were found a significant relationship at the level of 0.01 using linear regression statistical test. Hypothesis test results showed that all accepted hypothesis by comparing the F table with F value. F table in this study the probability of 2.44 to 0.01. The results of a comparison F value > F table so that all the hypotheses constructed accepted. For more details can be seen in Table 4.

Table 4 addressed that six strong relationship affect the dependent variable is the quality system powerful influence on user satisfaction. These results indicate that the better the quality of e-learning system, the higher user satisfaction, it can be seen from one of the indicators of ease of use of e-learning system that can be accessed by utilizing the technology website. These findings confirm previous studies which stated that the quality system is significant effect on user satisfaction. These findings also confirm one theory of Guiemareset [32] which states that the size of user satisfaction on the computer system is reflected by the quality of systems owned.

Table 4. Correlation and hypotheses

Variable	Correlation	Interpretation	F-Value	Information
SQ--> US	0,600*	Strong	90,031*	Accepted
IQ--> US	0,760*	Strong	219,236*	Accepted
SV--> US	0,631*	Strong	105,667*	Accepted
OS--> US	0,567*	Medium	75,990*	Accepted
OE--> US	0,505*	Medium	54,843*	Accepted
UE--> US	0,672*	Strong	131,510*	Accepted
CS--> US	0525*	Medium	60,885*	Accepted
SI-->US	0,402*	Medium	30,815*	Accepted
SQ--> IT	0,534*	Medium	63,907*	Accepted
IQ--> IT	0,630*	Strong	105,062*	Accepted
SQ--> IT	0,594*	Medium	87,433*	Accepted
OS--> IT	0,548*	Medium	68,609*	Accepted
OE--> IT	0,503*	Medium	54,219*	Accepted
UE--> IT	0,600*	Strong	90,217*	Accepted
CS--> IT	0,529*	Medium	62,036*	Accepted
SI-->IT	0,427*	Medium	35,659*	Accepted
US-->NB	0,547*	Medium	68,438*	Accepted
IT-->NB	0,568*	Medium	76,069*	Accepted

Note: $*p<0.01$; SQ=Service Quality; IQ=Information Quality; SV=Service Quality; OS=Organizational Structure; OE=Organizational Environment; UE=User Experience; CS=Computer Self Efficacy; SI=Social Influence; US=User Satisfaction; IT=Intention To Use; NB=Net Benefit; Interpretation Column Explain Correlation Status; Information Column Explain hypotheses constructed status.

Information quality strongly influence satisfction user. These results also showed that the quality of information provided by e-leaerning to users, the higher the user's satisfaction. It can be seen from indicators of data completeness, format, timely and benefits perceived by users of e-elarning so as to increase the sense of user satisfaction. These findings confirm one theory of Ives [29] which states that the quality of information is a key dimension of instrument involves end-user satisfaction. Information quality significantly to the strong influence intention to use. This proves it increasingly user feels the information is accurate, useful and complete the user's interest in using e-learning will be higher. These findings are consistent with research conducted by Rai [31] found that the quality is significantly related to the desirability of using, when interest in use is measured as the dependency system.

Service quality strong influence on user satisfaction. These results indicate that the better quality of service to users, the higher user satisfaction. This is evident from a quick indicator of responsiveness, the existence and the good response e-learning officer at the user. Myers [30] states that the quality of service as well as quality systems and quality of information has an influence on user satisfaction.

User experiance strong influence on user satisfaction. This result proves that the better the user experience in using e-learning, the higher user satisfaction towards the e-learning, as well as user experiance strong influence on intention to use. It can be proved that e-learning has an attractive design so that the user wants to go back to using e-learning.

User satisfaction and intention to use has an influence on the net benefit to the medium category. This shows still need to attempt to improve user satisfaction and intention to use. Efforts to improve it is by improving the relationship of several variables still have a relationship category were to variable user satisfaction and intention to use.

6. CONCLUSION

Based on the results of the analysis conducted in this study, it can be deduced as follows:

1. System quality strong influence on user satisfaction. These results indicate that the better the quality of e-learning system.
2. Information quality strong influence on user satisfaction. These results also showed that the quality of information provided by e-learning to users. Information quality is also a strong influence on intention to use.
3. Service quality strong influence on user satisfaction. This shows that the better quality of service to users, the higher user satisfaction.
4. User expreiance strong influence on user satisfaction and intention to use.
5. User satisfaction and intention to use has an influence on the net benefit to the medium category. This shows still need to attempt to improve user satisfaction and intention to use. Efforts to improve it is by improving the relationship of several variables still have a relationship category were to variable user satisfaction and intention to use.

7. RESEARCH LIMITATIONS AND RECOMENDATION

1. For the government of government policy in the form of: planning, quality standardization, network infrastructure and content, as well as readiness and culture of human resources for deploying information technology, especially in the use of e-learning system in Indonesia for e-learning systems will be used or not is dependent of government policy.
2. For colleges, universities organizers e-learning system in Indonesia to further improve the support of the organizational structure, organizational environment and quality of service. With the growing support of the organizational structure, organizational environment and the quality of service is expected to have an impact on the use and user satisfaction, and ultimately will have an impact on individuals and organizations.
3. For further research, research will be the object of research is currently only located in Central Sulawesi, research will be advisable to increase the research object and expand the sample in order to produce better results if more diverse group. The study involves only a single perspective of students, research will be advised to use the perspective of the organization / institution (unit manager of e-learning system) and the instructor / lecturer of the course.

8. ACKNOWLEDGMENT

Our thanks to STMIK Adhi Guna that give us funding to realize this research. And our thanks to ACM SIGCHI for allowing us to modify templates they had developed.

9. REFERENCES

[1] Keller, C. & Cernerud, L. Students' perception of e-learning in university education. *Learning, Media and Technology, 2002. 27*(1), 55-67.

[2] LaRose, R., Gregg, J., & Eastin, M. Audio graphic telecourses for the Web: An experiment. *Journal of Computer Mediated Communications*, 1998.*4*(2).

[3] Bhuasiri, W., Xaymoungkhoun, O., Zo, H., Rho J., and Ciganek, A.P. Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty, Computers & Education. 2012. (58) 843–855.

[4] Roswati. Evaluasi program/proyek. *Jurnal Pendidikan Penabur* . 2008. No.11/Tahun ke-7/Desember.

[5] Al-Adwan, A. & Smedley, J. K. "Implementing e-learning in the Jordanian Higher Education Systems: Factors affecting impact". *International Journal of Education and Development using Information and Communication Technology*, . 2012. 8 (1), pp121-135.

[6] Asabere, N. and Enguah, S. "Use of Information & Communication Technology (ICT) in Tertiary Education in Ghana: A Case Study of Electronic Learning (E-learning)". *International Journal of Information and Communication Technology Research*. 2012. 2 (1), pp.62-68.

[7] F. Lasrado, "Attitudes towards e-learning: Exploratory evidence from UAE," in The 2nd Annual Forum on e-Learning Excellence in the Middle East, Dubai, UAE, 2009

[8] J. Zouhair, "Surveying Learners' Attitudes Toward a Saudi E-learning System," International Journal of Information and Electronics Engineering, vol. 12, September 2012

[9] Dvorackova, M., & Kostolanyova, K. (2012). Complex model of e-learning evaluation focusing on adaptive instruction. *Procedia – Social and Behavioural Sciences, 47,* 1068-1076.

[10] Raspopovic, M., & Lucic, V. Analysis of e-Learning success factors. In *Proceedings of the Third International Conference on e-Learning* (pp. 102-107), Belgrade Metropolitan University, Belgrade, Serbia. 2012

[11] Allen, M.W. Michael Allen's guide to E-learning. Hoboken, New Jersey: John Wiley & Sons, Incorporated. 2003

[12] Horton, W., & Horton, K. (2003). ELearning tools and technologies. Wiley Publishing: Indianapolis.

[13] Wahono, Romi Satria.Sistem e-learning Berbasis Model Kreativitas Komunitas. 2007 http://www.ilmukomputer.com.

[14] Jay Cross and Ian Hamilton, Beyond eLearning, Internet Time Group. 2002

[15] Gani, Lilik, E-Learning is a Must, Pendayagunaan Teknologi Informasi dan Komunikasi Untuk Pemerataan Akses dan Peningkatan Mutu Pendidikan, disampaikan dalam Workshop E-Learning di Universitas Indonesia. 2006. 29-31 Agustus.

[16] Yusof, M. M., Kuljis, J., Papazafeiropoulou, A.,Stergioulas, L. K. 2008. An Evaluation Framework For Health Information Systems: Human, Organization, and Technology- Fit Factors (HOT-Fit). International Journal of Medical Informatics,77(6), 386–398

[17] DeLone, W. H., and Mclean, E. R. The DeLone McLean Model Of Information System Success: A ten-Year Update, Journal of Management Information. 2003. Vol. 19, No. 4: 9-30.

[18] Venkatesh,V. dkk. *User Acceptance of Information Technoligy: Toward a Unified Views*. MIS Quarterly. 2003. Volume 27.

[19] Abd Latif Abdul Rahman, Adnan Jamaludin and Zamalia Mahmu. Intention "to Use Digital Library based on Modified UTAUT Model: Perspectives of Malaysian Postgraduate Students". 2011

[20] Hayashi, A., Chen, C., Ryan, T., & Wu, J. The role of social presence and moderating role of computer self efficacy in predicting the continuance usage of e-learning systems. Journal of Information Systems Education. 2004. 15(2), 139-154

[21] De Angeli, A., Hartmann, J., and Sutcliffe, A.(2009)."*The effect of brand on the evaluation of websites. Interact, Part II*".LNCS 5727: 638 – 651.

[22] Landrum, Hollis., et al. 2009. Measuring IS System Quality with SERVQUAL: Users' Perceptions of Relative Importance of the Five SERVPERF Dimensions. Informing Science: the International Journal of an Emerging TransdisciplineVolume 12, 2009. Page 17-35.

[23] Gorla, Narasimhaiah *et.al.* (2010). Organizational Impact of System Quality, Information Quality, and Service Quality. *Journal of Strategic Information Systems,* 19: 207-228.

[24] Ramayah, T., Lee, J. W. C., & Osman Mohamad. (2010). The role of quality in e-learning satisfaction and usage among university students in Malaysia. Paper presented at the International Conference on Business and Management Education, Bangkok, Thailand.

[25] Sugiyono."Metodologi Penelitian Bisnis" PT. Gramedia.Jakarta. 2007

[26] Hartijasti, Y. Top management commitment in enterprise resource planning implementation success: Premilinary study in Indonesian stateowned interprises. *Journal of Information Technology Applications & Management* 18:42-59. 2011

[27] Din Jong, & Wang. Student Acceptance of Web-based Learning System. Proceedings of the 2009 International Symposium on Web Information System and Applications. 533-536. Nanchang, P. R. China:Academy Publisher. 2009

[28] Wang, Y., Wang, H., & Shee, D. Measuring e-learning systems success in an organizational context: Scale development and validation. Computers in Human Behavior, 23(4), 1792-1808. 2007

[29] Ives, B., Olson, M. and Baroudi, S. The measurement of user information satisfaction. Communications of the ACM, 26(10), pp. 785–793. 1983

[30] Myers, B., Kappelman, L., & Victor, R. Prybutok, A comprehensive model for assessing the quality and productivity of the information systems function: toward a theory for information systems assessment. Information Resources Management Journal, 10(1), 6 -25. 1997

[31] Rai, A., Lang, S.S., & Welker, R.B. "Assessing the Validity of IS Success Models: An Empirical Test and Theoretical Analysis". *Information Systems Research*, 13(1), 50-69. 2002

[32] Guimaraes, Tor, Sandy D Staples., dan James D Mckeen. "Empirically Testing Some Main-User Related Factors for System Development Quality". The Quality Management Journal. ABI/INFORM Global. page 39–55. 2003

Group Collaboration and Effective Tools in Online Education

Suhansa Rodchua
University of Central Missouri,
Warrensburg, MO64093, USA
001-660-543-4438
rodchua@ucmo.edu

ABSTRACT

In college teaching with adult students, encouraging critical thinking, problem solving and teamwork with project-based learning can be challenging. Group project is a great assignment showing students the relevance to real world practices and promoting active learning with joy. However, many college students showed low satisfaction with working as a group to research and write a report. Many of these students complained that some group members did not put forth effort into the group work, but took the credit. The purpose of this paper is to present effective collaboration tools and active learning activities in E-learning. Advanced communication and technological tools, especially web-based tools become an important issue for educators to optimize student uses and to sustain a high level of engagement in disciplinary contents.

This paper also discusses the results from the survey questionnaire with 236 undergraduate and graduate students enrolled in classes between 2014 -2016. The data shows the 11 tools ranking how helpful students perceived them. The finding of this study can support online course developers and educators in maximizing the use of Web-based tools, and today's technology in group meeting and collaboration.

CCS Concepts

Social and professional topics → Professional topics → Computing education→Adult education.

Keywords

Group collaboration; web-based tools; online education; web conferencing; virtual meeting.

1. INTRODUCTION

Active learning strategies and group collaboration tools are needed to support student's learning experience, performance, and satisfaction. When students are assigned motivating projects and they use the right tools to work together, students will make improvements on final outcomes and achieve learning goals. According to the article in *NY Times*, published on February 25, 2016, "In Silicon valley, software engineers are encouraged to work together, in part because studies show that groups tend to innovate faster, see mistakes more quickly and find better solutions to problems. Studies also show that people working in teams tend to achieve better results and report higher job satisfaction" [1]. There are compelling reasons to believe that group projects are an effective learning activity and vital to the organization; group projects can help students practice teamwork, problem solving, critical thinking, and communication skills.

Meyers and Jones [2] define active learning as learning environments that allow students to communicate and reflect as they approach the course through problem-solving exercises and some other activities. A myriad amount has been written in the past decades about research on how people learn. Studies clearly show that a person must be engaged to learn. If student learning is the goal, effective teaching means creating effective learning environments where students actively participate and engage with the materials [3]. This concept is also applied to college education with an emphasis on critical thinking, teamwork, and problem solving skills. The development of critical thinking skills in students is a top goal of higher education. With today's global society and competition, the workforce requires effective teamwork with understanding of diverse culture on top of these major skills [4]. Group project can be a great active learning strategy in higher education.

However, adult college students showed low satisfaction in working as a group to research and write a report. Many of these students complained that some group members did not put forth effort into the group work, but took the credit. Rodchua [5] conducted a previous study in 2009 with 151 college students in 11 courses in an Industrial Management program regarding the usefulness of tools and activities in students' learning. The level of satisfaction ranged from 57.08% to 93.22%. Results showed that students highly agreed that the Internet and World Wide Web contributed to their understanding of course contents with 93.22%. The lowest satisfaction was the use of group activity with a value of 57.08%. As educators and course developers, we should not ignore or cancel a group project because students do not like it much. How does one bring value added to group activity and enhance student satisfaction? What are effective collaborative tools and current technologies used in group project?

2. PURPOSE OF STUDY

The purpose of this paper is to present current technology and applications in online group collaboration for higher education. The study discusses active learning strategies and the web-based tools that contributed to students' understanding of course contents, ranking from low to high. The derived data presented in this paper was collected from the 236 students enrolled in industrial management and technology programs between 2014-2016. Active learning and cooperative group work are the main outcomes in developing activities and assignments in this study. The major topics discussed in this article are:

- Literature reviews on current technology and online collaborative tools

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.
ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124126

- Uses of Web-based tools and activities: survey's results
- Discussion and conclusion.

3. CURRENT TECHNOLOGY AND COLLABORATIVE TOOLS

The online collaborative tools can benefit students working in a group project in any environment: face-to-face, hybrid, and 100% online delivery. Today's organizations and leaders need to rely on the intelligence and resourcefulness of their staff. Goman [6] indicates that collaboration is not a 'nice to have' organization philosophy, but it is an essential ingredient for organizational survival and success. Duffy [7] states that using the right online collaboration tools can make teams stronger and more productive; these tools help remote teams communicate more efficiently. For example online meeting can eliminate the back-and-forth nature of email communication. Furthermore, Duffy explains "One company that deployed a suite of collaboration tools and made a concerted effort decreased email by 60 percent over three years" [7]. As distance education continues to grow, online course content delivery has been implemented over the years through different methods and technology. The commonly used methods are the blended/hybrid, synchronous, and asynchronous [8], [9], [10]. According to the National Center for Education Statistics [NCES] 2009 report, 1254 out of 1448 respondents (representing 79.70 percent) used asynchronous internet-based technologies for instructional delivery at the college level or for credit-granting distance education. In the same report 950 out 1448 respondents (representing 65.61 percent) used synchronous internet-based technologies for instructional delivery at the college level or for credit-granting distance education in 2006/07 [11], [12].

Today's technology progressively expands in every arena of communication which highly benefits online group collaboration. The following present the effective tools and technology used in synchronous and asynchronous communication. According to Yiadom-Boakye Master's thesis [12]

3.1 Synchronous Communication

Synchronous communication enables real-time communication in a "same time-different place" mode. These tools allow people to connect at a single point in time, at the same time. Synchronous tools possess the advantage of being able to engage people simultaneously [13]. Synchronous e-learning is commonly supported by media such as videoconferencing and chat. It has the potential of developing a learning community where learners and teachers experience a more social environment with questions and answers occurring in real time [8].

3.2 Asynchronous Communication

Asynchronous communication allows people to connect together at each person's own convenience and schedule. It enables collaboration over a period of time whereby participants located in different places contribute to ongoing discussions at different times [13]. Asynchronous e-learning is commonly facilitated by media such as e-mail and discussion board [8].

With today's progressing technology, there are numerous of tools and software used in online group collaboration. Figure 1 presents the tools used in synchronous and asynchronous communication. The asynchronous tools in this Figure 1 can be divided into 2 categories: content management and team management. These tools can be used in organizing group communication; planning and brainstorming, meeting, scheduling, and storing materials.

This paper presents the 4 different platforms of synchronous communication (virtual meeting) from basic to advanced level, increasing dependence on sophisticated technology, see Figure 2.

- Audio telephone– speaker phone, conference phone
- Audio Voice over IP – Skype, Google Hangouts
- Audio Video – Skype Video, Google Hangouts video

Video conferencing with multimedia and recording– Adobe Meeting, GoToMeeting, Webex

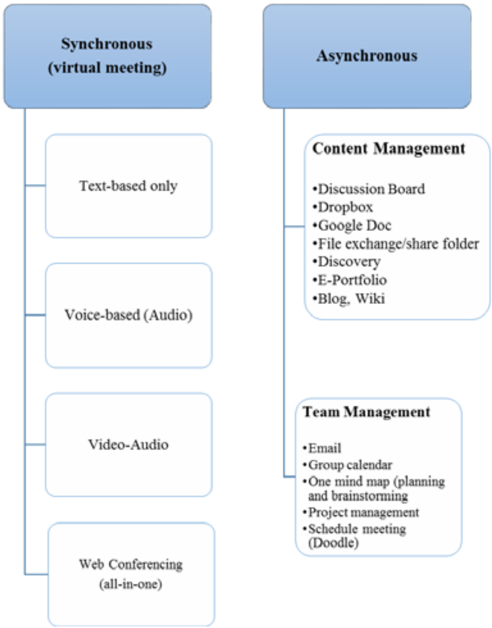

Synchronous
(virtual meeting)
Asynchronous
Text-based only
Voice-based (Audio)
Video-Audio
Web Conferencing
(all-in-one)
Content Management
•Discussion Board
•Dropbox
•Google Doc
•File exchange/share folder
•Discovery
•E-Portfolio
•Blog, Wiki
Team Management
•Email
•Group calendar
•One mind map (planning and brainstorming
•Project management
•Schedule meeting (Doodle)

Figure 1. Functionality of online collaboration tools

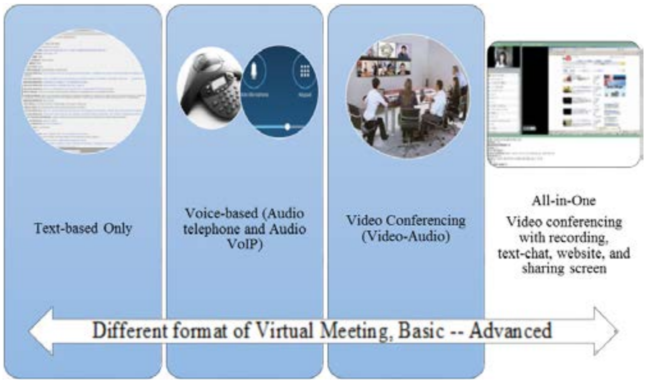

Text-based Only
Voice-based (Audio telephone and Audio VoIP)
Video Conferencing (Video-Audio)
All-in-One
Video conferencing with recording, text-chat, website, and sharing screen
Different format of Virtual Meeting, Basic -- Advanced

Figure 2. Virtual meeting - increasing dependence on sophisticated technology

The following are definition and suggested implementation methods of selected online tools used in group project and online collaboration.

- Dropbox is the place for keeping and accessing all documents, files, articles and everything else for the group meeting. Bulygin [14] states that each may own quite a few pieces of technology, including multiple laptops, tablets and smartphones. With Dropbox, users can access their files from each gadget they own.
- File exchange or share folders is a part of Dropbox. This is a simple tool as creating a new folder on your computer, putting files in there, and sharing a link with team members. The file creator can give access to a specific person/group.

After that person accepts the invitation to the shared folder, all the documents that the file creators added will appear on the other person's computer [14].

- Google Docs is the tool that allow users to create online documents, presentations, and spreadsheets and share the link with other people. All people who have access to the link can edit the document together at the same time in live-mode.
- Internet and World Wide Web is a valuable practices in online delivery. The course designer or instructor should supply students with useful and informative websites from well-known organizations (.org), or schools/university (.edu). The online database from the library organized by subject area are constructive and beneficial to students' learning.
- Discussion board is used for posting assignments or subjects for class discussion; it is a great tool of web-based course delivery to encourage interaction among students and extend the body of knowledge and creative thought. The feedback through the discussion board can come from the instructor or be peer-reviewed. Since this is a public area, there should be a guideline or good examples of constructive feedback.
- Email (electronic mail) is a basic tool for online communication, and it helps to enhance the relationship between sender and receiver. Since it is a written form, it should be treated as a formal communication. It is suggested that instructors should reply to students' email with prompt feedback. The message should be clear and answer to students' questions [5].

4. USES OF WEB-BASED TOOLS AND ACTIVITIES: SURVEY'S RESULTS

During the semester, the course's instructors conducted virtual chat meetings with students, recorded chat discussion, and utilized Discussion Board and Email within Blackboard, web commercial software, The questionnaire asked students to rate their level of agreement with the web-based tools and learning activities which contributed to their understanding of course contents. The study used a five-point scale ranging from 1 through 5 (strongly disagree-disagree-neutral-agree-strongly agree). There were eleven items in the category of activities and web-based technology: 1) Blackboard ease of navigation, 2) Case Studies, 3) Chat archives, 4) Discussion Board, 5) Email, 6) Group activity, 7) Format of materials presented, 8) Interaction among classmates, 9) Interaction with the instructor, 10) Use of Internet/Web, and 11) Virtual chat.

The derived data presented in this paper are from the undergraduate and graduate students enrolled courses in Industrial Management and Technology programs between 2014-2016, 17 online sections with a total of 236 respondents. Some of these courses were: IndM 4010 Current Issues in Industry,

IndM 4210 Industrial Management,

IndM 4230 Lean and Quality Management,

IndM 4260 Organizational Dynamics,

IndM 5230 Seminar in Industrial Management

IndM 5240 Engineering Economy

IndM 5222 Principles of Lean Systems

SOT 5010 Applied Research in Technology

At the end of semester, students were asked to complete a course survey questionnaire. This study emphasizes only the results of the web-based tools section. Table 1 presents demographic data of respondents on: 1) average time spent on homework per week, 2) type of career, and 3) overall GPA. Figure 3 shows average time students spent on their homework per week.

Table 1. Respondents' demographic data

Questions	Percent (%)
Average time spent on homework per week:	
1-3 hours	22.7
3-5 hours	29.2
5-7 hours	33.0
7 hours +	15.1
Type of career:	
Student	38.9
Industry	42.2
Education	7.0
Military & Government	7.7
Others	4.2
My overall GPA:	
Below 2.5	0.5
2.5 to 3.0	5.5
3.0 to 3.5	30.8
Above 3.5	63.2

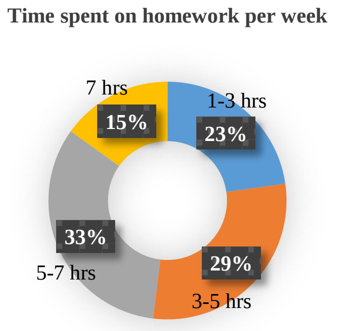


Figure 3. Donut Chart on average time

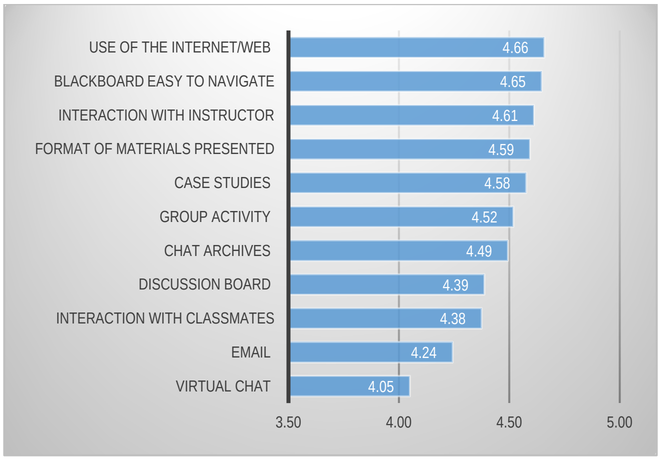


Figure 4. Students' perception on using web-based tools and activities, ranking low-high

The students rated the eleven items, 1-low and 5-high. Figure 4 ranks the average percent of students' perception on using Web-based tools and activities from low to high. According to the survey results, students agreed that the use of some web-based tools and learning activities helped them to better understand the course materials.

On a 5.0 scale, students agreed that the use of Internet and World Wide Web highly contributed to their understanding of course contents with 4.66; the #2 was Blackboard ease of navigation with average scores of 4.65. The use of group activity is ranked #6 with 4.52 and the lowest average scores was the use of virtual chat with scores of 4.05. Emphasizing on the students' perception on group activities, it is worth noting that the scores of group activities have been increasing. The researcher's previous study in 2009 shows that the group activity was ranked the lowest, #11. After some technology and effective tools in group collaboration were implemented into the group project, students tended to be more satisfied and worked well together. The result in 2016 shows that the group activity was ranked #6.

The finding in this section can assist both course developers and course instructors in the process of developing instructional materials and/or delivering course materials. The result shows that students seem to think that interaction among classmates (4.38) and group activity (4.52) would help them in their understanding of course contents. It is important to note that group activity and interaction among classmates are directly related to teamwork, communication, and social skills. Educators should not avoid highlighting these two items in their course development and delivery. The friendly and available applications/software are very helpful in group meetings and project management.

5. DISCUSSION AND CONCLUSION

Designing the course materials, assignments and learning activities to facilitate diverse learning style is a challenging job for course designers. Delivering course materials by promoting interaction and feedback is more intricate and demanding for online course instructors. Fortunately, with helpful functions and applications in the web-based environment and today's technology, we can maximize the use of these tools and learning activities in both asynchronous and synchronous formats. What can educators and online course developers do to create effective group activities? Morrison [15] discusses the strategies for group learning activities which should be noted: 1) creating transparency of expectations and purpose, 2) providing clear instruction, 3) forming small groups, 4) monitoring and supporting, and 5) including etiquette guidelines. In addition, Morrison also suggests some of the collaborative tools used in her class: MindMeister, Google Docs, BigMarker, SlideRocket, and Skype.

Group project can be a great assignment for student learning in critical thinking, problem solving, and teamwork skills. To be effective, a group project must foster active, reasonable and practical participation. Drummond [16] presents in his study, *A Brief Summary of the Best Practices in College Teaching*, that people and their brains learn by doing, and learning is a constructing process. He compiled best practices in college teaching under twelve headings which should be noted: lecture practices, group discussion triggers, thoughtful questions, reflective responses to learner contributions, rewarding learner participation, active learning strategies, cooperative group assignments, goals to grades connections, modeling, double loop feedback, climate setting, and fostering learner self-responsibility. These practices could be applied either collaboratively or individually and they can be modified or strengthened to reflect modern society and environment [16].

This study's results show that students perceived group activity as a helpful tool in their understanding of course contents. Also, group evaluations among members might help to encourage students to help each other and work together. Table 2 presents an example of a rubric for assessing level of group member participation and interaction. This evaluation sheet should be counted into the grade for a group project; each item is worth 5 points, totaling of 50 points for group member evaluation.

Table 2. Rubric for assessing group member participation

Criteria items (5 points each)	**M1**	**M2**	**M3**	**M4**
	(name of group members can be added into each column)			
Asked questions to promote understanding				
Group members seemed to view the project as a priority				
Provided valuable input to the project				
Individuals willingly participated in chats and email correspondence				
Handled communication to group members in a professional manner				
Produced timely contributions to the project				
Group members appeared to be interested in generating quality work				
Individual was willing to do whatever it took to complete the project				
Overall quality of work of group member				
Overall contribution to the project (the score you would give them)				
Total (50 points)				

The group can include 2-7 members depending on the nature of the project, how extensive it is, and the amount of work. Effective online collaborative tools are vital to the successful group project. Both synchronous and asynchronous tools can be highly beneficial to group meetings, planning, and content management. Some of well-known applications used in group meeting are Skype, Adobe Meeting, GoToMeeting, and Google Hangouts video. The common tools used in content and team management are discussion boards, Dropbox, Google Doc, E-Portfolio, blog, email, group calendar, one mind map, and schedule meeting (Doodle).

The future research may focus on the value added of using video-audio web conference comparing with only text-based and/or audio based meetings. Educators and can utilize these technological advancement in creating active learning and group assignments.

6. ACKNOWLEDGMENT

Thanks to students in the M.S. in Industrial Management and M.S. in Technology programs for participating in this study.

7. REFERENCES

[1] Duhigg, C. (Feb. 25, 2016). What Google Learned from its quest to build the perfect team. The New York Times Magazine. Retrieved January 15, 2017 from https://www.nytimes.com/2016/02/28/magazine/what-google-learned-from-its-quest-to-build-the-perfect-team.html?_r=0

[2] Meyers, C. and Jones, B. T. (1993). Promoting active learning (1st edition). San Francisco: Jossey-Bass.

[3] Tewksbury, B. J. and Macdonald, R. H. (2005). On-line course design tutorial. Retrieved December 10, 2016 from http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/strategies.html

[4] Bucy, M. C. (Spring 2006). Encouraging critical thinking through expert panel discussions. College Teaching 54.2, 222-224. Heldref publications.

[5] Rodchua, S. (2009). Strive for Excellence: Maximizing the Uses of Effective Web-based tools. Publication Proceeding. 2009 International Conference E-case, Singapore.

[6] Goman, C. K. (February 13, 2014). 8 tips for collaborative leadership. Retrieved from http://www.forbes.com/sites/carolkinseygoman/2014/02/13/8-tips-for-collaborative- leadership/#3562d2504526

[7] Duffy, J. (January, 5, 2017). The best online collaboration software of 2017. PC Magazine. Retrieved January 30, 2017 from http://www.pcmag.com/article2/0,2817,2489110,00.asp

[8] Hrastinski, S. (2008). A Study of Asynchronous and Synchronous e-learning Discovered that each Support a Different purpose. Educause Quarterly, 4. Retrieved March 25, 2010 from http://net.educause.edu/ir/library/pdf/

[9] Negash, S., and Wilcox, M.V. (2008). E-learning Classifications: Differences and Similarities. Retrieved February 20, 2010 from http://www.igiglobal.com

[10] Johnson, G. M. (2008). The Relative Learning Benefits of Synchronous and Asynchronous Text - Based Discussion. British Journal of Educational Technology, 39(1). Retrieved February 18, 2010 from http://web.ebscohost.com.cyrano.ucmo.edu

[11] National Center for Education Statistics [NCES] (2009). Public-Use Data Files and Documentation: Distance Education at Postsecondary Institutions. Retrieved April 22, 2010 from http://nces.edu.gov/survey/pequis/downloads.asq#6

[12] Yiadom-Boakye, G. (2011). Students' perception about virtual chat (synchronous) and discussion board (asynchronous) course content delivery. Unpublished MS Thesis. University of Central Missouri.

[13] Ashley, J. (2003, December). Synchronous and asynchronous communication tools. Retrieved November 16, 2010 from http://www.asaecenter.org/Resources/articledetail.cfm?

[14] Bulygin, D. (April 4, 2016). 7 free easy-to-use online collaboration tools – make teamwork simple. Retrieve January 15, 2017 from http://trendblog.net/6-easy-to-use-online-collaboration-tools-make-teamwork-simple/

[15] Morrison, D. (October, 9, 2012). 5 Tools and Strategies that Support Group Collaboration Online. Online Learning Insights. Retrieved January, 10, 2017 from https://onlinelearninginsights.wordpress.com/2012/10/09/5-tools-and-strategies-that- support-group-collaboration-online/

[16] Drummond, T. (1995). A brief summary of the best practices in college teaching: Intend to challenge the professional development of all teachers. Retrieved on November 5, 2015 from http://tomdrummond.com/helping-other-adults/best-practices/

Accelerated Learning Method Using Edmodo to Increase Students' Mathematical Connection and Self-Regulated Learning

R. Poppy Yaniawati
Pasundan University
Sumatra 41 Bandung, Indonesia
+6281572002168
pyaniawati@unpas.ac.id

Rahayu Kariadinata
UIN Sunan Gunung Djati
Nasution 105 Bandung, Indonesia
+6281322115799
rahayu.kariadinata@uinsgd.ac.id

Bana G. Kartasasmita
Pasundan University
Sumatra 41 Bandung, Indonesia
bana.kartasasmita@unpas.ac.id

Evi Sari
Pasundan University
Sumatra 41 Bandung, Indonesia
+6285294457789
evisari@gmail.com

ABSTRACT

This study aims to analyze implementation of accelerated e-learning method using edmodo media to increase mathematical connection ability and self-regulated learning of students. The research method employed was mixed method research with embedded design. Subjects of the study were eleventh grade students of a vocational secondary school in Tasikmalaya, Indonesia. Research instruments used were test for mathematical connection ability, questionnaire of students' self-regulated learning, observation and interview guidelines. Statistical analysis were t-test, mann-whitney test, and two-way anova. results of this study showed that (1) mathematical connection abillity of high and low clasification students who studied used accelerated learning with edmodo was better than that of students who studied with conventional learning; (2) no differences were found in self-regulated learning of high and low classification students who studied used accelerated learning with edmodo was better than that of students who studied with conventional learning; (3) a positive correlation was found between mathematical connection ability and self-regulated learning students.

CCS Concepts

Social and professional topics → Adult education.

Keywords

Accelerated learning; edmodo; mathematical connection ability; self-regulated learning.

1. INTRODUCTION

Mathematics is a universal science that constitutes the basis for the development of science and modern technology. It plays an important role in many scientific disciplines and it enhances man's thinking powers. Mathematics forms various ways for thinking and for solving problems in everyday life, resulting in mathematics becoming a tool for mankind in today's ever increasing pace in the development of science, technology, and art.

The challenges demand that mathematics be taught well in schools and in higher education institutions. Mathematics supplies early provisions for solving problems facing mankind. Today we find the use of modern technology, electronic and digital, in almost all aspects of life. Today we live in the digital era. Education institutions are expected to possess the capability to integrate developments in modern technology and information, and learning activities in the classroom. Sumarmo (2004) stated that mathematics education has a two-way development, i.e. to meet demands of today's living and demands of life in the future.

The ever increasing role of mathematics education today is found to be in disparity with expectations in the process, quality, and results of learning mathematics in the Vocational Secondary School, Tasikmalaya, Indonesia. The average score attained by its students in mathematics in the 2014–2015 national examination was 53.62 and for the year 2015–2016 the score was 54.15. The students were not capable to solve higher-order-thinking problems in the examinations. The National Council of Teachers of Mathematics (NCTM, USA) stated in 2003 that the goal of learning mathematics is to develop skills for mathematical problem solving, mathematical reasoning and proofs, mathematical communication, mathematical connection, mathematical representation, knowledge of technology, and disposition [toward learning mathematics].

Cognitive ability was found to be low in those students, and self-regulated learning was low as well. One possible factor influencing these findings could possibly be the learning process that did not take full advantage of learning media, resulting in less-enjoyable learning experiences. This resulted in the students' low mastery of mathematical concepts, and difficulties in their ability to find connections among mathematical concepts.

It is suggested, therefore, that there is a compelling need for improving the learning process, especially to improve the mathematical connection ability and self-regulated learning in the

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124128

students. One learning methodology with a potential to meet this need is the accelerated learning method. In the stages of the accelerated method, there is a process for conditioning students to make or discover connections among their existing knowledge, and for interpreting independently their conceptual comprehensions. Rose and Nicholl (2009) stated that students who are successful in applying the MASTER steps in accelerated learning will achieve truly relaxed frame of mind (M) and self-confidence and are ready to learn; they acquire (A) information appropriate for their needs; they search out (S) meanings and implications in problems they face; and they are able to trigger (T) their memory when needed; they exhibit (E) what you know (present), one group presented material, whereas the other groups ask questions and express ideas; they reflect (R) how you've learned, backward way of thinking about what you have done.

The learning process grows more interesting and becomes more interactive when student-friendly media is used. Learning media is a mediating infrastructure in a learning process (Daryanto, 2012). Progress in technology allows us not only to learn anywhere but also at anytime when facilitated by electronic learning systems. One of the many e-learning media that has more than sufficient features to support learning with various interactive contents is the Edmodo media, a product developed by Borg and O'Hara in 2008 (Rismayanti, 2012).

This study aims to evaluate whether the mathematical connection ablity of high and low clasification students who study use accelerated learning method with Edmodo media is better than those who study in the conventional learning; to evaluate whether the mathematical self-regulated learning ability of students with high and low clasification students who study use accelerated learning method with Edmodo media is better than those who study in the conventional learning; to evaluate the correlation between the students' ability in mathematical connection and their self-regulated learning in mathematics.

2. METHOD AND ANALISIS

2.1 Method

This study used a mixed method research with embedded design with the qualitative aspects embedded in the quantitative ones. The research instruments were a test to measure mathematical connection ability, a survey on the students' self-regulated learning, observations on learning activities, and interviews guidelines. The population for the study was the entire eleventh grade students at the Manangga Pratama Vocational Secondary School in Tasikmalaya, Indonesia. A purposive sampling technique was used to determine the sample for the study, followed by random sampling to accomodate differences in the students' abilities in the same grade. The researchers chose two classes with the prediction that the students' abilities were relatively equal. Determination of the experimental and the control groups was done by random-class selection. The experimental class had 32 students and the control class had 29 and in both classes there were students of high and low clasificasion in mathematical abilities.

2.2 Analysis

To gain an overall description of the mathematical ability of the research subjects, a test for initial mathematical ability was given to all students in this study. The students were then divided into one group of high ability and another of low ability; the criteria for grouping was the ratio of individual score in the test compared to the average of scores of all students subjected to the clasification mathematical ability test. Pre- and post-tests were given to gain information on effectiveness of the accelerated learning method using Edmodo media. Descriptive statistics, normality and homogeniety data, t-test results, and data for a two-way anova analysis were obtained from the pre- and post-test data. Normalized-gain (N-gain) scores were used to measure increases of students' mathematical connection ability. A t-test was used for analysis of self-regulated learning. Pearson product-moment analysis was used to find correlation between mathematical connection ability data and self-regulated learning of students.

3. RESULT

3.1 Mathematical Connection Ability

The result of students' mathematical connection skill is shown in the Table 1.

Tabel 1. Student's Mathematical Connection Ability Based on Students' Academic Competence

	Experiment Class (Accelerated Learning using Edmodo)						**Control Class (Expository learning)**					
	Pretest		***Posttest***		***N-Gain***		***Pretest***		***Posttest***		***N-Gain***	
		S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
High Achiever	5,08	2,48	15,42	4,72	0,68	0,35	4,19	1,72	9,81	1,60	0,35	0,09
Low Achiever	2,90	2,65	10,70	4,71	0,46	0,25	2,69	2,10	9,38	2,53	0,39	0,13
Total	3,72	2,75	12,47	5,19	0,54	0,30	3,52	2,01	9,62	2,04	0,37	0,11

Note: Ideal Maximum Score 20

Prior to research intervention, the two groups had no significant difference in the tested abilities. After intervention, the Mann-Whitney U analysis produced a p-value, sig = 0.855 > α at α = 0.05. This showed that the hypothesis H_0 was accepted. The pre-test average score for mathematical conncetion ability of students who studied with accelerated learning method using Edmodo media is the same with the mathematical connection ability of students who studied using cnventional learning.

Analysis of mathematical connection ability using N-gain scores. The normalized-gain data for mathematical connection ability of the experiment group and that for the conventional group had normal distributions; Shapiro-Wilk analysis produced a significance value of 0.202 > 0.05 for the experiment group while the conventional group had the value sig 0.314 > 0.05. The variance was not normal; Levene analysis showed a value of sig 0.000 < 0.05. Thus the t-test was used and the result showed sig 0.02 < 0.05 which rejected the H_0 hypothesis. The mathematical connection ability average N-gain score for students who studied with accelerated learning method using Edmodo media is better than the average N-gain score for the same ability of students who studied with conventional learning.

A two-way anova analysis was used to test of mean difference for N-gain data of the mathematical connection ability of the experiment group and that of the conventional group against their initial mathematical ability classification (high and low). Results showed that the H_0 hypothesis was rejected with a value of sig = 0.001 < 0.05 according to learning groups, and a value of sig = 0.038 according to initial mathematical ability classification. Thus there exists a difference in the increase of mathematical connection ability of the experiment group as compared with the conventional group, according to learning groups and according to initial mathematical ability classification.

3.2 Mathematical Self-regulated Learning

A survey of the students' mathematical self-regulated learning was carried out to examine their self-regulated learning; collected data was analyzed using mean deference test. Self-regulated learning N-gain data from the experiment group and that from the conventional group came from data distributions which were not normal. Shapiro-Wilk analysis on data of the two groups found that the experiment group had sig = 0.970 > 0.05 and for the control (conventional) group sig = 0.951 > 0.05. Variance homogeneity test on N-gain data using Levene test produced a value sig = 0.929 > 0.05 This indicated that variance of data from the two groups was homogeneous. A t-test was administered for examination of N-gain data on mathematical connection ability of the experiment group and of the control group. This t-test produced a value of significance of 0.794. Test for difference between two means used a one-way analysis that produced (0.5) sig (0.397) > 0.05 Hence, the H_0 hypothesis was accepted. Students in the experiment group did not significantly have better self-regulated learning in comparison with the control group.

A two-way anova analysis was used to examine mean deference for survey data on students' mathematical self-regulated learning (experiment and control groups), based on initial mathematical ability grouping (high and low). Results showed that, based on initial mathematical ability grouping, there was no significant difference in mean scores for self-regulated learning of the experiment group and of the control group. This was because the H_0 hypothesis was accepted with a significance value of 0.324 > 0.05 Hence, against the background of initial mathematical ability, the self-regulated learning of students (with high and low clasification in initial mathematical ability) who learned mathematis using accelerated learning model using Edmodo media, was significantly not better than that of students who learned mathematics in the conventional learning.

3.3 Correlation between Students' Mathematical Connection Abilities and Mathematical Self-regulated Learning

To discover size measure for relationships between students' mathematical connection and mathematical self-regulated learning, analysis used Pearson product-moment correlation calculations because the two data sets had normal distributions. Results showed that abilities for mathematical connection and for mathematical self-regulated learning exhibited a positive or unidirectional relationship with correlation value of 0.023 and significance value of 0.862. Thus, if a student's mathematical self-regulated learning increases then his or her mathematical connection ability rises. If a student's mathematical self-regulated learning decreases then his or her mathematical connection ability diminishes.

4. DISCUSSION

4.1 Mathematical Connection Ability

The mathematical connection ability of students (of high and low clasification) who learned with accelerated learning method is better than that of students (with same clasification) who learned in conventional learning. This is in agreement with Fajri (2013) who stated that in their teaching, teachers need to develop further students' mathematical connection ability. Fauzi (2012) stated earlier that it is the student who plays the main role in making mathematical connections. This shows that learning with accelerated learning method adds contributions and roles to students' mathematical connection ability. This accelerated learning approach is appropriate for students be they of high or low clasification. According to Cahyani (2014) the accelerated learning model is a model for learning that is capable of fully awakening students' learning abilities, creating enjoyable and satisfying learning experiences for them, and contributes much to students' enjoyment, intelligence, competence, and success.

Group discussions and presentations of discussion results can initiate students of high mathematical abilities to assist students of low abilities in his or her group. In group discussions, students can collaborate among themselves to complete presented learning materials. Rose and Nicholl (2009) stated that in accelerated learning with MASTER steps, beginning with the Mind step, motivating, conditioning students, checking prerequisite knowledge, and explaining benefits of materials in relation to everyday living; the Search Out step, group discussions to develop one's own knowledge certainly demands connection ability that creates solutions for problems at hand.

4.2 Students' Self-regulated Learning

There was no significant difference found between students who learned using the accelerated learning method and those who learned in conventional ways. Based on initial mathematical ability classification (high and low) there was no difference found in self-regulated learning in mathematics between high and low student groups. Students' self-regulated learning in mathematis was found to be at the good category. With reference to indicators for diagnosis, the students' needs for learning is at the good level where students know their own shortcomings and superiorities so they are aware of their own needs. However, the students are still weak in the indicators for learning initiatives, in the initiatives to study learning materials, in asking and answering questions in class; in task implementation, they still wait for friends and the teacher to tell them which source book to use. This finding is enhanced by results from research on self-regulated learning by Hargis (Sumarmo, 2004) that the individual who has high self-regulated learning ability tends to study better, is capable of effectively observing, evaluating, and regulating their learning activities, saving time in finishing tasks, efficient in use of time, and receives good scores. Daryanto (2013) stated that student engagement in self-diagnosis of his or her own learning needs is a very important necessity because the student will be more motivated in learning and studying something that they feel and see as a learning need. In line with that, Bude (2009) states that learning does not have to be directive since the students may lose their ideas which results in derivation of self-regulated learning as well as learning motivation.

A high clasification students who practices self-regulated learning at home using accelerated learning method using Edmodo media tends to get better achievements than a student learning in conventional ways; the first student can access study materials easily and read them in a relaxed situation. Study materials can be studied earlier and are interesting and easy to comprehend. The Edmodo media, however, is still expensive and some students still do not have the necessary supporting system, like the Internet, in their homes. The use of Edmodo media in this research study is only as an additional aspect, in agreement with Yaniawati (2010) who stated that one of the characteristics of e-learning in learning activities is as a supplement.

4.3 Correlation between Mathematical Connection Abilities and Self-regulated Learning

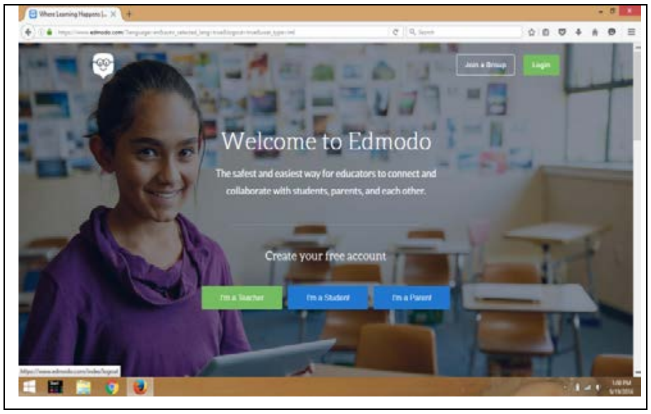
A relationship was found between mathematical connection ability and self-regulated learning. This indicates that students who possess high mathematical connection ability have high self-regulated learning and vice-versa. This is in parallel with Ratnaningsih (2012) who concluded that there is significant influence of mathematical self-regulated learning on students' ability in mathematical connection. The contribution of self-regulated learning is in the determination of self-strategy for problem solving. The teacher's role in teaching is therefore not only developing students' cognitive abilities but developing their self-regulated learning as well.

4.4 Implementation of Accelerated Learning Using Edmodo

Tabel 2. Teacher and Students' Activities

Stages	Teacher and Students' Activities
Activities Introduction	• Teachers say hello and check student attendance; • Teachers communicate purpose of learning. (Mind); • Teachers motivate and condition students to be ready to learn (Mind); • The teacher asked the students about what the statistics related to everyday life and recall statsistika material in class X (Trigger); • The teacher divides the students into several groups with 3-4 people per group of heterogeneous academic abilities;
Core activities	• The teacher presents the core ideas chart the material to be studied previously uploaded within Edmodo (Acquire); • The teacher distributes a worksheet to students who have uploaded within Edmodo; • In the worksheets, the students are given steps to determine the size of the centralization of data and for ways to interpret it. Students construct their own knowledge by doing worksheets and discussion with other members of the group (Search out); • Teachers guide students to be active in the group; • Teachers lead students to present the results of their knowledge in front of the class, while another group respond (Exhibit);
Closing activities	• Teachers and students evaluate learning (Reflect); • Students fill out a learning journal as a reflection of the learning process has been implemented; • The teacher asks the students to make a summary of the material that has been studied (Trigger); • Teachers provide quiz questions and the solution is already uploaded on Edmodo; • Teachers remind students to learn material matter next meeting. (Trigger).

Face display of Edmodo can be seen in Figure 1.


Welcome to Edmodo

The safest and easiest way for educators to connect and collaborate with students, parents, and each other.

Create your free account

Figure 1. Edmodo Display Face

5. CONCLUSIONS

- Increases in mathematical connection ability of students of high and low clasifications who used the accelerated learning method with edmodo were found better than that of students who used conventional ways for learning.
- No differences were found in mathematical self-regulated learning of high and low classifications students who used accelerated learning method with edmodo when compared to mathematical self-regulated learning of students who learned in conventional ways. Students in conventional learning ways excel in aspects of diagnosis of learning needs, selection and implementation of learning method and self-concept; their learning initiatives, however, are weak.
- A positive correlation was found between students' mathematical connection ability and their self-regulated learning.

6. ACKNOWLEDGMENT

Author gratefully acknowledge to the Departement of Mathematics Education, Faculty of Graduate Studies, Pasundan University, Indonesia, for providing research facilities, and the Directorate General of Higher Education, Republic of Indonesia, for the sponsorship under Grant Competence (2016).

7. REFERENCES

[1] Bude. L. at al. (2009). "The Effect Of Directive Tutor Guidance In Problem-Based Learning Of Statistics On Students' Perceptions And Achievement". *Higher Education*. Vol. 57: 23–36

[2] Cahyani M, dkk. (2014). Penerapan Model Pembelajaran Accelerated Learning dalam Pola Lesson Study untuk Meningkatkan Hasil Belajar Matematika Siswa Kelas III Semester 1 SDN 3 Subang Kecamatan Sukasada TahunAjaran 2014/2015. *E-Journal Mimbar PGSD Universitas Pendidikan Ganesha. Jurusan PGSD. Volume 2 No 1 tahun 2014.*

[3] Daryanto, (2012). *Media Pembelajaran*. Bandung: PT. Satu Nusa.

[4] Fajri, N; dkk. (2013). Peningkatan Kemampuan Koneksi dan Komunikasi Matematis Siswa dengan Menggunakan Pendekatan Contextual Theaching and Learning (CTL). *Jurnal Pendidikan Matematika PARADIKMA. Fakultas Keguruan dan Ilmu Pendidikan Matematika Syiah Kuala Banda Aceh. Volume 2 No 2 Hal 149 – 161.*

[5] Fauzi, A.M. (2012). Kemampuan Koneksi Matematis Siswa dengan Pendekatan Pembelajaran Metakognitif di Sekolah Menengah Pertama. *Jurnal Pendidikan PARADIKMA FPMIPA UNIMED. Volume 6 No 1. Hal 49 – 64*.

[6] Rose, C. dan Nicholl, MJ. (2009). Accelerated Learning for The 21 Century Cara Belajar Cepat Abad XXI. Jakarta : Nuansa.

[7] National Council of Teachers of Mathematics (NCTM). (2003). *Principles and Standars for School Matematics*. Reston: NCTM, Inc.

[8] Ratnaningsih C. (2012). Model Group Investigation (GI) untuk Meningkatkan Kemampuan Koneksi Matematis dan Kemandirian Belajar Siswa SMP. Tesis Pasca Sarjana UNPAS : Tidak diterbitkan.

[9] Rismayanti, A (2012). *Mengenal lebih Dekat Edmodo sebagai Media E-learning dan Kolaborasi* [on line]. Tersedia https://www.google.com/#q=mengenal+lebih+dekat+edmodo+sebagai+ media+E-learning+%.09 dan +kolaborasi. [19 November 2015].

[10] Scott, K.M. (2016). “Change in University Teachers’ Elearning Beliefs and Practices: A Longitudinal Study”. *Studies in Higher Education.* Vol. 41, No 3, 582-598.

[11] Sumarmo, U. (2004). *Kemandirian Belajar: Apa, Mengapa, dan Bagaimana dikembangkan pada peserta didik*. Makalah diajukan pada seminar pendidikan matematika dijurusan matematika FPMIPA. Universitas Negeri Yogyakarta, tgl 8 Juli 2004. Tidak diterbitkan

[12] Yaniawati, P. (2010). *E-Learning Alternatif Pembelajaran Kontemporer*. Bandung: Arfino Raya.

[13] Yaniawati, R. P. (2013). “E-learning to Improve Higher Order Thinking Skills (HOTS) of Students”. *Journal of Education and Learning.* Vol 7 (2) pp. 109.

The Implementation of GeoGebra Software-Assited DDFC Instructional Model for Improving Students' Van-Hiele Geometry Thinking Skll

Rahayu Kariadinata
UIN Sunan Gunung Djati
Nasution 105 Bandung, Indonesia
+6281322115799
rahayu.kariadinata@uinsgd.ac.id

R. Poppy Yaniawati
Pasundan University
Sumatra 41 Bandung, Indonesia
+6281572002168
pyaniawati@unpas.ac.id

Wati Susilawati
UIN Sunan Gunung Djati
Nasution 105 Bandung, Indonesia
wati85@uinsgd.ac.id

Kanesha Banoraswatii
UIN Sunan Gunung Djati
Nasution 105 Bandung, Indonesia
kanesha.banoraswati@gmail.com

ABSTRACT

This research aims to discover the improvement of students' Van-Hiele based on geometry thinking skills (visualization, analysis, ordering and deduction) through GeoGebra Software-assisted DDFC (Definition, Design, Formulation, and Communication) instructional model. This research employs quasi-experimental method with pretest and posttest control group design. The research was conducted in State of Junior High School (SMPN) 8 Bandung, Indonesia. The data population in the current research were grade VII students. The students of VIIF and VIIG classes were selected through random sampling. GeoGebra Software-assisted DDFC Instructional model was applied in VII F, while conventional method was employed in VIIG. Based on the analysis, it can be concluded that: 1) the students' geometrical level on each Van-Hiele's thinking skill level (visualization, analysis, ordering and deduction) in GeoGebra Software-assisted DDFC instructional model and conventional learning model is improved from pretest to posttest, 2) there is a difference on students' Van-Hiele geometry thinking skill degree of acquisition between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model, 3) thereis a difference on students' Van-Hiele geometry thinking skill achievement between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model.

CCS Concepts

Applied computing → Computer-assisted instruction.

Keywords

DDFC instructional model; geogebra; van-hiele's geometry thinking skill.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.
ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124129

1. INTRODUCTION

Geometry is one of the branches in mathematics education which discusses volume and shapes-related objects involved in human life which is important to learn. Consequently, the geometrical concept has been introduced since the early childhood education (kindergarten). There are several importances of learning geometry as explained by Walle (2001:309): 1) geometry helps people have complete appreciation toward their world, 2) the exploration on geometry may help develop problem solving skill, 3) geometry plays a pivotal role in the other mathematics fields, 4) geometry is applied by people in daily life, 5) geometry is full of enigma and fun.

In learning geometry, a student should undergo five geometry thinking skill levels, namely level 0 (introduction/visualization), level 1 (analysis), level 2 (informal deduction/ordering), level 3 (deduction) and level 4 (accuracy). The five stages are commonly known as Van-Hiele's geometry thinking skill levels. Based on Van-Hiele's theory, the students will come through five thinking stages (levels) in comprehending geometry (Walle, 1994: 309).

The research investigating Van-Hiele's geometry thinking skill has been conducted widely particularly to high school students. The results of the researches revealed that Junior High School students just reached level 0-2 on Van-Hieles theory. The research conducted by Burger and Shaughnessy in 1986 (Muhassanah et al., 2014) discovered that the highest thinking level of Junior High School is on level 2 (informal deduction/ordering). Most of them are on level 0 (visualization). The statement is also supported by Walle (1994) who reported that most of Junior High Schoolstudents are on level 0 (visualization) to level 2(informal deduction/ordering).

According to the preliminary research result conducted by the researcher to grade VII students in Junior High School 8 Bandung, Indonesia, it can be discovered that the students' geometry thinking skill was on level 2 (informal deduction/ordering) after being given geometry test on rectangular material. On visualization level, 100% students were able to recognize and label a rectangular shape, while on analysis level, 100% students are able to analyze the characteristics of a rectangular shape, 40.30% of the students are capable of identifying and ordering inter-related geometrical shapes

The students' geometry thinking level should be developed through an innovative instructional model which promotes learning experiences to the students in understanding geometrical concepts. One of the learning models that can be applied is Definition, Design, Formulation, and Communication (DDFC) instructional model. The term DDFC in this instructional model is derived from four terms of "instructional phases, namely defining problems, designing solution, formulating result, and communicating result. As a whole model, this instructional model is developed mainly in order to develop creative and critical learners. Therefore, the development of this instructional model is theoretically developed based on problem solving principles, that has been widely believed as a vehicle to develop higher order thinking skills (Kusmawan, 2001).

The problem proposed by DDFC instructional model is a contextual problem, such as geometrical problem which relates to daily life. The students, however, are unable to visualize between the problems and their experiences or prior knowledge, since the students do not own prior experiences before.The problem in visualizing and constructing geometrical concept can be solved by utilizing *Dynamic Geometry Software* such as GeoGebra.

GeoGebra is a software employed to help students learn mathematics, particularly geometry and algebra (Hohenwarter, 2008). The geometrical learning process which employs GeoGebra allows the students to construct, explore, and conduct innovation process more effectively and efficiently. Based on the statements above, the researcher intended to conduct a study related to the implementation of GeoGebra Software-assisted DDFC to improve students' Van-Hiele geometry thinking skill. The research focuses on visualization, analysis, ordering, and deduction levels of Van-Hiele's theory.

Generally, this research aims to discover the improvement and achievement of the students' Van-Hiele geometry thinking skill level before and after applying GeoGebra Software-assisted DDFC and conventional instructional models.

2. RESEARCH METHODS

2.1 Research Design

This research employs quasi-experimental method with non-equivalent (pretest dan posttest) Control Group Design. The framework of research design can be identified in Table 1 as follows

Table 1. The Framework of Research Design

O	X_1	O
O	X_2	O

Descriptions:
O = test (pretest dan posttest)
X1 = the treatment of GeoGebra Software-assisted DDFC Instructional Model
X2 = the treatment of conventional learning model

2.2 Data Analysis Techniques

Descriptive statistical analysis is utilized in order todiscover the students' geometrical ability based on Van-Hiele's thinking skill level in GeoGebra Software-assisted DDFC instructional model and conventional learning model classes. To discover the improvement of the students'thinking skill level based on Van-Hiele's theory between GeoGebra software-assisted DDFC instructional model and conventional learning model classes, N-gain test analysis is employed. The formula of N-gain is as follows (Hake,1999):

$$\text{N-gain} = \frac{S_{postest} - S_{pretest}}{S_{\max imum} - S_{pretest}}$$

Description :
N-gain = normalized gain
Smaximum = maximum score (ideal) from pretest and posttest
Spostest = the average of posttest score,
Spretest = the average of pretest score

The level of normalized gain (N-gain) can be classified in Table 2. as follows.

Table 2. Category of N-Gain

N-Gain coefficient	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Moderate
$g < 0,3$	Low

T-test analysis is utilized to measure the difference on students' Van-Hiele geometry thinking skill achievement between the students who received GeoGebra softwareassisted DDFC instructional model and conventional learning model.

According to Gutierrez, Jaime & Fortuny(1991:238), Van-Hiele's degree of acquisition are consisted of five categories; No Acquisition (NA), Low Acquisition (LA), Intermediate Acquisition (IA), High Acquisition (HA) and Complete Acquisition (CA) as illustrated in Table 3

Table 3. Degree of a Van-Hiele aquisition

Van-Hiele's degree of acquisition	Description
0 < NA <15	No Acquisition
15 < LA <40	Low Acquisition
40 < IA <60	Intermediate Acquisition
60 < HA <85	High Acquisition
85 < CA <100	Complete Acquisition

3. RESEARCH RESULT AND DISCUSSION

3.1 Degree of Acquisition Analysis of Van-Hiele's Geometry Thinking Skill in GeoGebra Software-assisted DDFC Instructional Model and Conventional Learning Model Classes

To discover the degree of acquisition analysis of Van-Hiele's geometry thinking skills in GeoGebra software assisted DDFC instructional model and conventional learning model classes, pretest and postest are illustrated as in Table 4 below.

Table 4. The description of pretest and postest at each Van-Hiele level

Van-Hiele's Thinking Level	Test Types	Class	Min	Max	Mean	Deviation Standart
Visualization	Pretest	Experiment	35	100	73.85	23.92
		Control	33	100	62.00	23.95
	Postest	Experiment	67	100	87.95	8.20
		Control	67	89	85.70	10.75

Analysis	Pretest	Experiment	33	92	60.00	17.57
		Control	27	87	56.70	12.48
	Postest	Experiment	60	100	84.75	10.84
		Control	51	96	77.15	12.09
Ordering	Pretest	Experiment	0	60	25.00	1.96
		Control	0	60	30.60	1.48
	Postest	Experiment	20	100	75.55	16.16
		Control	32	100	62.62	16.97
Deduction	Pretest	Experiment	0	72	35.60	20.03
		Control	0	60	30.40	30.40
	Postest	Experiment	40	100	80.93	13.19
		Control	20	100	69.65	16.38

Description :
Experiment Class = GeoGebra software-assisted DDFC instructional model
Control Class = Conventional learning model

According to the data in Table 4, it can be identified that the students' average score on each Van-Hiele's thinking skill (visualization, analysis, ordering and deduction) is improved from pretest to posttest. The data can justify that GeoGebra software-assisted DDFC instructional model and conventional learning models canimprove the students' geometry thinking skill at each level. The illustration of students' average score in Table 5 converted to Van-Hiele's geometry degree of acquisition can be shown as follows.

Table 5. The description of Van-Hiele degree of aquisition at each level

Van-Hiele's Thinking Level	Test Types	Class	Mean	Van-Hiele's Degree of Acquisition
Visualization	Pretest	Experiment	73.85	HA
		Control	62.00	HA
	Postest	Experiment	87.95	HA
		Control	85.70	HA
Analysis	Pretest	Experiment	60.00	IA
		Control	56.70	IA
	Postest	Experiment	84.75	HA
		Control	77.15	HA
Ordering	Pretest	Experiment	25.00	LA
		Control	30.60	LA
	Postest	Experiment	75.55	HA
		Control	62.62	HA
Deduction	Pretest	Experiment	35.60	LA
		Control	30.40	LA
	Postest	Experiment	80.93	HA
		Control	69.65	HA

Description :
Experiment Class = GeoGebra software-assisted DDFC instructional model
Control Class = Conventional learning model

3.2 The Analysis of Van-Hiele's Geometry Thinking Skill Improvement in GeoGebra Software-Assisted DDFC Instructional Model and Conventional Learning Model Classes

Based on N-gain analysis, it can be identified that N-gain average for the students who received GeoGebra Software-assisted DDFC instructional model treatment is 0.6645. The score can be classified as a medium category. Therefore, it can be concluded that there is an improvement for Van-Hieles geometry thinking skill before and after applying GeoGebra software-assisted DDFC instructional model.

The average N-gain score for the students who received conventional learning model is 0.5012. The score can be classified as a medium category. Therefore, it can be concluded that there is an improvement for Van-Hiele'sgeometry thinking skill before and after applying conventional learning model.

To discover the difference in terms of Van Hiele's geometry thinking skill improvement between the students who received GeoGebra software-assisted DDFC instructional mode and those who received conventional learning model, t-test was utilized. However, parametric statistical assumption had been utilized before hand for t-test namely normality of the data and variance homogeneity forN-gain data of both classes

Based on the assumption test analysis, it can be identified that N-gain data for both classes have normal distribution and both of the variances are homogeneous. After that, t-test analysis were utilized in this research. The result of analysis can be seen in Table 6

Table 6. T-Test for equality of means of N-Gain

		T	df	Sig. (2-tailed)	Mean Difference
N- Gain	Equal variances assumed	5.258	78	0.000	0.16325
	Equal variances not assumed	5.258	73.27	0.000	0.16325

The hypotheses of the analysis are as follows :

Ho : There is no improvement on Van-Hiele's geometry thinking skills between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model

Ha : There is an improvement on Van-Hiele's geometry thinking skills between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model

Conclusion :

If the probability > 0.05 then Ho is accepted

If the probability < 0.05 then Ho is rejected

In Table 6, it can be seen that sig score is accounted for 0,000. Since 0.000 < 0.05, then Ho is rejected. Therefore, Ha is accepted since there is an improvement on Van-Hiele's geometry thinking skills between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model and those who received conventional learning model. Based on the result analysis of posttest average, it is discovered that the students who received GeoGebra software-assisted DDFC instructional model have higher acquisition than that of the students who received conventional learning model.

3.3 The Analysis of the Difference on Students' Van-Hiele Geometry Thinking Skill Degree of Acquisition Between the Students who Received GeoGebra Software-Assisted DDFC Instructional Model and Conventional Learning Model

To discover the difference on students' Van-Hiele geometry thinking skill degree of acquisition between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model, t-test was utilized. However, parametric statistical assumption had been utilized before hand for t-test, namely normality of the data and variance homogeneity for N-gain data of both classes.

Based on the assumption test analysis, it can be identified that N-gain data for both classes have normal distribution and both of the variances are homogeneous. After that, t-test analysis were utilized in this research. The result can be seen in Table 7.

Table 7. T-Test for equality of means of students' Van-Hiele geometry thinking skill

		T	**df**	**Sig. (2-tailed)**	**Mean Difference**
Van Hiele's Geometry Thinking Skill Acquisition	Equal variances assumed	4.425	78	0.000	8.925
	Equal variances not assumed	4.425	77.31	0.000	8.925

The hypotheses of the analysis are as follows :

Ho : There is no difference on Van-Hiele's geometry thinking skills between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model

Ha : There is a difference on Van-Hieles geometry thinking skills between the students who received GeoGebra software-assisted DDFC Instructional model and conventional learning model

Conclusion :

If the probability > 0.05 then Ho is accepted

If the probability < 0.05 then Ho is rejected

In Table 7, it can be identified that sig scoreis 0.000. The score 0.000 < 0.05, then Ho is rejected. Therefore, Ha is accepted since there is a difference on Van-Hieles geometry thinking skills between the students who received GeoGebra software-assisted DDFC Instructional model and conventional learning model and those who received conventional learning model. Based on N-gain analysis, it is discovered that the students who received GeoGebra software-assisted DDFC instructional model have higher acquisition than that of the students whoreceived conventional learning model

4. DISCUSSION

Based on the analysis of descriptive statistical analysis on the students' Van-Hiele's geometry thinking skill for each level, it can be identified that there is an improvement from before and after applying GeoGebra software-assisted DDFC instructional model and conventional learning model. This findings can demonstrate that both learning models are able to influence positively to the students' Van-Hiele's gemoetry thinking skill.

The improvement of Van-Hiele's geometry thinking skill in the classroom which received GeoGebra software assisted DDFC instructional model is considered better compared to those who received conventional learning model. Similar result is also discovered in the students'degree of acquisition on Van-Hiele's geometry thinking skill, in which the students who received GeoGebra software-assisted DDFC instructional model is considered better compared to those who received conventional learning model. This is in line with the opinion of Yaniawati (2010) that e-learning is more effective than conventional. Furthermore, Yaniawati (2013) report that learning achievement using e-learning are better than conventional

This is caused by the DDFC instructional model is basedon four problem solving stages so that the students are ableto construct experiences as well as understanding with the utilized media, to develop convincing mathematical thinking skills about the validity of certain representation, to make aprediction, to solve a problem or propose an answer, to involve students' intellectual in the form of proposing answers and the tasks that relate the students as well as challenge each student

Additionally, the teachers play a pivotal role in DDFC instructional model, such as at the level of defining problems, where the teahers establish an environment which allows the questions to come up easier as well as to guide brainstorming activities. At designing solution level, the teachers provide directions about working safety and time, the available resources, establish challenging situation for the students to think, as well as assist the students to communicate their experiences being developed with their own ideas/opinion/thought. At formulating the result level, the teachers provide the conditions in data analysis and presentation technique, as well as provide the conditions in preparing presentation, while at the level of communicating the result, the teachers emphasize supportive situations as well as facilitate the interactions between presenters and audiences (Kusmawan, 1998)

Pizzini (1996) stated that through problem solving assessment, the students will be able to be a dependable independent thinker. They are encouraged to become anexplorer-finding new invention; an inventor-developing ideas/thoughts and a new innovative assessment; designer–creating the latest plan and model; decision maker–learnhow to decide a wise decision; and as a communicator–develop methods and teachniques to exchange opinions and interactions. These learning stages allow the students to be able to think gradually based on Van-Hiele's theory, so that the students are able to think systematically based on their thinking level.

Moreover, the utilization of GeoGebra can influence the students' Van-Hiele geometry thinking skill level due to the advantages proposed by GeoGebra. As stated by Mahmudi (2010), abstract geometrical objects can be visualized as well as manipulated accurately, efficiently and rapidly through GeoGebra. GeoGebra has a function as alearning media which provides visual experiences in interacting with geometrical concepts.With variative and interesing interface as well as its ease to manipulate various geometrical objects, it is expected that the students could improve their interest, learning creativities as well as geometial learning effectivity.

5. CONCLUSION

Based on the research result and discussion, this research can be concluded that:

1) the students' geometrical level on each Van-Hiele's thinking skill level (visualization, analysis, ordering and deduction) in GeoGebra software-assisted DDFC instructional model and conventional learning model is improved from pretest to posttest
2) there is a difference on students' Van-Hiele geometry thinking skill degree of acquisition between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model. The result demonstrates that the students who received GeoGebra software-assisted DDFC instructional model have higher improvement than that of the students who received conventional learning model. The degree of acquisition for the students who received GeoGebra software-assisted DDFC instructional model considered better compared to conventional learning model
3) there is a difference on students' Van-Hiele geometry thinking skill achievement between the students who received GeoGebra software-assisted DDFC instructional model and conventional learning model. The result can reveal that the students who received GeoGebra software-assisted DDFC instructional model have higher improvement than that of the students whoreceived conventional learning model

6. ACKNOWLEDGMENT

We would like to thank the Dean of the Faculty of Education and Teacher Training, UIN Sunan Gunung Djati Bandung Indonesia, for supporting us.

7. REFERENCES

[1] Gutierrez, Jaime & Fortuny. An Alternative Paradigm to Evaluate the Acquisition of Van- Hiele Levels. *Journal for Research in Mathematics Education.* 1991, Vol. 22, No. 3, 237-251. Retrieved February, 23, 2017 from http://edumat.uab.cat/gutjaifor91.pdf

[2] Hake, R. *Analyzing Change/Gain Score*. Indiana: Indiana University. 1999

[3] Hohenwarter, M., et al. Teaching and Learning Calculus with Free Dynamic Mathematics Software GeoGebra. *TSG 16: Research and development in the teaching and learning of calculus ICME 11,* Monterrey, Mexico 2008. Retrieved March 10, 2017 from https://archive.geogebra.org/static/publications/2008-ICME-TSG16-Calculus-GeoGebra-Paper.pd.

[4] Kusmawan, U. *Model Intruksional DDFK Problem Solving.* Hhasil studi. PSI-Universitas Terbuka . 1998

[5] Kusmawan, U. Model Instruksional DDFKProblem Solving. *Jurnal Pendidikan Volume* 2.1.2001 Retrieved March 12, 2017 from :http://pk.ut.ac.id/jp/2dan.htm

[6] Mahmudi. A. Membelajarkan Geometri denganProgram Geogebra. *Delta-Pi: Jurnal Matematikadan Pendidikan Matematika* ISSN 2089-855XVol. 5, No. 1, April 2016

[7] Muhassanah,N, Sujadi,I dan Riyadi. Analisis Keterampilan Geometri Siswa Dalam Memecahkan Masalah Geometri Berdasarkan Tingkat Berpikir Van-Hiele. *Jurnal Elektronik Pembelajaran Matematika*. Vol. 2., No.1,p54-66,Maret 2014. ISSN:2339-1685. Retrieved March 20, 2017 from http://jurnal.fkip.uns.ac.id/index.php/s2math/article/viewFile/3639/2546

[8] Pizzini, E.L. *Implementation Handbook for theSSCS Problem Solving Instructional Model.*Iowa: The University of Iowa. 1996

[9] Walle, Jhon. *Elementary School Mathematics*.New York: Longman. 1994

[10] Van de Walle, John A. Geometric Thinking andGeometric Concepts. In *Elementary and MiddleSchool Mathematics : Teaching Developmentally,4th ed*. Boston: Allyn and Bacon. 2001.Retrieved February 15, 2017 from https://www.learner.org/courses/ learningmath/geometry/pdfs/session9/vand.pdf

[11] Yaniawati, P. (2010). *E-learning*: Alternatif Pembelajaran Kontemporer. Bandung: Arfino Raya.

[12] Yaniawati, R. P. (2013). "E-learning to Improve Higher Order Thinking Skills (HOTS) of Students". *Journal of Education and Learning.* Vol 7 (2) pp. 109-120

Developing an Informal Science Education Activity based on Edmodo

Qiusha Min
School of Educational Information Technology, Central China Normal University
Wuhan，Hubei
86-18971461590
qiusham@ mail.ccnu.edu.cn

Guanghui Wu
School of Educational Information Technology, Central China Normal University
Wuhan,Hubei
86-18872745183
2452460134@qq.com

Neng Liu
School of Educational Information Technology, Central China Normal University
Wuhan,Hubei
86-18272160182
946962074@qq.com

ABSTRACT

With the fast development of science and technology, science education is becoming more and more important. However, traditional science education methods are not effective and seems to decline interest among young people for science study. This paper presents a new learning strategy for effective science learning. This strategy integrates an online learning platform, Edmodo, to provide abundant resources, convenient communications, and inquiry learning opportunities. Via Edmodo, science learning is not restricted within a museum or a school. Learners could read science articles, discuss with others and visit exhibitions online. The experimental results show that participants performance in science learning is significantly improved by the informal science education activity based on Edmodo and most participants are satisfied with this science education strategy. Thus, this study may inspire museums or science education associations to integrate Edmodo into science education to improve the effectiveness of science learning.

CCS Concepts

• Applied computing➡Education➡E-learning

Keywords

Informal science education, Edmodo, inquiry learning.

1. INTRODUCTION

Since science and technology play a more and more important part in social life, there has been increasing attention given to science education currently. The goal of science education has gone through three stages, which are scientific knowledge, scientific methods and scientific inquiry. Nowadays, science education emphasizes the process of scientific inquiry. The goal of science education emphasizes learners to master the scientific knowledge and enhance scientific literacy through explorations. However, current science education activities are lack of inquiry learning. For example, most informal science education happened in the museum and learners are attracted by exhibits. In most cases, this science learning only scratched the surface of scientific principal. In order to improve the effect of science education activities, it is preferable to introduce an online platform. This platform supports the sharing of various resources. Learners canpre-visit instructional materials before a field trip to the science museum, extend learning after the field trip, and accomplish various kinds of exploratory scientific activities on the online platform. An online platform has a positive effect on science education, particularly in the informal setting. Compared with other online platforms, Edmodo platform has many advantages, e.g. a high level of interaction, open access and resource sharing. Therefore, this paper presents a science education activity based on Edmodo and evaluates its effect through a one-group pretest-posttest experiment.

2. RELATED WORK

Science education plays a very important role in public understanding since it can improve people's thinking ability and avoid public plight in the knowledge deficit. A study demonstrated that high school students and college students have lower scientific literacy, which is inextricably linked to their lack of scientific education [1]. Therefore, science education is very important both for the individual and the country.

Traditional science education are usually implemented in schools. However, this teaching strategy are not effective and seems to decline interest among young people for science study [2]. Therefore, many researchers have proposed new strategies for science education. Liu and Chen presented a game-based learning method for science education and their results demonstrated this learning method was effective [3]. Wang et al. applied in inquiry-based instruction on science learning and their results shown that this instruction method could increase learners' motivation and interest [4]. Sriarunrasmee, Suwannatthachote and Dachakupt proposed a learning model using virtual field trips with inquiry learning and critical thinking process to enhance science learning outcomes [5]. Zydney and Warner found that there were many mobile apps for science learning which can be integrated into science education [6].

Among several mobile apps, Edmodo is preferred by learners [7]. Edmodo is actually a social learning platform that is used to provide a simple way for teachers to create and manage an online classroom community as well as enables students to connect and work with their classmates or teachers. Edmodo can be used to post assignments, create polls for student responses, share audio

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.
ICEMT '17, July 9–11, 2017, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00

DOI: https://doi.org/10.1145/3124116.3124133

and video clips, create learning groups, post a quiz, and share a calendar of events. A lot of previous studies have indicated that Edmodo adoption in education can support student collaborations and inquiry-based learning, hence improving learning quality [8-10]. However, science education overlooks this learning platform for a long time. There is a clear need to integrate Edmodo into informal science education activities and evaluate its impact on science learning.

3. AN INFORMAL SCIENCE EDUCATION ACTIVITY BASED ON EDMODO

The strategy for an informal science education activity based on Edmodo is presented in this section. The overview of this strategy is described in Fig. 1. There are three main components in the strategy, which are online learning resources, a museum field trip, and online activities.

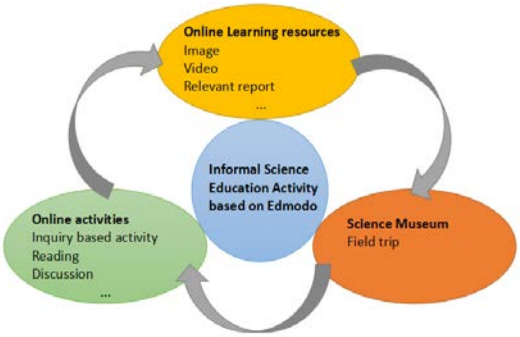
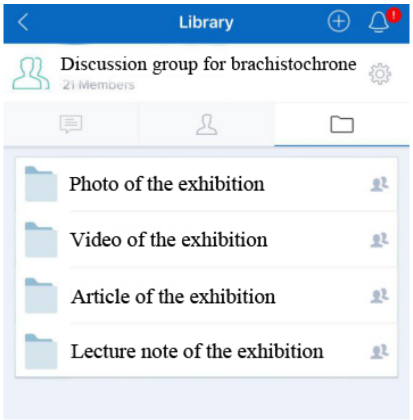


Figure 1. Overview of informal science education strategy based on Edmodo.

3.1 Online Learning Resources

Learning resources provide important opportunities for learners to make an advanced preparation before the field trip to the science museum and to enhance learning after the field trip. Gennaro pointed out that pre-visiting instructional materials could improve the effect of a museum field trip [11]. Therefore, an effective science education activity should provide abundant learning resources for learners to make an advanced preparation. In addition, learning resources is also very important for inquiry-based learning, discussion, and extended reading after the field trip. Implementing these activities can greatly enhance learning in a science education activity. The learning resources are uploaded on Edmodo which include ebooks, images and videos (see Fig.2).



Discussion group for brachistochrone
21 Members

- Photo of the exhibition
- Video of the exhibition
- Article of the exhibition
- Lecture note of the exhibition

Figure 2. Screenshot of the leaning resources interface on Edmodo.

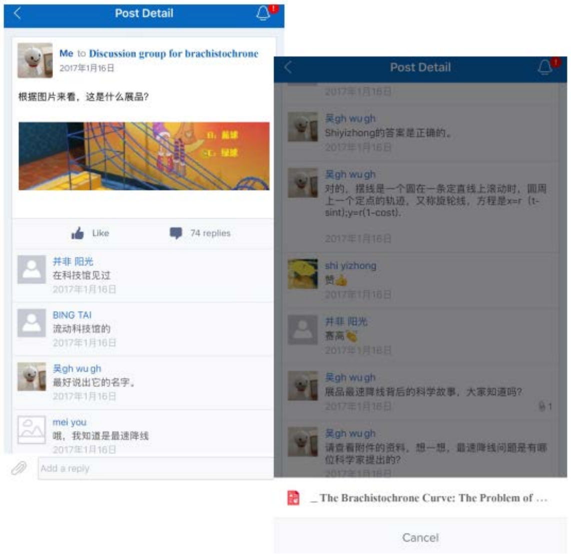
3.2 A Museum Field Trip

Since science museums provide an opportunity to experience hands-on, real-world examples of science, a museum field trip is the best way to fully explore science concepts while encouraging learners to have fun while learning. Many science museums include interactive exhibits; fascinating videos, living history programs, and three dimensional displays. Interactive experiences ensure that learners internalize concepts.

3.3 Online Activities

Online activities can be hold after museum field trips. These activities are very important for learners to reinforce what they learned in a museum field trip. For traditional informal science education, learning activities are restricted to the science museum which lack of learning platform supports. Therefore, after a museum field trip, it is difficult to collect learners' feedback and reinforce what they just learned in the science museum.

In our strategy, there are some online activities which can be hold on Edmodo e.g. inquiry-based learning, discussion and extended reading. Through taking these activities, learners will not only reinforce learning in the science museum, but also develop their ability on critical thinking, creative thinking and problem solving. The example of discussion on Edmodo is shown in Fig 3.



Me to Discussion group for brachistochrone
2017年1月16日
根据图片来看，这是什么展品?

井非 阳光
在科技馆见过
2017年1月16日

BING TAI
流动科技馆的
2017年1月16日

吴gh wu gh
最好说出它的名字。
2017年1月16日

mei you
哦，我知道是最速降线
2017年1月16日

2017年1月16日

吴gh wu gh
Shiyizhong的答案是正确的。
2017年1月16日

吴gh wu gh
对的，摆线是一个圆在一条定直线上滚动时，圆周上一个定点的轨迹，又称旋轮线，方程是x=r（t-sint);y=r(1-cost).
2017年1月16日

shi yizhong
赞👍
2017年1月16日

井非 阳光
赛高👏
2017年1月16日

吴gh wu gh
展品最速降线背后的科学故事，大家知道吗?
2017年1月16日

吴gh wu gh
请查看附件的资料，想一想，最速降线问题是有哪位科学家提出的?
2017年1月16日

_The Brachistochrone Curve: The Problem of …

Figure 3. Screenshot of the discussion activity on Edmodo.

4. EXPERIMENT AND RESULTS

An experiment to determine the effectiveness of this strategy for informal science education was conducted in our university. A total of 20 students with an average age of 24 years participated in this experiment.

4.1 Procedure

A one-group pretest-posttest design was adopted to evaluate the effectiveness of this Edmodo integrated strategy for informal science education. All the participants visit Wuhan Science and Technology Museum and learn a brachistochrone curve from an exhibition. The experiment procedure is shown in Fig. 4 which includes four stages, i.e. pre-test, pre-visiting instructional materials, a museum field trip, online activity and post-test and interview.

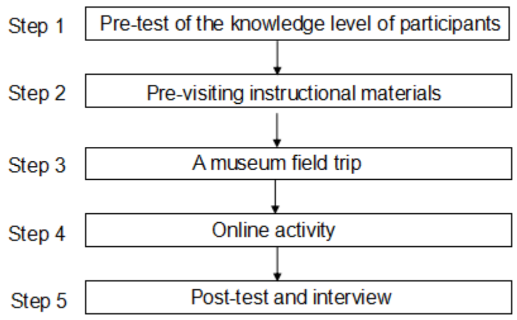


Figure 4. Experimental process.

4.2 Result

The data of pre-test and post-test are used to evaluate participants science learning performances by the Edmodo integrated activity. The details of the exam results for both pre- and post-test are shown in Table 3. It is clear that the average test score of post-test (87) was substantially higher than that of pre-test (37). The t-test obtained t=16.12, $p<0.001$, so a significant difference ($p<0.05$) was found between pre-tests and post-tests. Therefore, these results indicate that the participants science learning is significantly improved by this Edmodo integrated activity.

Table 1. Exam scores for pre-test and post-test

Graphics	Size	Mean	Standard deviation	T-test
Pre-test	20	27	9.79	16.12
Post-test	20	87	9.79	

The investigation of participants' satisfaction with the Edmodo integrated science education activity was conducted by a group interview. Most participants indicated that they were pleased to experience this science education activity, especially for inquiry learning on Edmodo. There are abundant resources on Edmodo which can be used to support inquiry learning. In addition, discussion can be easily implemented online. Participants felt that Edmodo was a wonderful social learning platform that enabled them to enjoy science learning. The experimental results confirmed that this Edmodo integrated strategy for informal science education is effective and increases students' satisfaction towards science learning.

5. CONCLUSION

The purposes of this study were to present a new strategy for informal science education which is integrated with Edmodo and to conduct an evaluation of the effectiveness of this strategy. The experimental results have demonstrated that the Edmodo-integrated strategy can significantly improve the effect of science education activities and promote learners' satisfaction with these activities. Since this strategy integrates Edmodo, it can provide abundant learning resources, various learning activities, and convenient communication tools and hence give learners the opportunity to implement inquiry based science education. The results of this paper can be useful for museums or science education associations to create high-quality science learning experiences.

6. ACKNOWLEDGMENTS

This work was financially supported by the specific funding for education science research by self-determined research funds of CCNU from the colleges' basic research and operation of MOE (No. ccnu16JYKX009) and the self-determined research funds of CCNU from the colleges' basic research and operation of MOE (No. CCNU17QN0015 and CCNU17KYZHSY24).

7. REFERENCES

[1] Edwards, M.L. 2014. A Sociohistorical Examination of George Herbert Mead's Approach to Science Education. *Public Understanding of Science*. 25, (Dec. 2014), 531-542, DOI=http://doi.org/10.1177/0963662514560966.

[2] European Commission. and High Level Group on Science Education, For ECDG.2007. *Science education now : a renewed pedagogy for the future of Europe*. Office for Official Publications of the European Communities.

[3] Liu,E.Z.F. and Chen P.K. 2013.The Effect of Game-Based Learning on Students' Learning Performance in Science Learning – A Case of 'Conveyance Go', *Procedia - Social and Behavioral Sciences*, 103,26(Nov. 2013), 1044-1051. DIO= https://doi.org/10.1016/j.sbspro.2013.10.430.

[4] Wang, P.H., Wu, P.L., Yu, K.W. and Lin, Y.X. 2015. Influence of Implementing Inquiry-based Instruction on Science Learning Motivation and Interest: A Perspective of Comparison. *Procedia - Social and Behavioral Sciences*, 174,12(Feb.2015), 1292-1299. DOI= https://doi.org/10.1016/j.sbspro.2015.01.750.

[5] Sriarunrasmee, J., Suwannatthachote, P. and Dachakupt, P. 2015. Virtual Field Trips with Inquiry learning and Critical Thinking Process: A Learning Model to Enhance Students' Science Learning Outcomes. *Procedia - Social and Behavioral Sciences*. 197,25(Jul. 2015), 1721-1726. DOI= https://doi.org/10.1016/j.sbspro.2015.07.226 .

[6] Zydney,J.M and Warner, Z.2016. Mobile Apps for Science Learning: Review of Research. *Computers & Education*. 94 (Mar. 2016), 1-17. DOI= https://doi.org/10.1016/j.compedu.2015.11.001.

[7] Balasubramanian, K., Jaykumar, V. and Fukey,L.N. 2014.A Study on Student Preference towards the Use of Edmodo as a Learning Platform to Create Responsible Learning Environment. *Procedia - Social and Behavioral Sciences*. 144,20(Aug. 2014), 416-422. DOI= https://doi.org/10.1016/j.sbspro.2014.07.311.

[8] Paliktzoglou, V. and Suhonen, J. 2014. Microblogging in Higher Education: The Edmodo Case Study among Computer Science Learners in Finland. *Journal of Cases on Information Technology*.16,2 (Apr.2014),39-57.

[9] Holland, C. and Lin, M.2011. Supporting Student Collaboration: Edmodo in the Classroom. In *Society for Information Technology & Teacher Education International Conference*(Nashville, Tennessee, Mar 07,2011).AACE, Chesapeake, VA, 3232-3236.

[10] Thongmak, M. 2013. Adopting Edmodo© to enhance classroom collaboration: Thailand case. In *the 21th International Business Information Management Association (IBIMA) Conference*(Vienna, Austria, June,27-28,2013).

[11] Gennaro, E.D.1981. The effectiveness of using previsit instructional materials on learning for a museum field trip experience. *Journal of Research in Science Teaching*, 18,3(May. 1981), 275-279.DOI= https://doi.org/10.1002/tea.3660180312.

A Comparison of Academic and Non-academic Staffs' Balanced Score Card Based E-Performance Appraisal: A Case Study

Zeplin Jiwa Husada Tarigan
Lecturer Master of Management
Faculty of Economics,
Petra Christian University
Siwalankerto 121-131, Surabaya
East Java, Indonesia
+62312983244
zeplin@petra.ac.id

I Nyoman Sutapa
Lecturer Industrial Enginering
Faculty of Industrial Technology
Petra Christian University
Siwalankerto 121-131, Surabaya
East Java, Indonesia
+62312983432
mantapa@petra.ac.id

Jenny Mochtar
Lecturer English Department
Faculty of Letters
Petra Christian University
Siwalankerto 121-131, Surabaya
East Java, Indonesia
+62312983062
jennymd@petra.ac.id

ABSTRACT

Performance appraisal is a tool used by most organizations, including higher education, to appraise the performance of their staffs. Staffs in higher education in Indonesia are roughly divided into two groups, the academic and non-academic, and both groups are usually appraised annually. This study is based on a research of the e-performance appraisal used by Petra Christian University to appraise its academic and non-academic staffs. The performance appraisal used is based on Balanced Score Card (BSC) focusing on four perspectives, learning and growth, internal business process, customer satisfaction and financial performance. Data entries on the performance of the staffs are input on-line by the administrative departments responsible for the data. The data were collected using judgmental sampling and simple random sampling of forty academic and forty non-academic staffs. Using t-test, it is revealed that in the aspects of learning and growth, and financial performance, there is a discrepancy between the academic and non-academic e-performance. In the aspects of customer satisfaction and internal business process, there is no significant discrepancy.

CCS Concepts

Applied computing → E-learning.

Keywords

Pair comparasion performance; employee appraisal and balanced score card.

1. INTRODUCTION

The competitiveness of a nation is very much determined by how the human resources are able to manage the potentials that they have [1]. Education is a conscious and planned effort to actualize the learning process and condition to strengthen the religious spirituality, self-control, personality, intelligence, morality and skills needed for the individual, the society, the nation and the country as regulated by the constitution [2]. In the Indonesian education system, the focus on quality is not only the responsibility of the school and government, but the responsibility of all components, including the society. Therefore, the society needs to be concerned about quality, contributes to quality improvements and consistently focus on quality. Actualizing good quality in the life of a nation is one of the responsibilities of higher education that has a strategic role in enriching the intellectual life of a nation. One indicator of good quality is the achievement of its graduates in many areas of life, not only in academic achievements, but also in sports, arts etc. [3].

The three components involved in higher education as regulated by the Indonesian constitutions [2] and higher education ministerial regulation [4] are the students, the academic and the non-academic staffs. Students are defined as members of the society who undertake the effort to improve themselves using the learning process available in accordance to the major, level and type of specific education [5]. Academic staffs are defined as professional educators and scientists who transform, develop and disseminate knowledge and technology through education, research and community service [4]. Non-academic staffs are defined as members of the society who devote themselves and employed to support the management of higher education such as librarians, administrative staffs, technicians, laboratory staffs and information system experts (ibid.)

In Petra Christian University, performance appraisal for both the academic and non-academic staffs are done based on the same method, focusing on the e Balanced Score Card with the same variables which are learning and growth, internal business process, customer satisfaction and financial performance. Performance is the result of activities done by an individual (in quantity and quality) in accordance to her/his responsibilities. Performance appraisal is basically the key factor to improve an organization effectively and efficiently based on policies and programs conducted to boost the skills of its human resources. In general, performance appraisal on each individual staff would profit the dynamics of organizational growth to know the existing condition of the overall staffs' performance. Online data input by academic and administrative departments to the university website at sim.petra.ac.id, ensure the secrecy and validity of the data. Thus this research is done to find out whether there is a discrepancy between the performance of the academic and non-academic staffs

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.

© 2017 Association for Computing Machinery.

ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124132

based on the perspectives of BSC (Balanced Score Card) and e-performance appraisal.

2. BALANCED SCORE CARD (BSC)

Balanced Score Card is a management concept introduced a representative performance measurement system by Norton and Kaplan in 1992 a concept developed from a conventional performance appraisal which commonly measures only the company's financial aspect [6, 7]. His concept is based on an effective approach that balanced the appraisal between individual's performance and the organization's strategic plan. The approach is based on four perspectives, which are learning and growth, internal business process, customer satisfaction and financial performance [8]. BSC uses a list of indicators, financial and non-financial, in which an organization can control its operation and at the same time balances other indicators to control short term and long term performances. In addition, BSC is a management strategic system that defines the organization's mission and strategy into operational goals and performance indicators using four different perspectives.

BSC keeps the financial perspectives as financial indicator is beneficial to sum up the results of measured economic decision. Financial indicator would show how an organization's strategy, implementation and execution would contribute to the improvement of profit. The financial perspective would describe the consequences of the economic decision in the three other perspectives. The customer perspective defines the customers and the market segmentation where businesses would compete. The perspective of internal effort process defines the internal process need to give additional values to customer and owner. The last perspective, learning and growth, defines the capability needed by the organization to create long term growth and improvements. This last perspective is related to the other three main factors, the employee's capabilities, the information system's capabilities and the employee's attitude such as motivation and empowerment

2.1 BSC Design for Academic Staff's Individual Performance

Academic staffs everywhere have the same responsibilities, to teach and to do research. Esdar et al. [9] stated that in Germany, young academic staffs, especially, have the responsibilities both in teaching and research. Brew et al. [10] eksplores the productivities of the British and Australian academics in their research, using some indicators such as trainnings on how to do research, participation in research and being a member of a research team. The characteristics of the academic staff's performance as regulated by the Indonesian government, falls into three main areas which are teaching, research and community service. The government's requirement on the academic staff's performance in these three areas needs to be synchronized with the performance appraisal based on BSC.

Based on the mapping as in Figure 1, there are several indicators that fall into learning and growth, such as certification, formal education qualification and academic function career. For internal business process, some indicators that are used are attendance, work participation and corrections of audit findings. For customer satisfaction in the area of community service and research, the indicators used are academic staff's involvement and the satisfaction of the stake holders. In the area of teaching, the indicators used are students' satisfaction on teaching-learning process and the management's satisfaction of the academic staff's performance. For financial perspective, indicators used in the three areas are funding from external parties.

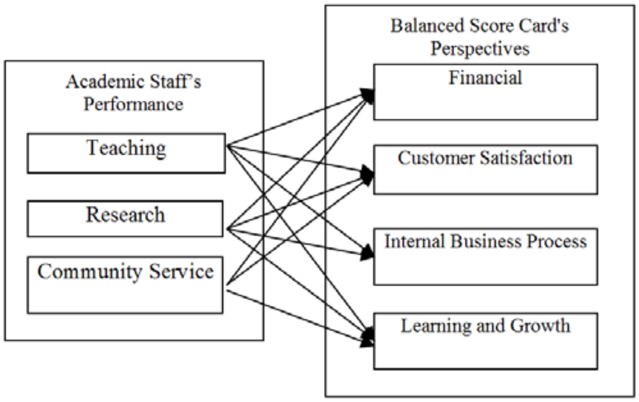

Academic Staff's Performance
Teaching
Research
Community Service
Balanced Score Card's Perspectives
Financial
Customer Satisfaction
Internal Business Process
Learning and Growth

Figure 1. Mapping of academic staff's performance based on the Indonesian government's requirement using the BSC's perspectives

2.2 BSC Design for Non-academic Staff's Individual Performance

Reserach done by Ifedili [11] on private universities in Negeria, reveal that the number of non-academic staff is larger than the academic staff. The large number of the non-academic staffs are needed to carry out the administrative loads efficiently and effectively to cut cost

The performance characteristic of the non-academic staff is focused on their ability to do their responsibilities. For learning and growth, the indicators used are the superior's appraisal of their performance and the trainings they have attended. For internal business process, the indicators are attendance and percentage of the job done. For customer satisfaction, the approach used is service quality [12, 13,14]. The indicators are the satisfaction of the students and of the academic staffs. And for financial perspective, the indicator is the efficiency of operational cost.

3. RESEARCH METHOD

This research is conducted to compare each BSC's perspective between the academic and non-academic staffs. Data collecting was done with judgmental sampling, using the criteria such as length of working experience in the university is five years or more [15]. Data were taken from forty academic staffs representing all departments and forty non-academic staffs representing all working units. The collected data was analyzed using two independent sample t-tests.

The hypothesis used in this research is to examine the discrepancy of performance between the academic and non-academic staffs from the perspectives of BSC. The hypothesis is:

H_1: Is there any significant discrepancy between the academic and non-academic staffs from the financial perspective.
H_2: Is there any significant discrepancy between the academic and non-academic staffs from the internal business process perspective.
H_3: Is there any significant discrepancy between the academic and non-academic staffs from the customer satisfaction perspective.
H_4: Is there any significant discrepancy between the academic and non-academic staffs from the growth and learning perspective.

4. Hypothesis Testing and Discussion

Based on the calculation and the used of SPSS, the average discrepancy of the sample t-test between the academic and non-academic staffs are as the following:

Table 1. T-Test of academic and non-academic staffs based on the perspective of Financial

Financial	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.001	.982	-3.248	78	.002
Equal variances not assumed			-3.248	77.811	.002

Based on the calculation and the used of SPSS, the average discrepancy of the sample t-test between the academic and non-academic staffs from the financial perspective, there is a significant point of 0.002<significant point (0.05) accepted hypothesis H_1, which means that there is a significant discrepancy between the academic and non-academic staffs' performance. This discrepancy is caused by the organization's policy for academic staffs to gain external funding for their activities, especially in research as well as community service. The external funding gained would boost the university's performance.

Table 2. T-Test of academic and non-academic staffs based on the perspective of Customer Satisfaction

Customer Satisfaction	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	9.252	.003	-1.713	78	.091
Equal variances not assumed			-1.713	69.426	.091

Based on Table 2 the calculation and the used of SPSS, the average discrepancy of the sample t-test between the academic and non-academic staffs from the customer satisfaction perspective. There is a significant point of 0.091 > significant point (0.05) rejected hypothesis H_2, which means that there is no significant discrepancy between the academic and non-academic staffs' performance in the BSC customer satisfaction perspective. This finding is related to the same customers that the academic and non-academic staffs have, the students that they teach and serve and their superiors in their working units.

Table 3. T-Test of academic and non-academic staffs based on the perspective of Internal Business Process

Internal Business Process	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.017	.898	-.036	78	.971
Equal variances not assumed			-.036	77.707	.971

Based on the calculation and the used of SPSS Table 3 the average discrepancy of the sample t-test between the academic and non-academic staffs from the customer satisfaction perspective. There is a significant point of 0.971 > significant point (0.05) rejected hypothesis H_3, which means that there is no significant discrepancy between the academic and non-academic staffs' performance in the BSC internal business process perspective. There is no significant discrepancy because the two groups used the online integrated system for their work

Table 4. T-Test of academic and non-academic staffs based on the perspective of Learning and Growth

Learning & Growth	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	48.024	.000	-5.345	78	.000
Equal variances not assumed			-5.345	54.830	.000

Based on Table 4 the calculation and the used of SPSS, the average discrepancy of the sample t-test between the academic and non-academic staffs from the financial perspective, there is a significant point of 0.000<significant point (0.05) accepted hypothesis H_4, which means that there is a significant discrepancy between the academic and non-academic staffs' performance in the learning and growth perspective.

This significant discrepancy is caused by the organization's policy that is in-line with the government regulation that focuses more on the improvement of the qualification of the academic staffs. The system of academic careers and leveling for the academic staffs is also well-established and many scholarships are provided exclusively for academic staffs. As for non-academic staff, the opportunity to improve themselves is only through trainings.

For near future, another research will be conducted using the approach of Analytical Hierarchy Process (AHP) to calculate the weight of each indicator from BSC. Also, another related research topic is an examination on the impact of the employees' satisfaction to the performance evaluation system.

5. CONCLUSION

Based on the data analyzed, there are some findings:

1. Significant discepancy in the e-performance of the academic and non-academic staffs in relation to the financial perspective of BSC.
2. No significant discepancy in the e-performance of the academic and non-academic staffs in relation to the customer satisfaction perspective of BSC.
3. No significant discepancy in the e-performance of the academic and non-academic staffs in relation to the internal business process perspective of BSC.
4. Significant discepancy in the e-performance of the academic and non-academic staffs in relation to the learning and growth perspective of BSC.
5. Identifying in which area the significant discrepancy occurs between the academic and non-academic staffs would give input to the top management on how to lessen the gap of the discrepancy. The discrepancy in learning and growth that is found would not benefit the organization and it is necessary for the organization to create a system that is also beneficial for the non-academic staffs. The perspective of learning and growth should be applicable for all staffs involved in the running of an organization because it is how a healthy organization is created.

6. REFERENCES

[1] Ferrell, O.C. and Hartline, M. 2010. *Marketing strategy*, South Western College Pub Fifth Edition.

[2] Undang-Undang Republik Indonesia tentang Pendidikan Tinggi no 12/2012.

[3] Komariah, A. dan Triatna, 2005. *Visionary leadership: menuju sekolah efektif*, Jakarta, Bumi Aksara.

[4] Permenristekdikti tentang SNPT no 44/2015 di Indonesia.

[5] Undang-Undang Republik Indonesia tentang Sisdiknas no 20/2003.

[6] Lee, S., Park, S.B., and Lim, G.G. 2013. Using balanced scorecards for the evaluation of Software-as- a-service. *Information & Management*, 50, 7(Nov. 2013), 553-561.

[7] Perkins, M., Grey, A., and Remmers, H. 2014. What do we really mean by “Balanced Scorecard*”?. International Journal of Productivity and Performance Management*, 63, 2, 148-169. https://doi.org/10.1108/IJPPM-11-2012-0127.

[8] Park, S., Lee, H., and Chae, S.W. 2017. Rethinking balanced scorecard (BSC) measures: formative versus reflective measurment models. *International Journal of Productivity and Performance Management*, 66, 1, 92-110. https://doi.org/10.1108/IJPPM-08-2015-0109.

[9] Esdar, W., Gorges, J., and Wild, E. 2016. The role of basic need satisfaction for junior academics’ goal conflicts and teaching motivation. *Higher Education*, 72, 2 (Agt. 2016), 175-190. doi:10.1007/s10734-015-9944-0.

[10] Brew, A., Boud, D., Namgung, S.U., Lucas, L., and Crawford, K. 2016. Research productivity and academics conceptions of research. *Higher Education*, 71, 5 (May 2016), 681-697. doi:10.1007/s10734-015-9930-6.

[11] Ifedili, C.J.A. 2006. Analysis of application of 1:3 ratio in employement of academic and non-academic staff in Nigerian Universities. *Education*, 127, 1 (Fall 2006), 129-138

[12] Dužević, I. and Časni, A. Č. 2015. Student and faculty perceptions of service quality: the moderating role of the institutional aspects. *Higher Education*, 70, 3 (Sept. 2015), 567-584, doi:10.1007/s10734-014-9857-3.

[13] Brandon-Jones, A. and Silvestro, R. 2010. Measuring internal service quality: comparing the gap-based and perception-only approaches. *International Journal of Operations and Production Management*, 3, 12, 1291-1318. https://doi.org/10.1108/01443571011094271.

[14] Sojkin, B., Bartkowiak, P., and Skuza, A. 2012. A: determinants of higher education choices and student satisfaction: the case of Poland. *Higher Education*, 63, 5 (May 2012), 565-581. doi:10.1007/s10734-011-9459-2.

[15] Cooper, D.R. and Schindler, P.S. 2008. *Business research Methods*,” 10th ed., McGraw Hill/Irwin.

An Online Training Platform Framework for Creative Idea Generation and Development

Xirong Gao
School of Management
No.2 Chongwen Road
Nanan District, Chongqing, China
(86)13996045018
gaoxr@cqupt.edu.cn

Jian Yang
School of Management
No.2 Chongwen Road
Nanan District, Chongqing, China
(86)13101276051
cquptyj@yahoo.com

Fei Yang
School of Management
No.2 Chongwen Road
Nanan District, Chongqing, China
(86)13350374170
469011821@qq.com

ABSTRACT

For the problem of national creative idea deficiency, we proposed an original idea of creativity training platform construction. First, we defined the concept of creativity training platform and clearly set its target location. Second, we put forward a function concept model of creativity training platform in order to acquire massive creative ideas based on the perspective of creative ideas development process. Finally, according to the function model and the systematic principle, we designed a three-tier system structure framework of the platform, and illustrated every function setting of each system unit in detail. The success in operation of creativity platform would be significantly essential to the innovation-driven development strategy.

CCS Concepts

Information systems~Computing platforms.

Keywords

Creativity training; Platform design; Creative ideas development

1. INTRODUCTION

Since the industrial revolution, the lack of national creativity has been the key factor restricting the development of China's social economy. Over the past 30 years of reform and opening up policy, China now has a solid economic foundation and is capable to open up to the pace of innovation oriented country. However, the lack of national creativity has become more and more prominent constraints to China's social and economic development. [1] In this context, it is the most urgent national mission to find a way to give birth to the national creativity of the public of China.

An online creativity training platform is an effective method to achieve the goal of innovation oriented country transformation, and to solve the problem of national creativity deficiency. Traditional creative training method conducted an offline operation mode to enhance the creative ability of people with the limits of time, space and the number of people involved, which would not meet the demand of massive creative ideas generation and of public creativity training mission. In order to overcome the disadvantages of the traditional creative training mode, a viable way is to establish an online creativity training platform which can not only be able to operate at any time, any place for people with a large capability for the public to participate in under the environment of virtual network, but also be able to train the creativity and generate massive ideas which would help China to transfer its population burden into creativity advantage. Therefore it is imperative to build a public creative training network platform.

However, what aspects should the public creativity be trained? How to promote the generation of creative ideas effectively? To answer these questions, it is necessary to carry on the system design and define the connotation of creativity training platform.

2. LITERATURE REVIEW

2.1 Research on Creative Idea

For the definition of creative idea, Li Zhidong & Zhang Renjun (2010) concerned that creative idea is a novel idea which could meet the needs of consumers, and it is a breakthrough on the existing technology, products and models [2]. Yang Zhangbo & Gao Shanxing (2013) thought that creative idea is an intellectual property with great economic value [3]. This paper argued that creative idea is both the starting point and the source of innovation activity, which plays the most critical leading role in entrepreneurial behavior, and the mission on creation and excavation of massive quality creative idea is the basic prerequisite for realizing "public entrepreneurship and innovation" policy of China.

On the research of creative idea value, the current scholars had put forward many dimensions of creative idea value, including intrinsic value [4], customer value [5], enterprise value [6], social value [7]. Among them, the intrinsic value of creative idea is embodied in the original degree and novelty of the creative content. The customer value is reflected in the degree that the creative function satisfies the actual demand of the customer. The enterprise value is reflected in the outcome of creative idea while the enterprise transforms the creative idea into the commercial product. The social value is reflected in the positive impact of creative idea on the society.

For the study of the creative idea formation process, Lubart [8] (2001) argued that creative formation is essentially a collection of many behaviors produced by new ideas. Based on the stage of the door theory, Basadur [9] put forward four stages of creative idea formation process: problem discovery stage, problem confirmation stage, problem solving stage, program application stage. Similarly, Amabile [10] (1996) proposed a four-stage creative idea formation model with four steps of problem identification, preparation, idea generation and idea implement.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124127

Bothos (2008) [11] argued that the process of creative idea formation follows seven stages of identifying opportunities, analyzing opportunities, creating creative elements, evolving creative elements, creating ideas, choosing ideas, and forming product concepts. He emphasized that these seven stages were usually a repeated solution process, rather than a sequential, one-way process. Betty et al. [12] argued that all the good ideas were almost improved by the initial roughness, and he emphasized the importance of continuous improvement, development and management after creation.

As for the study of creative ability, Guiford (1977) argued that creativity is the creative ability and he pointed out that creative ability included talent, motivation and personality traits [13]. Csikszentmihalyi (1988) divided creative ability into three aspects: individual, subject, and work in accordance with the different areas of creative implementation [14]. Based on the creation of individual perspective, Stenberg (2009) proposed a six-dimensional creative capacity structure model, including intelligence, knowledge, thinking style, personality, motivation and environment, which provided a theoretical guidance for the creative ability training [15].

In the study of creativity training, Tony Wagner (2015) discovered the trainability of creative thinking by investigating typical American young innovators and proposed a framework for cultivating young people's creative thinking [16]. Through the creative design training experiment, Chen Guojin (2010) studied the relationship between creative training and innovation ability, and put forward the content and methods of creative training [17]. In the experimental study, scholars at home and abroad have carried out creative training research. among them, Nakagawa (2011), Hajiyakhchali (2013), Phaksunchai et al. (2014), Salakhatdinova & Palei (2015) conducted experiment of college students. Tripon (2015) carried out the enterprise staff creative training experiment.

2.2 Research on Platform

The modern Chinese dictionary interprets the platform as a workbench for the production in the engineering area. From a functional point of view, the platform is a special tool or place which is designed to achieve a function. The "platform" concept in the academic field was originally derived from the field of new product development [18]. The main function of the Product Platform is to modify existing products for the purpose of new product development.

Recent years, the network platform began to flourish. The application of the platform began to extend to fields of technological innovation, product manufacturing, information sharing, network industry organizations, network business services and other fields [19]. There are two reasons to illustrate why the network platform is widely used. First, the network platform is of high efficiency. Relying on computer and virtual network technology, network platform could provide efficient services for the majority of users without the limit of time, space and any physical factors. Second, the network platform can use the network externalities to achieve value-added purposes [20]. According to Metcalfe's law, it is inferred that the value of the network platform and the number of users of the platform show a geometric growth. Therefore, we can realize the huge value of the network platform by stimulating the network effect of the platform.

Innovation network platform is one of the hottest research topics in recent years. Innovation network platform is the virtual place where engages in innovative activities. The development of innovation platform is an important way to integrate innovative resources, promote industrial common technology R&D, and promote the upgrading of industrial structure. It is also an effective way to enhance the overall innovation capability of the country and realize the economic growth to innovation-driven transformation. Wang Xueyuan (2011) [21] argued that the innovation network platform is a multi-functional collection system which provide innovation services. Hong Xiaojun (2008) [22] pointed out five characteristics of innovation network platform: innovation subject diversity, agglomeration element relevance, conditional scale, high quality of innovative resources and platform function complex.

2.3 Literature Shortcoming and Improvement

The existing research has the following shortcomings. First, ignore the great value of massive creative ideas; Second, lack the theoretical research on creativity training in the field of public; Third, little research about the process of creativity training from the perspective of idea generation process; Fourth, no research concerned about creativity training through online innovation platform. Therefore, based on the perspective of creative generation process, this paper puts forward the idea of constructing creativity training platform, defines the connotation of the creativity training platform, sets its target orientation, designs platform function and its system framework.

3. THE DIFINITION OF CTP

Creativity training platform(CTP) provides creativity training, idea development and management services for the public who have the idea of start a company, and it is also an open innovation online platform for the national policy ” mass entrepreneurship and innovation”. Being different from the traditional innovation platform, Creativity training platform has three special features: (1) Creativity training platform is the first one to provide free training service to the public for creativity training; (2) Creativity training platform helps to find the most valuable creative ideas from the massive ideas and provide capital for the potential ideas development; (3) Creativity training platform has special products, namely the creative ideas and creative talents on the platform. The two products are the unique profit sources for constructing a special e-business model of creativity training platform.

Accurate target positioning and distinctive features are the important basis for the existence and development of innovation platform. Based on China’s “public entrepreneurship, innovation” policy background, Creativity training platform should always take “raising the national creative ability and getting the massive high-quality creative ideas” as the primary strategic target position. In addition, the platform should play the role of resources integration and configuration, stimulate the network effect to produce massive creative ideas of the public of China with the motto of “openness, sharing, learning, innovation”.

4. FUNCTION DESIGN

The function of the platform is set up to meet the needs of users and realize the value of the platform. In this paper, based on the needs of the platform users, we build a creativity training platform functional conceptual model (see Figure 1) in order to obtain massive high-quality creative ideas. The specific steps are as follows. First of all, the ultimate aim of the platform could be divided in three parts, including initial idea formation, idea value realization and idea tracking management, which form the objective level of creativity training platform; then, we design the three meta functions according to the three sub-aim, including idea generation, idea development and creative ideas database; finally, looking into each meta function, we design the sub functions, which form the sub function level.

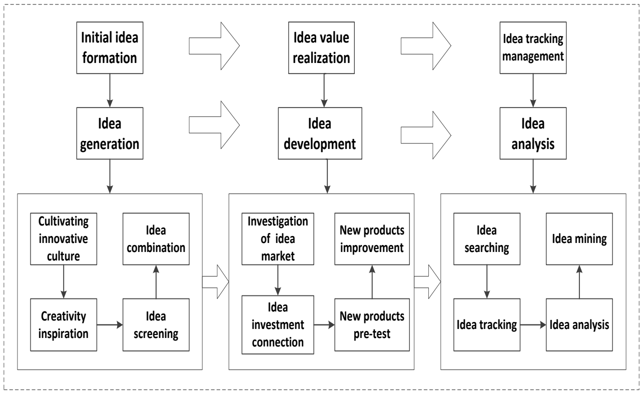

Initial idea formation
Idea value realization
Idea tracking management
Idea generation
Idea development
Idea analysis
Cultivating innovative culture
Idea combination
Creativity inspiration
Idea screening
Investigation of idea market
New products improvement
Idea investment connection
New products pre-test
Idea searching
Idea mining
Idea tracking
Idea analysis

Figure 1. Functional concept model of CTP

Therefore, we get the 3 meta-functions and the 12 sub-functions of the creativity training platform.

a) Idea generation meta-function. Idea generation is the initial stage of creative ideas development. Creativity training platform is designed to train the creative ability of the public through the idea generation module, which includes cultivating innovative culture, creativity inspiration, idea screening and idea combination.

b) Idea incubation meat-function. Idea incubation is the implementation phase of idea development and it is the process of idea value realization. Creativity training platform is designed to hatch creative ideas value through the idea incubation function module, which includes investigation of creative idea market, idea investment connection, new products pre-test and new products improvement.

c) Idea analysis meta-function. Idea analysis is the final stage of idea development, and it is a creative resource tracking management process. Creativity training platform is designed for managing creative ideas through idea analysis meta-module, which includes idea searching, idea tracking, idea analysis and idea mining. Therefore, a creative idea database is needed for idea analysis and management.

5. PLATFORM SYSTEM FRAMEWORK

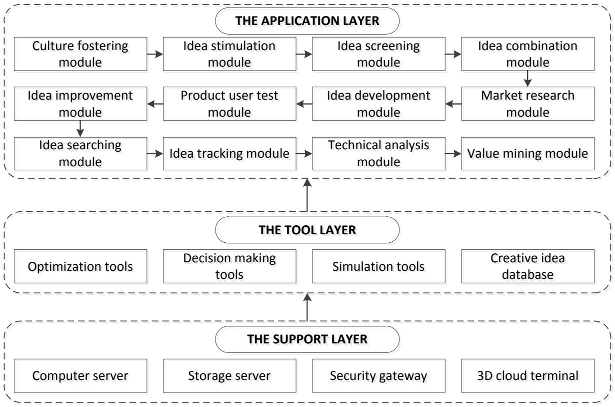

THE APPLICATION LAYER
Culture fostering module
Idea stimulation module
Idea screening module
Idea combination module
Idea improvement module
Product user test module
Idea development module
Market research module
Idea searching module
Idea tracking module
Technical analysis module
Value mining module
THE TOOL LAYER
Optimization tools
Decision making tools
Simulation tools
Creative idea database
THE SUPPORT LAYER
Computer server
Storage server
Security gateway
3D cloud terminal

Figure 2. System framework of CTP

Based on the concept model of creativity training platform, according to the principle of the system design, the three layer structure system framework of the platform is designed (see Figure 2). It includes three layers, namely application layer, tool layer and support layer. Among them, the application layer is the core part of creativity training platform, and it is the source value of the platform; the tool layer provides management tools for application layer, and provides technical support for idea generation, idea incubation, idea analysis, and it is the key part for platform to improve its productivity; the support layer is the basic guarantee of stable operation, and it provides network connector, cloud services and saving-loading services.

5.1 The Application Layer

From the three meta-functions of the creativity training platform, we designed the core function modules of "idea generation room", "idea incubator" and "idea analysis room".

1) The idea generation room module

To achieve the aim of giving birth of massive high-quality creative ideas, the idea generation room is divided into four modules, including culture fostering module, idea stimulation module, idea screening module and idea combination module. The specific functions of each module unit are as follows:

a) Culture fostering module: this module is designed to diagnose public innovation culture short-board, to design innovation culture forging scheme, to cultivate the spirit of individual innovation and team innovation, to foster social innovation culture. The operation path of this module is “public innovation culture short-board diagnosis”→ “innovation culture forging scheme design” → “individual innovation culture cultivating test” → “outcome valuation” → “test improvement and continuous cultivating”.

b) Idea stimulation module: this module is designed to stimulate the original and modified creative ideas. This module uses brainstorming method to achieve the purpose of idea generation and improvement.

c) Idea screening module: this module is designed to screen high-quality creative ideas from massive ideas generated in the creativity training platform. First, it is necessary to build a creative idea database. Second, the aim of screening ideas could be achieved by big data analysis. The operation path of this module is “Online creative ideas collection”→ “Screening rule determination”→ “Computer recognition of rules”→ “Creative ideas screening implementation”→ “Creative ideas sorting and ordering”.

d) Idea combination module: this module is designed to combine different ideas and improve the creative ideas. Different ideas have different functions, so it would be viable to combine several ideas into one comprehensive idea.

2) Creative idea incubator module

In order to realize the function of "creative idea implementation and value acquisition", the idea incubator module is composed of market investigation module, idea development module, product user test module and idea improvement module. The functions of each module unit are as follows:

a) Market research module: through the format of the market survey, the selected creative idea is evaluate for its market prospect, and for forecasting the potential market demand for specific ideas.

b) Idea development module: this module helps to link the original idea generator with finance support through crowdsourcing approach and venture capital links. The crowdsourcing is a good finance support to the creative idea community, for implementation and development of creative ideas. The congregation is to raise the market prospects of good ideas to the angel community, for the implementation of the development of creative ideas.

c) Product user test module: this module is developed to improve the original product through user experience test. The test includes testing the product's usefulness, convenience, comfort, which would give a direction for finding out the drawbacks of the product and improving the product. The original of the new product could be the real object, or a 3D print item, or a virtual video files, etc.

d) Idea improvement module: this module is consisted of the prototype selection, market introduction, user feedback, learning improvement modules. Among them, the prototype screening is finding out the initial prototype idea which is suitable for enterprises based on market dynamics and enterprise resources; the market introduction is the tool for importing new products into the market and tracking the market information of the new product; the user feedback gets the information of user test experience through user feedback dynamic searching platform; the learning improvement is designed automatically to improve the product by computer self-learning program.

3) Idea analysis room system module

In order to track the implementation of creative ideas and generate more value-added services for the platform, idea analysis room is composed of idea searching module, idea tracking module, technical analysis module and value mining module. The functions of each module unit are as follows:

a) Idea searching module: using of data capture algorithm, this module is designed to link the creative idea community sites, look for creative talent, collect information, and to find out creative idea opportunities for cooperation.

b) Idea tracking module: this module is designed for tracking the dynamic situation of generated creative ideas, timely grasping the improvement situation and market changing potential of the creative idea, and creating new combination of opportunities for idea cooperation.

c) Technical analysis module: this module provides technical support and data analysis services for the acquisition, evaluation, selection, combination, application and improvement of creative idea implementation and development.

d) Value mining module: this module uses the intelligent data analysis technology to classify, cluster, associate, select, evaluate the creative ideas and helps to discover the potential value of creative ideas in the creative idea databases.

5.2 The Tool Layer

The tool layer mainly provides the information data and the technical analysis method for the creative idea analysis and management, which is composed of the optimization tool, the decision tool, the simulation tool and the specialized database. The function of each component unit is as follows:

a) Optimization tools: the optimization tools are Lingo, MATLAB, etc., which would be beneficial for creative idea generation, incubating and analyzing.

b) Decision making tools: Decision, Tools, @RISK6, and so on, which are used to provide decision-making tools for the generation, incubation and analysis of creative ideas.

c) Simulation tools: the use of the system simulation tool Arena, image processing tools, such as Illustrator, for the generating, hatching and analyzing of creative ideas.

d) Creative idea database: using ETL、OLAP to build the database, which could save the creative idea information and provide creative idea searching and query services.

5.3 The Support Layer

The support layer provides hardware and software and cloud technology support for creativity training platform, including computing server, storage server, security gateway, 3D cloud terminal. The function of each component unit is as follows:

a) Computing server: the cloud computing technology is used for the generation, incubation and analysis of ideas to provide computing services.

b) Storage server: the cloud storage technology is applied for the generation, incubation and analysis of creative ideas to provide storage services.

c) Security gateway: the cloud security technology is conducted to provide security for the operation of creativity training platform.

d) The 3D cloud terminal: using 3D cloud technology, the platform is able to achieve the functions of 3D display, 3D printing, 3D image of the original new products, which provides three-dimensional, visualization, virtual design, 3D display and presentation service for idea generation, incubation and analysis.

6. CONCLUSION

From the point of view of national creativity deficiency, based on the process perspective of idea development, we proposed a functional concept model of creativity training platform, and discussed the system design of the platform. The main conclusions are as follows:

1) We proposed a new online platform to train the creativity of the public and defined its definition. The creativity training platform is designed for creative idea generation, development and management. The aim of the platform is to improve the creativity of the public and acquire massive high-quality creative ideas so as to achieve the Chinese innovation policy of mass entrepreneurship and innovation.

2) Based on the perspective of creative idea development process, the concept model of creativity training platform is constructed, which obtains 3 meta-functions and 12 sub-functions. The 3 meta-functions are idea generation, idea incubation and idea analysis. The 12 sub-functions are cultivating innovative culture, creativity inspiration, ideas screening, idea combination, investigation of creative idea market, idea investment connection, new products pre-test, new products improvement, idea searching, idea tracking, idea analysis and idea mining.

3) According to the principle of system design and the concept model of the creativity training platform, we designed the framework of the platform system, which consists of three layers: the application layer, the tool layer and the support layer. Among them, the application layer includes three functional modules: "idea generation room", "creative idea incubator" and "idea analysis room". The idea generation room is designed to realize "spawned massive high-quality creative" function, by culture fostering module, idea stimulation module, idea screening module and idea combination module; the creative idea incubator is designed to realize "creative implementation and value" function, by market investigation module, idea development module, product user test module and idea improvement module; the idea analysis room is designed to track and mange creative ideas, by idea searching module, idea tracking module, technical analysis module and value mining module.

The construction of creativity training platform is a complex project which could be divided into several sub-projects, such as online creativity training methods, index system of creative idea value, valuation of creative ideas, creative idea computer screening from massive ideas, the construction of creative idea database, data analysis of massive ideas and so on.

7. ACKNOWLEDGMENT

This work was supported by Graduate Education Teaching Reform Project of Chongqing City in 2016(YJG20163071), Education Science "in 13th Five-Year" Planning project of Chongqing City in 2016(2016-GX-006) and 2012 National Social Science Foundation of China (12BGL017).

8. REFERENCES

[1] Stevens G, Burley J. 3000 raw ideas equal 1 commercial success! [J]. Research-technology Management, 1997, 40 (3): 16-27.

[2] Li Zedong, Zhang Renjun. Product innovation front-end creative formation: based on full participation in the system model [J]. Science and technology progress and countermeasures, 2010,27 (20): 48-52. (In Chinese)

[3] Yang Zhangbo, Gao Shanxing. Study on creative management of creative enterprises from the perspective of industrial value chain [J]. Science and Technology Progress and Countermeasures, 2013,30 (6): 51-55. (In Chinese)

[4] Han Shunfa, Li Xiangmin. Analysis of the value of creative industry with double decision of innovation and culture [J] .Journal of Science, 2009, (2): 555-560. (In Chinese)

[5] Hu Bin. The intrinsic mechanism and policy orientation of creative industry value creation [J]. China Industrial Economy, 2007, (5): 22-29. (In Chinese)

[6] Liu Youjin, Zhao Ruixia, Hu Liming. Study on the Organizational Model of Creative Industry - Based on the Perspective of Creative Value Chain [J]. China Industrial Economy, 2009, (12): 46-55. (In Chinese)

[7] Han Shunfa. Research on the Value of Creative Industry Based on Two-way [J]. Science and Technology Progress and Strategy, 2010, (4): 59-63. (In Chinese)

[8] Lubart T I. Models of the Creative Process: Past, Present and Future [J]. Creativity Research Journal, 2001, 13 (3): 295-308.

[9] Basadur M. Managing creativity: A Japanese model [J]. The Executive, 1992, 6 (2): 29-42.

[10] Amabile T M. Creativity and innovation in organizations [R]. Boston, Massachusetts: Harvard Business School, 1996: 1-15.

[11] Bothos E, Apostolou D, Mentzas G. Idea selection and Information Aggregation Markets [C] // Engineering Management Conference, 2008. IEMC Europe 2008. IEEE International. IEEE, 2008: 1-5.

[12] Betty Y A, Jill M. Team Players and Team Managers: Special Educators Working with Paraeducators to Support Inclusive Classrooms [J]. Creative Education, 2012, (3): 322-327.

[13] Bai Kai. Creative training: tourism management undergraduate education in the future to enhance the space and development focus [J]. Academic Forum, 2011, 20 (8): 175-183. (In Chinese)

[14] Csikszentmihalyi M. Society, culture and person: A systems view of creativity [A]. Sternberg R J. The nature of creativity [C]. New York: Cambridge University Press, 1988.

[15] Sternberg. Creative Psychology [M]. Beijing: China People's University Press, 2009. (In Chinese)

[16] Tony Wagner. Innovator's Cultivation: How to Cultivate Innovative Talents in Changing the World [M]. Beijing: Science Press, 2015. (In Chinese)

[17] Chen Guojin. Creativity training and training of mechanical students in innovation ability [J]. Journal of Hangzhou Dianzi University (Social Science Edition), 2010, 6 (2): 63-66. (In Chinese)

[18] Wheelwright S C, Clark K B. Revolutionizing Product development: quantum leaps in speed, efficiency, and quality [M]. New York: Free Press, 1992.

[19] Wu Yixiang, Xu Mengjie. Manufacturing enterprise "service platform" strategy, cross-level collaboration and industry interaction development [J]. China Industrial Economy, 2011, (11): 48-58.

[20] Kapoor R, Lee J M. Coordinating and competing in ecosystems: how organizational forms shape new technology investments [J]. Strategic Management Journal, 2013,34 (3): 274-296.

[21] Wang Xueyuan, Wang Hongqi, Li Wenqi. Identification and grade recognition of innovation platform [J] .Journal of Science, 2011, (6): 924-929. (In Chinese)

[22] Hong Xiaojun. Conceptual Screening and Construction Strategy of Innovation Platform [J]. Science and Technology Progress and Countermeasures, 2008, (7): 7-9. (In Chinese)

ICEMT 2017

E-Commerce and Business Management

A Study of Barriers to E-Commerce Adoption among Small Medium Enterprises in Indonesia

Mus Aidah
Department of Information System
STMIK Adhi Guna
Palu, Central Sulawesi, Indonesia
+62 812 4343 6678
mus.aidah78@gmail.com

Hajra Rasmita Ngemba
Department of Information System
STMIK Adhi Guna
Palu, Central Sulawesi, Indonesia
+62 811 4536 968
hajra.rasmita@gmail.com

Syaiful Hendra
Department of Informatics Engineering
STMIK Adhi Guna
Palu, Central Sulawesi, Indonesia
+62 811 4538 853
syaiful.hendra.garuda@gmail.com

ABSTRACT

This study discusses the barriers that affect the adoption of e-commerce on SMEs in Indonesia, especially in the city of Palu, Central Sulawesi. In this study the barriers are grouped into five groups: technical, economic, political, organizational, legal and regulatory and social culture. The results in this research found resistance correlated most strongly to the adoption of e-commerce are economic and organizational barriers. Besides the next instance is the discrepancy between the barriers perceived by SMEs based on the level of business, status, and long-established businesses.

CCS Concepts

Information systems.

Keywords

Barriers; E-commerce; SMEs; adoption of E-commerce in SMEs Indonesia.

1. INTRODUCTION

The role of small and medium enterprises is very important for the economic growth of a country. For this reason, governments around the world spend their time developing the SMEs sector to boost economic growth [1]. It is also a particular concern of government in Indonesia. In 2013 according to data [2], the number of SMEs in Indonesia reached 57,895,721 units. The SMEs sector in Indonesia proved to have absorbed 114 144 082 workers, have contributed to 9:29% of export value and 5.89% of Gross Domestic Product (GDP).

Although SMEs strongly contribute to the economy, but the competition faces large businesses and more modern competitors have put SMEs in a disadvantaged position [3]. This gap also occurs in ICT adoption among large enterprises and SMEs. According to [4] large companies tend to invest more in ICT and to apply ICT in a more sophisticated way than the small firms. Many studies conducted by experts which ICT can help SMEs to increase knowledge, reduce production costs, improve efficiency, maintain relationships with suppliers and improve customer [5], [6], [7], [8].

Advantages that be gained from the use of ICT is felt not to be able to encourage SMEs to adopt ICT. According to [9] states that have the high cost of access has been one of the factors causing low IT adoption by SMEs. The study [10] stated that the inadequate infrastructure in Indonesia became a major factor that led to the slow adoption of technology by SMEs. The need for the availability of the software, hardware, and networking in the IT management problems that pose more complicated because it requires skilled staff to implement and maintain IT services [11]. Evidence from the low level of adoption of e-commerce by [12], E-commerce in Indonesia is still low in number and quality despite the fact that the potential of E-commerce in Indonesia is quite high.

In application of e-commerce on SMEs, there is a reason to know the obstacle of SMEs in adopting e-commerce. Therefore, this study aims to examine the barriers that affect the adoption of e-commerce on SMEs in Indonesia.

The results of this study are expected to provide input for the government, especially the Central Sulawesi provincial administration and SMEs organizations in Indonesia. Furthermore, this paper is divided into several sections. Part II discusses the diffusion of innovation, the adoption of ICT in SMEs Indonesia and the barriers to widespread adoption of e-commerce on SMEs. In section III, it is about the research methods. Then, the results and discussion described in section IV. Last but not least, Part V contains the conclusion that closes this article.

2. BASIC THEORY

2.1 Diffusion of Innovations

Diffusion is the process by which an innovation is adopted by members of a community [13]. There are four factors that affect the adoption of an innovation by a member or part of an organization, namely: (1) the innovation itself, (2) the communication channels used to disseminate innovation, (3) time, and (4) where the place the innovation introduced [14]. Adoption of innovation has complex meaning because it concerns the decision-making process that is influenced by many factors to accept new ideas. Adoption of innovation is part of our corporate strategy, resulting in the adoption process required innovation enough information.

According to [14] distinguish people who adopt innovations based on time to 5, namely: (1) the innovator; (2) early adopter; (3) early majority; (4) late majority; and (5) laggard. Judging from the unit of analysis, there are levels of innovation diffusion approach. First, some researchers see this problem in

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124124

macro within a community or at the state level [15]; [16]; [17]. Second, several other investigators look into this matter at the level of organization or institution [18]; [19] and third, some researchers see diffusion of innovation at the individual level [20].

2.2 ICT SMEs Adoption in Indonesia

Based on many conducted surveys, they found that more large companies use IT to improve company performance compared with SMEs. Many reasons were put forward lack of IT adoption by SMEs. One of them is still despising the knowledge of the potential of IT to promote business. Studies conducted [21] found that there are four factors that determine the adoption of new technologies by SMEs, namely: (1) the characteristics of SMEs; (2) the strategy and management of the competition SMEs; (3) the influence of internal and external parties in the decision-making process of adoption; and (4) the characteristics of the new technology that will be adopted.

According to [22] argues that the use of IT provides a positive value for the management strategies associated with the aspect of communication, access to information, decision-making, data management and knowledge management in an organization. According to [23] argues that IT provide benefits to business organizations to reduce costs and improve business organizations in coordination with outsiders. However, some researchers with the research that was done revealed the fact that the adoption of IT in SMEs is still lower than expected [24]; [25].

Until now, it can be seen that the adoption of IT by SMEs in Indonesia is still very low. AMI Partners research institute revealed the fact that only 20% of SMEs in Indonesia which has a computer [26] to support its business activities. Besides, the adoption of IT in SMEs are also constrained by the characteristics of the organization, in this case the SMEs themselves [27].

2.3 Barriers to Adoption of E-Commerce on SMEs

In a previous study on the adoption of e-commerce, most researchers also examined on the level of adoption of e- commerce [28]; [29]. Each company has a wide variety of different levels in the adoption of e-commerce [28]. Some studies also abundant with new obstacles to the adoption of e-commerce in SMEs. According to [30] reported on the difficulty of finding and retaining qualified personnel with the necessary skills and knowledge and the risk of dissipation of company-specific knowledge.

The purpose of this study was to identify the main obstacles to the adoption of e-commerce in Indonesia, because the study of the barriers to widespread adoption of e- commerce on SMEs Indonesia is still lacking. This study reviewed several international studies and models that may apply to the state of SMEs in Indonesia.

3. RESEARCH METHOD

3.1 Research Model

The variables used in this study the adoption of [31], who conducted a survey of constraints adoption of e-commerce in Egypt. The variables of this study consisted of demographic, social, cultural, economic, political, legal, technical, organizational, and adoption of e-commerce on SMEs (see Figure 1). This study adapts to the conditions of SMEs in Indonesia. The hypothesis of this study is:

1. There is a relationship demographics (SMEs level, status, and long-standing effort) that against the barriers to widespread adoption of e-commerce.
2. Barriers technical, economic, political, legal and regulatory, organizational, social and cultural correlates to the adoption of e-commerce on SMEs.

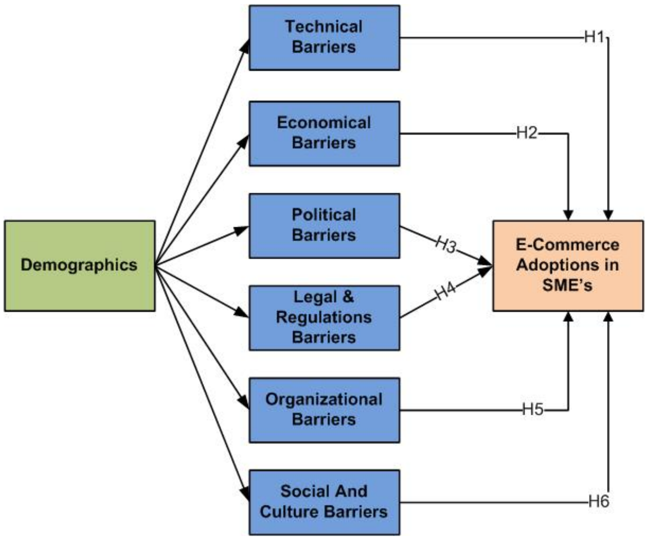


Figure 1. Research Model

The population for this study is SMES in Central Sulawesi, Indonesia. Select a sample of SMES with non probability sampling method, which uses the technique of convenience sampling. To test the model required a detailed questionnaire. Types of questionnaires used are covered. Likert scale each question is measured with a scale interval of 1 to 5. Strongly Disagree 1 score (SD), Disagree (D) score 2, Neutral (N) score 3, Agree (A) score 4, Strongly Agree (SA) 5. The data will be analyzed using SPSS version 15.

3.2 Variable Measurement

In general indicators on research variables as follows:

Table 1. Variables and indicators

Variable	Indicators	Adoption From
Technical Barriers	Lack of Internet security	[32]
	E-commerce infrastructure	[33]
	lack of qualified staff	[33]
	Lack of adequate power supplies	[33]
	Increase innovations and new technologies	[32]
Economical Barriers	Lack of financial infrastructure /resource	[33];[32]
	Unclear benefits from e-commerce adoption	[34]
	Lack of secure payment infrastructures	[35]
	Cost too high	[32]; [35]
Political Barriers	Change in regulations with each Government	[36]
	Changes in government policy	[35]
	Lack of an appropriate legal environment to apply e-commerce	[35]; [37]
	Low level of readiness among government institutions	[37]
Legal & Regulatory	Absence of legal and regulatory systems	[36]; [35]
	No simple procedures and guidelines	[36]

Barriers	Lack of e-commerce standards	[35]
	Lack of e-trading legislations	[36]; [37]
Organizational Barriers	Difficulty in changing the existing working procedures	[32]
	Lack of management support	[32]
	Organizational resistance to change	[38]
	Limited use of Internet banking and web portals by SMEs	[39]
Social & Culture Barriers	Lack of popularity for online marketing and sales	[22]
	Lack of awareness of e-commerce benefits	[37]
	Lack of external pressure from suppliers	[40]
	Lack of external pressure from customers	[40]
	Linguistic barriers	[32]; [35]
E-commerce Adoption in SME's	E-commerce helps in production operations	Researcher
	E-commerce helps in operational marketing / sales	Researcher
	E-commerce helps in the processing of financial companies	Researcher
	E-commerce helps in extending the reach of marketing	Researcher

4. RESULT AND DISCUSSION

4.1 Respondent Demographics

This section presents an overview of research data obtained from the respondents. Questionnaires were distributed as many as 260 questionnaires were returned as many as 256 so that a response rate of 98.46%.

Table 2. Respondent Demographics

	n	%
Level SMEs		
Micro	137	53.5
Small	111	43.4
Medium	8	3. 0
Status		
Owner	127	49.6
Employee	129	50.4
Gender		
Male	148	57.8
Female	108	42.2
Age (years)		
<25	85	33,2
25-29	83	32,4
30-39	56	21,9
≥40	32	12,5
Education completed		
Elementary school and junior high school	10	3.91
Senior high school	177	69.1
Bachelor, master, or doctoral degree	69	26.9
Type SMEs		
Factory	14	5.47
Wholesale/Retail	74	28.9
Construction	13	5.08
Services	32	12.5
Private/school	3	1.17
Restaurant	9	3.51
Furniture	11	4.30
Automotive	25	9.76
Electronic Product	39	15.2
Pharmacy	21	8.20
Etc.	15	5.86

In Table 2 it can be reveal that the majority of SMEs respondents in this study is coming from the micro level backgrounds as many as 137 units. While almost as many respondents status, between employees and owners of SMEs. For the gender of the respondents of this study are dominated by male as much as 57.8%. The average age of respondents is 25-30 years old because it started to increase awareness of entrepreneurship among youth. Long standing SMEs majority aged 2-10 years amounted to 80.9%. Respondent education, minority university degree, master's and doctorate, this is because the number of respondents with the status of employees with the maximum high school education. While the types of SMEs can be divided into several types which are dominated by wholesale / retail (74 units) and the next is the business of electronic products, and services. Then the type of business that most minorities are the business school / education with percentage 1:17, other business operating amounted to 5.86%.

4.2 Barriers Relationships Engineering, Economics, Politics, Law and Regulations, Organization, Social and Cultural Adoption of E-Commerce on SMEs

Six tested barriers were found a significant relationship at the level of 0.01 and 0.05 using the Spearman. The higher the resistance there is, the lower the level of adoption of e- commerce by SMEs. Barriers that have a high correlation to the economic obstacles then with significant organizational barriers are at the level of 0.01. This is because in Indonesia, many employers consider that investment in IT/e-commerce requires a high cost and infrastructure sufficiently complex financial institutions accessible to users, these findings are consistent with research conducted by [9]. While legal barriers and regulatory relationships is the lowest compared with the five other significant barriers at the level of 0.05. This condition has been supported by the application of the laws of information and electronic transactions in Indonesia. For more details can be seen in Table 3.

Table 3. Correlate

Barriers	Adoption of e-commerce SMEs	Rank
Technical	-0,298**	4
Ekonomical	-0,478**	1
Political	-0,394**	3
Legal & Regulation	-0,129*	6
Organizational	-0,410**	2
Social & Culture	-0,274**	5

Note: **p<0.01; *p<0,05

4.3 Respondents answer on Barriers to Adoption of E-Commerce

In Table 4, it was found that the highest barriers that affect the low adoption of e-commerce on SMEs is the lack of internet security with a mean of 3.73 then the lack of e- commerce standards with a mean value of 3.52. While the barriers to its lowest power supplies are inadequate (2.50), Lack of financial infrastructure / resource (2.70) and Lack of management support (2.73). This research was supported by research [31]; [32]; [33]; [35].

Table 4. Respondent Answer Rank

Indicators	Mean	SD	Rank
Lack of Internet security	3,73	0,802	1
Lack of e-commerce standards	3,52	0,826	2
E-commerce infrastructure	3,46	0,941	3
Lack of e-trading legislations	3,40	0,801	4

Lack of an appropriate legal environment to apply e-commerce	3,29	0,676	5
Limited use of Internet banking and web portals by SMEs	3,26	0,875	6
Absence of legal and regulatory systems	3,25	1,018	7
Lack of external pressure from suppliers and customers	3,24	0,982	8
Lack of external pressure from customers	3,17	0,987	9
Lack of secure payment infrastructures	3,17	0,953	9
No simple procedures and guidelines	3,16	0,992	10
Low level of readiness among government institutions	3,14	0,527	11
Changes in government policy	3,10	0,487	12
Lack of awareness of e-commerce benefits	3,07	1,005	13
Change in regulations with each Government	3,07	0,451	13
lack of qualified staff	2,94	1,010	14
Linguistic barriers	2,91	0,998	15
Cost too high	2,89	0,990	16
Unclear benefits from e-commerce adoption	2,88	0,954	16
Organizational resistance to change	2,88	0,906	17
Difficulty in changing the existing working procedures	2,84	0,996	18
Increase innovations and new technologies	2,80	0,947	19
Lack of popularity for online marketing and sales	2,79	1,008	20
Lack of management support	2,73	0,905	21
Lack of financial infrastructure /resource	2,70	0,942	22
Pasokan listrik kurang memadai	2,50	0,826	23

Note: a = Liker items with 5 level (1 = strongly disagree; 5 = strongly agree)

4.4 Test Different Demographics and Adoption Barriers to E-Commerce

Table 5. Test Different

	Barriers		
	Level SMEs	**Status**	**Established**
Technical	0.024*	0.003*	0.120
Ekonomical	0.002*	0.000**	0.042*
Political	0.003*	0.069	0.163
Legal & Regulation	0.130	0.479	0.776
Organizational	0.010*	0.724	0.619
Social & Culture	0.051	0.003*	0.025*

Note: **p<0.01; *p<0,05

In Table 5, it addressed the difference between the level of SMEs, and the status of long standing efforts of the barriers to widespread adoption of e-commerce which they feel, as an obstacle to the level of SMEs (micro, small and medium enterprises) differ in technical barriers, economic, political and organizational. While based on status (owners and employees) there was no difference in the political constraints, organizational and legal and regulatory. This situation occurs due to the perception of the owners and employees whom understand their rules made by the government in the form of legislation. Based on the old business establishment (new and old), there are different barriers in terms of economic and socio-cultural. This finding is consistent with the conditions and mastery of different capital market is dominated by businessmen longer standing.

5. CONCLUSION

5.1 Findings

This study found several findings including economic barriers and obstacles that the organization has a strong correlation to the adoption of e-commerce. That caused in Indonesia, many employers consider that investment in IT/e- commerce requires a high cost and infrastructure of financial institutions is quite complicated accessed by users. Legal barriers and regulatory relationships is the lowest compared to the five other significant barriers at the level of 0.05. Later it was found that the highest barriers that affect the low adoption of e-commerce on SMEs is the lack of internet security with a mean of 3.73. While most low barriers are inadequate power supplies with a mean of 2.50. In addition, this study found no difference between the level of SMEs, and the status of long standing efforts of the barriers to widespread adoption of e-commerce which they feel, as an obstacle to the level of SMEs (micro, small and medium enterprises) differ in technical barriers, economic, political and organizational. While mentioning the status of owners and employees, there was no difference in the political constraints, organizational and legal and regulatory. Based on the old business establishment (new and old), there are no barriers in terms of economic and socio-cultural.

5.2 Research Limitation and Recommendations

As with other studies, this study is not perfect and a lot of limitations.

1. This study only apply through the enclosed questionnaire survey method that has not been able to reveal things deeper. It is hoped further research is accompanied by an interview.
2. This study only examined six obstacles, expected in future studies can be added to other obstacles that can be found the highest obstacle that caused the adoption of e- commerce in Indonesia is low

6. ACKNOWLEDGMENT

Our thanks to STMIK Adhi Guna that give us funding to realize this research. And our thanks to ACM SIGCHI for allowing us to modify templates they had developed.

7. REFERENCES

[1] Travica, B. “Diffusion of electronic commerce in developing countries: the case of Costa Rica. Journal of Global Information Technology Management, 5(1). 2002. 4–24.

[2] Badan Pusat Statistik dan dan Kementerian Negara Koperasi dan Usaha Kecil Menengah (BPS dan KN KUKM). “Statistik Usaha Kecil dan Menengah”. Indonesia. 2013.

[3] Roosdhani, Wibowo et.all. “Analisis Tingkat Penggunaan Teknologi Informasi dan Komunikasi pada Usaha Kecil Menengh Di Kab. Jepara”. Jurnal Dinamika Ekonomi & Bisnis. 2012. Vol. 9 No. 2.

[4] Parida, V. “Achieving competitiveness through externally oriented capabilities:An empirical study of technology-based small firms”, Doctoral Thesis, Luleå University of Technology. 2010

[5] Nieto, M. J. & Fernández, Z. “The role of information technology in corporate strategy of small and medium enterprises”. Journal of International Entrepreneurship. 2005. 3(4): 251-262.

[6] Fillis, I., Johansson, U. & Wagner, B. “A conceptualisation of the opportunities and barriers to e-business development in the smaller firm”. Journal of Small Business and Enterprise Development. 2003. 10(3): 336-344.

[7] Karagozoglu, N. & Lindell, M. “Electronic commerce strategy, operations, and performance in small and medium-sized enterprises”. Journal of Small Business and Enterprise Development. 2004. 11(3): 290-301.

[8] Taylor, M. & Murphy, A. “SMEs and e-business”. Journal of Small Business and Enterprise Development. 2004. 11(3): 280-289.

[9] Jahanshahi AA, Zhang SX, Brem A. “E-commerce for SMEs: empirical insights from three countries”. Journal of Small Business Enterprise Development. 2013. 20 (4): 849–865.

[10] Sheth, J.N. dan Sharma, A. "International e-Marketing: Opportunities and Issues", International Marketing Review. 2005. Vol. 22 Iss: 6, pp.611 – 622.

[11] Thinkstrategies. “Solving the IT challenges of small and mid-sizeorganization via utility computing". Retrieved January 18, 2017, fromwww.thinkstrategies.com:www.thinkstrategies.com/images/CB E_Whitepaper_110602.pdf

[12] MacGregor, R.C.; Vrazalic, L. “A basic model of electronic commerce adoption barriers: A study of regional small businesses in Sweden and Australia”. J. Small Bus. Enterp. 2005. Dev., vol. 12, pp 510–527.

[13] Hashim, Junaidah. “Information Communication Technology (I C T) Adoption among SME Owners in Malaysia”. International Journal of Business and Information. 2007. Volume 2, Number 2, December Juwita,

[14] Rogers, E.M. Diffusion of Innovation. 4th edition, New York: The Free express. 1995.

[15] Kiiski, S., dan Pohjola, M.“Cross-country diffusion of the Internet. Information Economics and Policy”. 2002. 14, 297-310.

[16] Larry, P., Foster, W., Wolcott, P., dan McHenry, W. “The Internet in India and China. First Monday, 7 (10). 2002

[17] Wolcott, P., Press, L., McHerry, W., Goodman, S., dan Foster, W. “A framework for assessing the global diffusion of the Internet”. Journal of the Association for Information Systems, .2001. 2-6.

[18] Harrison, D. A., Mykytyn, P. P., Jr., dan Riemenschneider, C. K. “Executive decisions about adoption of information technology in small business: theory and empirical tests”. Information System Research. 1997. 8(2), 171-195.

[19] Plouffe, C. R., Hulland, J. S., dan Vandenbosch, M. “Richness versus parsimony in modeling technology adoption decisions - understanding merchant adoption of a smart card-based payment system”. Information Systems Research. 2001. 12(2), 208-222.

[20] Mathieson, K. “Predicting user intention: comparing the technology acceptance model with the theory of planned behavior”. Information Systems Research. 1991. 2(3), 173-191.

[21] Lefebvre, L., Harvey, J., dan Lefebvre, E. “Technological experience and the technology adoption decision in small manufacturing firms”. R&D Management. 1991. 21(3), 241-249.

[22] Adeosun, O. O., Adeosun, T. H., & Adetunde, I. A. “Strategic application of information and communication technology for effective service delivery in banking industry”. Journal of Social Sciences. 2009.5(1), 47-51.

[23] Hengst, M., Sol, H.G., “The impact of information and communication technology on interorganizational coordination”, In Proceedings: Hawaii International Conference in System Sciences, Island of Maui, Hawaii. 2001.

[24] Pavic, S., Koh, S.C.L;, Simpson, M.; and Padmore, J. “Could E- business create a competitive advantage in UK SMEs?” Benchmarking: An International Journal. 2007. 14 (3), 320-351.

[25] Yu, C.S. “Exploring influences on Taiwanese e-marketplace adoption decisions”. Journal of Global Information Technology Management. 2006. 9 (2), 5-21.

[26] Wahid, F., Iswari, L. Adopsi Teknologi Informasi Oleh Usaha Kecil dan Menengah Di Indonesia. Seminar Nasional Aplikasi Teknologi Informasi (SNATI), ISSN : 1907-5022, Yogyakarta, 2007

[27] Kartiwi M. & MacGregor R., “Electronic commerce adoption barriers in small to medium-sized Enterprises (sMEs) in Developed and Developing countries: A cross-country comparison”. Journal of Electronic Commerce in Organizations.2007. 5(3): 35-51.

[28] Ghasemzadeh, Fereidoun dan Sahafi, Laleh. “E-Commerce Adoption: A Two Dimensional Maturity Model”, 4th World Congress on the Management of Electronic Business, McMaster University Hamilton. 2003.

[29] Sarkar, Amitrajit. “E-Commerce Adoption and Implementation in Automobile Industry: A Case Study”, World Academy of Science. Engineering and Technology. 2009. Vol.58

[30] Kaynak, E., Tatoglu, E., & Kula, V. (2005). An analysis of the factors affecting the adoption of electronic commerce by SMEs: Evidence from an emerging market. International Marketing Review, 22(6), 623-640.

[31] Abdel Nasser H. Zaied. “Barriers to E-Commerce Adoption in Egyptian SMEs”. I.J. Information Engineering and Electronic Business. 2012, 3, 9-18 Published Online July2012 in MECS (http://www.mecs-press.org/) DOI: 10.5815/ijieeb.2012.03.02

[32] Alshehri M. & Drew S. “Challenges of e-Government Services Adoption in Saudi Arabia from an e-Ready Citizen Perspective”. World Academy of Science, Engineering and Technology. 2010. 66: 1053-1059.

[33] Kshetri N., “Barriers to e-commerce and competitive business models in developing countries: A case study”. Electronic Commerce Research and Applications, 2007, 6: 443–452.

[34] Cloete E., Courtney S., Fintz J. “Small business acceptance and adoption of e-commerce in the Western-Cape province of South- Africa”, Electronic Journal of Information Systems in Developing Countries. 2002. Vol 10, No 4, pp 1–13.

[35] Lawrence J. & Tar U., “Barriers to ecommerce in developing countries”. Information, Society and Justice. 2010, 3(1): 23-35.

[36] Kapurubandara M. & Lawson R. ―Mergence: Merging and Emerging Technologies, Processes, and Institutions‖, 20th Bled e- Conference e-commerce, June 4 - 6, 2007; Bled, Slovenia.

[37] Zaied A., Al-Khairalla F. & Al-Rashed W., ―Assessing e-Readiness in the Arab Countries: Perceptions towards ICT Environment in Public Organizations in the State of Kuwait‖, Electronic Journal of e-Government. 200. 5(1): 77 - 86.

[38] Kinuthia, J. N. K., & Akinnusi, D. M. "The magnitude of barriers facing e-commerce businesses in Kenya". Journal of Internet and Information Systems. 2014. 4(1), 12–27.

[39] Lane M., Vyver G., Delpachitra S. & Howard S. "An electronic commerce initiative in regional Sri Lanka: the vision for the central province, Electronic commerce Portal, Electronic Journal on information systems in Developing countries". 2004. 16(1): 1 – 18.

[40] Looi H., ―A model of factors influencing electronic commerce adoption among small and medium enterprises in Brunei Darussalam. International Journal of information technology. 2003. 10(1): 72- 87

Exploring the Determinants of Viewers' Loyalty toward Beauty YouTubers: A Parasocial Interaction Perspective

Hsiu-Chia Ko
Department of Information Management,
Chaoyang University of Technology,
Taichung, Taiwan, R.O.C.
886-4-23323000
hcko@cyut.edu.tw

Wen-Ning Wu
Department of Information Management,
Chaoyang University of Technology,
Taichung, Taiwan, R.O.C.
886-4-23323000
s10514612@cyut.edu.tw

ABSTRACT

Managing a YouTube channel has become a key strategy for YouTubers to establish personal branding. Popular YouTubers even have the opportunities to work with businesses and create mutual benefits for both sides. However, as the Internet celebrity market becomes more and more competitive, how YouTubers could continue maintain popularity by attracting viewers to revisit their channels regularly and enhancing viewers' loyalty has become a highly important issue that both YouTubers and businesses have to think about. Based on the Parasocial Interaction (PSI) perspective and self-disclosure theory, the aim of this study is to explore the role of PSI in influencing viewers' loyalty toward beauty YouTuber, as well as the determinants of PSI, empirically. The research results show that viewers' perception of beauty YouTubers' self-disclosure, similarity, expertise, and likability are the significant determinants of PSI. Moreover, the PSI can positively boost viewers' loyalty toward beauty YouTubers. Finally, this study also proposes several practical suggestions for Internet celebrities and businesses.

CCS Concepts

• **Information systems → Social advertising.**

Keywords

YouTube; self-disclosure; Parasocial interaction; beauty YouTubers; loyalty.

1. INTRODUCTION

With the emergence of new media platforms, audiovisual media is no longer limited to traditional TV, radio, and CD, etc. The rapid development of mobile devices and mobile network allows the public to have access to digitally mediated information, such as online streaming, digital TV, digital music, and video sharing websites, anywhere and anytime. Take YouTube for example, the number of YouTube users has exceeded 1 billion, which accounts for nearly one third of the entire Internet users in the world. Each day, YouTube users spend hundreds of millions of hours watching videos and accumulate billions of views [1].

In addition, YouTube allows ordinary people with great showmanship to demonstrate their talent and become a YouTuber. They establish individual channels on YouTube and share original user generated content (UGC) produced by themselves. These UGC includes their reviews on a product they have used, videos featuring their personal lives, and their interactions and communication with viewers.

Cases like the emergence of Vloggers and the success of YouTubers offer a link between brands and consumers [2]. Previous studies have shown that content originality has a positive impact on consumers' brand perception, brand selection [3], and attracting new consumer groups [4]. In other words, the UGC shared by YouTubers can affect consumers' shopping perception. Therefore, many popular YouTubers are potential partners, whom businesses or brands may invite to endorse their products. For businesses or brands, how to find YouTubers with a large number of loyal viewers and utilize their influence on enhancing consumers' shopping intention to advertise their produces is a vital issue. Similarly, as for the YouTubers, how to continue attract viewers to revisit their channels and enhance their loyalty in order to acquire more endorsement opportunities is also an important question.

Among the numerous types of celebrity YouTubers, beauty YouTubers are highly popular among female YouTube users. Beauty YouTubers share their experiences and opinions in the use of beauty products on their YouTube channels through audiovisual presentations. They also interact with viewers who leave comments on their videos. This type of interactions between beauty YouTuber and their viewers help the establishment of a positive relationship between both sides, which can be seen as a Parasocial Interaction (PSI).

PSI was first proposed by Horton and Wohl [5], who used the concept to illustrate the imagined relationship between performers and audiences. When the audience is watching a TV show, they feel that they are interacting with the performers as if they were friends. The audience perceives having an actual relationship with the performers. Previous studies have shown that in the case of interactive behaviors on social media, PSI can be applied as an indicator of the relationship between media consumers and producers [2, 6, 7]. Similarly, through watching UGC videos, viewers can develop a virtual relationship with YouTubers, which make them feel that they share a friendship-like relationship with YouTubers. As a result, the viewers are more likely to demonstrate their loyalty toward YouTubers due to their imagined close friendship.

In addition, exploring what factors would enhance viewers' perception of PSI with beauty YouTubers, thereby reinforcing

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.
ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124130

viewers' loyalty is also imperative. Xiang et al. have pointed out that similarity, likability, and expertise can affect PSI and expand Internet celebrities' influence on viewers [9]. Compared to TV stars, Internet celebrities appear to be friendlier and approachable to viewers. In the case of YouTube, viewers can subscribe to channels of YouTubers, with whom they share similar worldviews, backgrounds, or interest. They can watch beauty YouTubers' videos and leave comments. These types of interactions with beauty YouTubers can enhance viewers' perception of YouTubers' likability, similarity, and expertise.

Moreover, beauty YouTubers share their experiences and opinions of using beauty products and their lives with viewers through audiovisual items can be seen as a form of self-disclosure. Altman and Taylor have proposed the theory of Social Penetration Therapy (SPT) and argued that self-disclosure plays a key role in the development of close interpersonal relationships [10]. Therefore, apart from viewers' perception of beauty YouTubers' likability, similarity, and expertise, this study also investigates the impact of viewers' perception of beauty YouTubers' self-disclosure on their perception of PSI.

Given that Internet celebrities are a fairly new phenomenon; little research has been done on how Internet celebrities maintain viewers' loyalty. To fulfill this gap, the aim of this study is to explore the impacts of viewers' perception of YouTubers' self-disclosure, likability, similarity, and expertise on their perception of PSI with YouTubers, as well as further explore the influence of PSI on viewers' loyalty based on the PSI perspective and self-disclosure theory empirically. We use beauty YouTubers as the research subject. The research findings can help YouTubers understand what factors help earn viewers' loyalty. Also, the findings can be used as the criteria for businesses or brands in the search for their partnership with beauty YouTubers.

2. PARASOCIAL INTERACTION (PSI)

PSI was first proposed by Horton and Wohl in 1956 to explore the interactive relationship between audiences and performers. PSI is developed from an imagined friendship between audiences and performers [11]. Traditional PSI research focuses mostly on the relationship between radio broadcasting and listeners [12, 13, 26]. Recent studies have applied PSI to other areas, such as blogs [14], sports [15], TV shopping [16], and the Internet [17], where ideas are expressed to audiences with or without language [18] and the audiences feel they have become "true" friends with media figures [8].

Voluntary, provide companionship, and social attractiveness are the three main characteristics of PSI which are important in establishing interpersonal friendships [19]. PSI mainly occurs to group members who share similar backgrounds and interest [20]. As the PSI develops, audiences and performers maintain their relationship through more frequent interactions [21].

In online setting, Lauren I. Labrecque argued that the development of PSI should not be limited to traditional media; rather, through the features of design, online environments can facilitate the development of PSI between audiences and media figures [18]. For example, social media has become an indispensable tool for celebrities to reinforce their relationships with fans [19]. Given that YouTube is a representative of social media, using PSI perspective to explore the extent of viewers' perception of their relationship with beauty YouTuber is appropriate.

3. RESEARCH MODEL AND HYPOTHESES

3.1 Research Model

Although audiovisual platforms have become an important channel for businesses, brands, and Internet celebrities to share and distribute information to viewers, the effects of using an online audiovisual channel to maintain relationship with fans is unclear. Therefore, this study uses self-disclosure and PSI as the theoretical foundation to explore the determinants of viewers' perception of PSI with beauty YouTubers and their loyalty. The research model is portrayed in Figure 1.

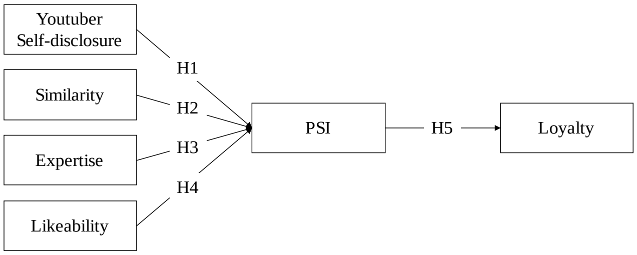


Figure 1. Research model

3.2 Hypotheses

3.2.1 The impact of YouTubers' self-disclosure on PSI

Self-disclosure refers to share an individual's own information and interact with others. The information can be personal information, feelings, interest, photos, experiences, etc. [24]. Altman and Taylor point out that self-disclosure plays a key role in building intimate interpersonal relationships [10]. In addition, Rimé [25] argued that in the development of a relationship, self-disclosure can maintain and strengthen the closeness of the relationship. Auter [26] revealed that media figures' self-disclosure is positively related to PSI.

Similarly, beauty YouTubers share their experiences of using beauty products and their lives on their personal channels, and viewers interact with YouTubers by leaving comments, may lead viewers to imagine that they share a real friendship with the beauty YouTubers. In other words, YouTubers' self-disclosure may enhance viewers' perception of PSI with YouTubers. Therefore, this study proposes the following hypothesis:

H1: Beauty YouTubers' self-disclosure has a positive impact on viewers' perception of PSI.

3.2.2 The impact of Social relationships characteristics on PSI

Xiang et al., in their study of consumers' impulse buying on social media, have pointed out that similarity, likability, and expertise are the three characteristics of social relationships [9]. Social relationships are a main factor affecting user behavior and interpersonal relationships [9]. Similarity refers to the degree in which individuals perceive similar beliefs, education, social status, and interest from the person they interact with [27]. Individuals tend to frequently interact with those they share a high degree of similarity with, and they confirm their own beliefs through these interactions [28]. Many studies have confirmed that there is a positive relationship between similarity and PSI [9, 20, 28]. In the YouTube context, viewers who interested in beauty and cosmetics may more likely to watch beauty related videos channels. As a result, they can easily identify they have similar interest, beliefs, and attitudes with beauty YouTubers. In this regard, the viewers may imagine that they share a physical friendship with the YouTubers due to their similarity.

Expertise has been defined as "authoritativeness," "competence," or "qualification," all of which indicate the amount of knowledge an individual has about a domain [9]. Kelman indicated that experts' opinions are more trustworthy and more reliable than those of non-experts [29]. Previous studies have shown that consumers tend to prefer products that bloggers have approved, or they ask for professional opinions from bloggers [30]. Likewise, through watching videos shared by beauty YouTubers or interacting with them, the viewers' could evaluate the YouTubers' expertise, which in turn may lead to the development of PSI between viewers and beauty YouTubers.

Likability is defined as individuals developing a good impression on someone they like in a natural way [31]. When meeting a person for the first time, individuals usually determine that person's social worth and evaluate if they want to establish further relationships with the person. Individuals tend to accept information distributed by people with great likability. In this study, viewers can determine a beauty YouTuber's likability from the number of "likes" and subscriptions this YouTuber has received. When they watch the videos shared by YouTubers with high likability, they may feel that they build a physical relationship with YouTubers.

Therefore, this study proposes the following hypotheses:

H2: Similarity that viewers perceive from beauty YouTubers has a positive impact on perceived PSI.

H3: Expertise that viewers perceive from beauty YouTubers has a positive impact on perceived PSI.

H4: Likability that viewers perceive from beauty YouTubers has a positive impact on perceived PSI.

3.2.3 The impact of PSI on loyalty

Loyalty is considered an essential component in binding relationships [32]. Oliver defined loyalty as consumers repeating buying the same type of product and using a certain type of service [22]. Min-Seong Kim et al. defined loyalty as something closely related to fans and celebrities. Before purchasing a product, fans would check the product's reputation and celebrities' suggestions [23]. When people feel attached to a group, they tend to generate positive feelings toward members of the group [33], interact with the members, and become loyal to them. Labrecque has proven that PSI has a positive impact on loyalty [18]. Kim et al. also prove that the relationship between community members and celebrities can affect loyalty [23].

Similarly, the viewers' perception of PSI with beauty YouTubers and their perception of interaction with the YouTubers can be a factor leading viewers to continue visit the YouTubers' channels and boost their loyalty. Therefore, this study speculates the following hypothesis:

H5: The PSI viewers perceive has a positive impact on their loyalty of beauty YouTubers.

4. RESEARCH METHOD AND DATA ANALYSIS

4.1 Instrument and Subject

This study adopted an online survey method to collect data, with female users who had followed beauty YouTubers' channels as the research subjects. The questionnaire was setup on a Survey Cake online survey platform (https://www.surveycake.com/). The items used in this study were all adapted from previous studies and some minor changes were done to fit the research setting. A 7-Point Likert Scale range from (1) strongly disagree, to (7) strongly agree was used to measure each item. A pretest was also conducted to confirm the content validity of instrument.

A total number of 274 valid samples were collected. All the samples were filled out by female users. The majority of the respondent were college-educated (n = 223, 81.4%). Users aged from 19 to 22 years composed the largest group (n = 127, 46.4%). On average, they visited their favorite YouTube channel every three to four days and spent 30 minutes on the channel per visit.

4.2 Instrument Reliability and Validity

This study uses average variance extracted (AVE) and composite reliability (CR) to measure the convergent validity. Because self-disclosure in this study was operationalized as a formative second-order construct, its AVE and CR were not portrayed in Table I. Table I also shows that AVE of each construct is greater than 0.5 and CR of each construct is greater than 0.7, indicating that the instrument meet the requirement of convergent validity [34].

In addition, Table II shows that all the square root of AVE is greater than the correlation coefficient of each construct, indicating that the measurement confirms the requirement of discriminant validity [34].

Table 1. The mean, standard deviation, AVE, and CR of each construct

Construct	Mean	Standard Deviation	AVE	CR
Y-SD^f	5.234	1.439	-	-
SIM	5.538	1.084	0.801	0.924
EXP	5.887	0.998	0.812	0.928
LIK	6.279	0.769	0.776	0.912
PSI	5.476	1.076	0.532	0.819
LOY	5.401	1.222	0.590	0.896

Note: Y-SD: YouTubers' Self-disclosure; SIM: Similarity; EXP: Expertise; LIK: Likability; PSI: Parasocial Interaction; LOY: Loyalty; ^{f} is a formative construct.

Table 2. The square root of AVE and correlation coefficient of each construct

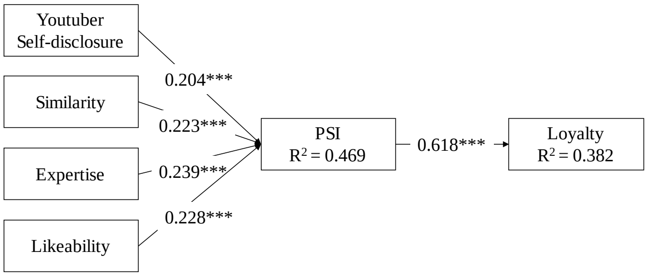
Construct	Y-SD	SIM	EXP	LIK	PSI	LOY
Y-SD^f	-					
SIM	0.300	**0.895**				
EXP	0.443	0.440	**0.901**			
LIK	0.441	0.417	0.624	**0.881**		
PSI	0.477	0.484	0.570	0.560	**0.729**	
LOY	0.535	0.397	0.483	0.514	0.618	**0.768**

Note: Numbers in bold type and diagonal direction are the square root of AVE; ^{f} is a formative construct.

4.3 Model and Hypotheses Testing

A Partial Least Squares (PLS) was used to test the research model. This study sets the number of bootstrapping as 500 samples, which was suggested by Chin [35].

Figure 2 shows the model test result. The results illustration that beauty YouTubers' self-disclosure ($\beta = 0.204$, $p < 0.001$), similarity ($\beta = 0.223$, $p < 0.001$), expertise ($\beta = 0.239$, $p < 0.001$), and likability ($\beta = 0.228$, $p < 0.001$) are significant predictors of viewers' perception of PSI, explaining 46.9% of the variation. Therefore, H1, H2, H3, and H4 are supported. Moreover, viewers' perception of PSI ($\beta = 0.618$, $p < 0.001$) positively affect viewers' loyalty toward beauty YouTubers, which explains the 38.2% of the variation. Thus, H5 is supported.



Note: * $p < 0.05$, ** $p < 0.01$, ***$p < 0.001$; ^{f} is a formative construct

Figure 2. Verification of the research model

5. CONCLUSION AND DISCUSSION

This study explores how beauty YouTubers' self-disclosure and viewers' perception of similarity, expertise, likability from the YouTubers affect their perception of PSI with YouTubers. Meanwhile, this study explores how the PSI influences viewers' loyalty. The results show that beauty YouTubers' self-disclosure, similarity, expertise, and likability all have a significant impact on the PSI, thereby positively enhancing viewers' loyalty toward the beauty YouTubers. Based on the research findings, we propose the following discussions:

5.1 Viewers' Perception of Beauty YouTubers' Self-disclosure and the Social Relationship Characteristics

Table I shows that the mean values of viewers' perception of beauty YouTubers' self-disclosure, similarity, expertise, likability, and PSI are all greater than 5.2. This implies that through watching video on beauty YouTubers personal channels, viewers can perceive the similarity between themselves and the YouTubers, the beauty YouTubers' expertise in beauty products, as well as their likability. Even more, viewers can build a close relationship akin to an actual friendship with YouTubers. The interrelationships among these factors were then discussed below.

5.2 The Impact of PSI on Loyalty

This study revealed that viewers' perception of beauty YouTubers' expertise is the most crucial factor determining the PSI, followed by likability and similarity. In other words, if viewers find the beauty YouTuber has a high degree of expertise, is liked by more viewers, and shares a high level of similarity with themselves, they are more likely to feel they share a friendship-like relationship with the YouTuber.

In addition to similarity, expertise, and likability, beauty YouTubers' self-disclosure plays a key role in determining the perceived PSI between viewers and beauty YouTubers. Unlike previous studies mostly focused on the impact of beauty bloggers or how features of social media affect viewer loyalty, this study further considered how the video type of self-disclosure on YouTube affects viewers' perception of PSI. The research results revealed that video type of self-disclosure can also effectively increase viewers' perception of PSI with beauty YouTubers. The beauty YouTubers' self-disclosure discussed in this study includes both beauty information and personal information. Therefore, when beauty YouTubers share professional information about cosmetics and beauty, such as their experiences and skills of using products, they can also share some aspects of their personal lives. This can help shorten the distance between viewers and the YouTubers, establishing and maintaining a close relationship with viewers.

Finally, this study revealed that PSI is an important factor in boosting viewers' loyalty toward beauty YouTubers. This means that through friendship-like relationship established and maintained between viewers and YouTubers, YouTubers can thus earn trust from viewers, which in turn enhances viewers' willingness toward recommending and sharing the channels to their circle, repeating to visit their channels, and accepting and following their suggestions to purchase beauty products.

5.3 Suggestions

This study proposes the following suggestions for beauty YouTubers, which help them to raise viewers' perceived PSI and draw viewer loyalty.

First, the research findings revealed that viewers' perception of beauty YouTubers' self-disclosure has a positive impact on their perceived PSI. Therefore, this study suggests apart from sharing their experiences and skills of using beauty and cosmetics products, beauty YouTubers can share some of their personal information in their videos to strengthen the viewers' perception of PSI.

Second, the research findings also showed that viewers' perception of similarity between beauty YouTubers and themselves has a positive impact on their perception of PSI. This study thus suggests beauty YouTubers should maintain qualities and attributes they already have. It is not ideal to change their qualities and attributes simply for following market demands.

Third, the research findings demonstrated that viewers' perception of beauty YouTubers' expertise has a positive impact on their perceived PSI. Therefore, this study suggests that beauty YouTubers have to continue to learn new beauty skills and knowledge, enrich their expertise, and maintain their professional image.

Fourth, the research findings showed that viewers' perception of beauty YouTubers' likability has a positive impact on their perceived PSI. Therefore, this study suggests that beauty YouTubers should infer and learn viewers' preferences by analyzing what kinds of materials are watched most frequently and what kinds of comments leaved by viewers were discussed most often. They can produce more videos related to the themes, which can help to attract more viewers and enhance their numbers of subscriptions.

Finally, the study revealed that beauty YouTubers have the potential ability to attract a large number of followers and even have the power to affect their purchase decision making. Therefore, this study suggests that businesses and brands could consider building partnership with beauty YouTubers. This can help them reduce endorsement cost and boost their product exposure, creating a win-win beneficial situation for both businesses and beauty YouTubers.

6. ACKNOWLEDGMENT

This research was supported by the National Science Council of Taiwan, Republic of China, under grant MOST MOST 105-2410-H-324-004.

7. REFERENCES

[1] YouTube. http://www.youtube.com.

[2] Lee, J. E. and Watkins, B. 2016. YouTube vloggers' influence on consumer luxury brand perceptions and intentions. *Journal of Business Research*. 69, 12, 5753-5760.

[3] Gruen, T. W., Osmonbekov, T., and Czaplewski, A. J. 2006. eWOM: The impact of customer-to-customer online know-how exchange on customer value and loyalty. *Journal of Business Research*. 59, 4, 449-456.

[4] Trusov, M., Bucklin, R. E., and Pauwels, K. 2009. Effects of word-of-mouth versus traditional marketing: Findings from an Internet social networking site. *Journal of Marketing*. 73, 5, 90-102.

[5] Horton, D. and Wohl, R. R. 1956. Mass communication and para-social interaction: Observations on intimacy at a distance. *Psychiatry*. 19, 215-229.

[6] Rubin, A. M., Perse, E. M., and Powell, R. A. 1985. Loneliness, parasocial interaction, and local television news viewing. *Human Communication Research*. 12, 2, 155-180.

[7] Grant, A. E., Guthrie, K. K., and Ball-Rokeach, S. J. 1991. Television shopping a media system dependency perspective. *Communication Research*. 18, 6, 773-798.

[8] Stern, B., Russell, C. A., and Russell, D. 2007. Hidden persuasions in soap operas: Damaged heroines and negative consumer effects. *International Journal of Advertising*. 26, 1, 9-36.

[9] Xiang, L., Zheng, X., Lee, M. K. O., and Zhao, D. 2016. Exploring consumers’ impulse buying behavior on social commerce platform: The role of parasocial interaction. *International Journal of Information Management*. 36, 3, 333-347.

[10] Altman, I., and Taylor, D. A. 1973. Social penetration: The development of interpersonal relationships. New York: Holt, Rinehart and Winston.

[11] Tsiotsou, R. H. 2015. The role of social and parasocial relationships on social networking sites loyalty. *Computers in human behavior*. 48, 401-414.

[12] Hoffner, C. 1996. Children’s wishful identification and parasocial interaction with favorite television characters. *Journal of Broadcasting & Electronic Media*. 40, 3, 389-402.

[13] Skumanich, S. A. and Kintsfather, D. P. 1998. Individual media dependency relations within television shopping programming: a causal model reviewed and revised. *Communication Research*. 25, 2, 200-219.

[14] Colliander, J. and Dahler, M. 2011. Following the fashionable friend: The power of social media. Weighing publicity effectiveness of blogs versus online magazines. *Journal of Advertising Research*. 51, 1, 313-320.

[15] Sun, T. 2010. Antecedents and consequences of parasocial interaction with sport athletes and identification with sport teams. *Journal of Sport Behavior*. 33, 2, 194-217.

[16] Lim, C. M. and Kim, Y. K. 2011. Older consumers’ TV home shopping: Loneliness, parasocial interaction, and perceived convenience. *Psychology and Marketing*. 28, 8, 763-780.

[17] Kassing, J. W. and Sanderson, J. 2009. You’re the kind of guy that we all want for a drinking buddy: Expressions of parasocial interaction on Floydlandis.com. *Western Journal of Communication*. 73, 2, 182-203.

[18] Labrecque, L. I. 2014. Fostering consumer–brand relationships in social media environments: The role of parasocial interaction. *Journal of Interactive Marketing*. 28, 2, 134-148.

[19] Ballantine, P. W. and Martin, B. A. S. 2005. Forming para-social relationships in online communities. *Advances in Consumer Research*, 32, 197-201.

[20] Turner, J. R. 1993. Interpersonal and psychological predictors of parasocial interaction with different television performers. *Communication Quarterly*. 41, 443-453.

[21] Grant, A. E., Guthrie, K. K., and Ball-Rokeach, S. J. 1991. Television shopping: A media system dependency perspective. *Communication Research*. 18, 773-798.

[22] Oliver, R. L. 1999. Whence consumer loyalty. *Journal of Marketing*. 63, 4, 33-44.

[23] Kim, M. S. and Kim, H. M. 2017. The effect of online fan community attributes on the loyalty and cooperation of fan community members: The moderating role of connect hours. *Computers in Human Behavior*, 68, 232-243.

[24] Liu, Z., Min, Q., Zhai, Q., Smyth, R., and Margulis, S. T. 2016. Self-disclosure in chinese micro-blogging: A social exchange theory perspective. *Information & Management*. 53, 1, 53-63.

[25] Rimé, B. 2007. Self-disclosure. *Encyclopedia of Mental Health*. 4, 66-74.

[26] Auter, P. J. 1992. Psychometric: TV that talks back: an experimental validation of a parasocial interaction scale. *Journal of Broadcasting & Electronic Media*. 36, 2, 173-181.

[27] Rogers, E. M. and Bhowmik, D. K. 1970. Homophily-heterophily: relational concepts for communication research. *Public Opinion Quarterly*. 34, 4, 523-538.

[28] Eyal, K. and Rubin, A. M. 2003. Viewer aggression and homophily, identification, and parasocial relationships with television characters. *Journal of Broadcasting and Electronic Media*. 47, 1, 77-98.

[29] Kelman, H. C. 1961. Processes of opinion change. *Public Opinion Quarterly*. 25, 1, 57-78.

[30] Cowles, D. L., Kiecker, P., Little, M. W. 2002. Using key informant insights as a foundation for e-retailing theory development. *Journal of Business Research*. 55, 8, 629-636.

[31] Fiske, S. T., and Neuberg, S. L. 1990. A Continuum of Impression Formation, from Category-Based to Individuating Processes: Influences of Information and Motivation on Attention and Interpretation. *Advances in Experimental Social Psychology*, 23, 1-74.

[32] Rusbult, C. E. and Hildebrand, T. 1987. Responses to dissatisfaction in close relationships: The exit–voice–loyalty–neglect model. In Perlman, D. and Duck, S. (Eds.), *Intimate relationships: Development, dynamics, and deterioration*. 209-237, 1987.

[33] Trepte, S. 2006. Social Identity Theory. In Bryant, J., Vorderer, P. (Eds.), *Psychology of entertainment*. 255-271. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

[34] Fornell, C. 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*. 18, 1, 39-50.

[35] Chin, W. W. 1981. The partial least squares approach to structural equation modeling. *Journal of Marketing Research*. 18, 1, 39-50.

The Influence of ERP System to the Company Performance Seen through Innovation Process, Information Quality, and Information Sharing as the Intervening Variables

Widjojo Suprapto
Lecturer Business Management
Faculty of Economics
Petra Christian University
Siwalankerto 121-131,
East Java Indonesia
+62312983242
joe.suprapto@petra.ac.id

Zeplin Jiwa Husada Tarigan
Lecturer Master of Management
Faculty of Economics
Petra Christian University
Siwalankerto 121-131,
East Java Indonesia
+62312983244
zeplin@petra.ac.id

Sautma Ronni Basana
Lecturer Financial Management
Faculty of Economics
Petra Christian University
Siwalankerto 121-131,
East Java Indonesia
+62312983244
sautma@petra.ac.id

ABSTRACT

Enterprise Resource Planning (ERP) system is an integrated information technology that combines all departments in a company with a single data entry. The ERP system is used to obtain quality information so that the head of the companies can easily make decisions accurately and timely. The information is also distributed among all related departments through sharing information. The quality information can improve the innovation process and company performance. Based on the questionnaires distributed to manufacturing companies in East Java and the data processed by SEM PLS, there are several conclusions. First, the ERP directly influences the information sharing but does not significantly influence the information quality. Second, innovation sharing influences directly the information quality and innovation process, but it does not give impacts to the operational performance. Third, the innovation quality has an impact on the innovation process and the operational performance. Fourth, the innovation process has a positive and significant impact directly to the operational performance

CCS Concepts

Information systems → Enterprise resource planning.

Keywords

Keywords: ERP system, information sharing, information quality, innovation performance, and operational performance.

1. INTRODUCTION

The Enterprise Resource Planning (ERP) system is an important tool for business process planning, information flow, execution and controlling a company's resources which are financial, material, equipment, and human resources [1]. The main objective of ERP is to integrate wide range resource information to synergize business partners, customer needs, and company performances. It can be defined as the integrated solution between business process and management functions. Meanwhile, the ERP system can be defined as a package of business software that enables a company to automate and integrate major business processes and to share data in the whole company in order to create and access information in each department in real time, and the data input is done only one time to maintain the accuracy, which becomes the objective of installing ERP system. Information sharing is an important issue in many companies. The importance of information sharing is needed to maintain the accuracy and the completeness of good information [2]. In doing the information sharing among the supply chain partners, it gives many benefits to the management of information, from the information of logistics to financial returns and product turn-over. The concept of collaboration in the research of Jones et al. [3] reveals that the knowledge and information owned by companies do not guarantee the creation of innovation. Research conducted by Bassellir and Benbasat [4] states that the implementation of information technology will increase the competency of a company, therefore the innovation process can run smoothly as it gives spaces for adaptation to increase the business practice of the company. The company performance improvement with the ERP system can influence the business process of a company because all internal and external I formation needed by the company can be accessed with the integrated system so the departments can easily exchange and share the information accurately and fast [5]. Finally, information sharing and information quality become the main keys for the competitive advantage of the companies. Information sharing becomes one factor that enables the company performance can run smoothly [6].

This research is conducted after some observations on the ERP implementation in manufacturing companies in East Java, Indonesia, where the implementation of ERP is decided by the top management without the consent from the middle managers. Most of the time, the middle managers are forced to implement the ERP system without knowing the bigger process or scheme, but they have to obey to the high level managers, especially in preparing the shared data. The head of departments or the middle managers still mostly do the report manually, and often rely heavily on the manual reports than the ERP system. This condition will delay the

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICEMT'17, July 9-11, 2017, Singapore, Singapore.
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
DOI: https://doi.org/10.1145/3124116.3124131

operational processes, which affect the innovation process as well. Synchronizing data among departments can be troublesome because the quality of the data are poorly managed. With the implementation of ERP in many manufacturing companies, the middle managers are forced to synchronize the data so that other departments can make use of the data. The process of synchronization gradually improves the quality of the data, which later on helps the top management to make decisions in innovating new products. Therefore, this research is going to investigate the influence of ERP system to the company's performance which is seen through the innovation process, the information quality, and the information sharing as the intervening variables.

2. THEORETICAL BACKGROUND

2.1 Information Sharing

The flow of information is always related to the movement of information or data in each department in a company. The information can be in the forms of data, information, and knowledge. Sharing information becomes the key factor in an internal organization to maintain its competitiveness. The understanding of information sharing can increase the competitiveness and the profitability of the company. Research in supply chain management states that the information flow is very crucial for the organization, because it is related to the information movement or data among members, including top management, and even when needed, to the business partners within the supply chain[6]. There are some indicators for information sharing that can be used, such as discussion among departments in a company [6], sharing knowledge among departments [5], [6] and data integration among departments [7].

2.2 Information Quality

Information quality is a measurement of the value of the existing needs which has been set up through the organized and processed data so that it can create a useful information for the users. The existing information is not always useful for the users. The information must be selected and evaluated according to the needs of the users. Li and Lin [8] state that the quality information is the information that complies these aspects: accuracy, completeness, timeliness, and relevance.

2.3 Innovation Process

Obeidat et al. [9] state that innovation is an introduction to a new configuration of the important production factors to the production system. The capital innovation is the company competency and R&D implementation in carrying out new technology and new products to fulfill the market needs, in which it includes new products, new technologies, new markets, new materials, and new combinations.

According to Gloet and Teriovski [10], innovation can be described as an implementation of the innovation, and intervene the findings to the company's operational processes to generate new products and systems. Plessis [11] considers innovation as a creation of new knowledge and ideas which are implemented to generate new business. It aims to improve the company's internal business processes and corporate structure and to create new markets for goods and services. Innovation process is the implementation of new things in the framework of the company's operations that include the improvement of product quality and new methods in delivering processes (including technical, methods, and software changes), the changes and improvements in order to enhance the quality of the goods or services from the manufacturing processes or logistic system, the dismissal of existing processes, or simple replacement or extension that provides some results in the form of the price, customization, seasonal trends, and other changes. Indicators that can be used to measure the innovation process are the introduction of new processes, the use of new technologies, and the ease of using the technology.

2.4 Operational Performance

Simatupang and Sridharan [12] outline three criteria in measuring the operating performance of a company within the supply chain; among others are fulfillment, inventory, and responsiveness. Fulfillment serves to identify the ability of a company to meet the customer demands in terms of the promptness of the delivery time, the accuracy of the requested product specifications, and the conformity of the quantity of demanded goods. Inventory means to identify the ability of a company to perform inventory management that includes the inventory turnover rate, the reduction in inventory quantity, and the reduction of the inventory costs. Responsiveness serves to identify the ability of a company to respond to the customer demands which includes the reduction of the waiting time, the flexibility in accommodating the demand, and the sensitivity to the customer demand. According to Melville et al. [13], the company's performance is a measure of the company's success both financial and nonfinancial. Operational performance is a measurable aspect of the results of the organization process that determines the size of the business scope. Operational performance is measured through five indicators, such as cost reduction, cycle time reduction, productivity improvement, quality management, and customer service improvement [14].

2.5 Conceptual Framework and Hypothesis

Ince et al., [1] write that the ERP system in a wider scope has an influence on the performance of the company, and the ERP system also has an influenced on the information sharing [15]. ERP system is a system that cans automatically interaction the company with its suppliers and customers along with updates information exchanges so that it can increase the efficiency in procurement and customer relationships [14]. In the end, the ERP system provides some good business innovations. The achievement of the company performance obtains some innovation processes through information sharing and information quality that has been implemented in the company using the ERP system (Figure 1).

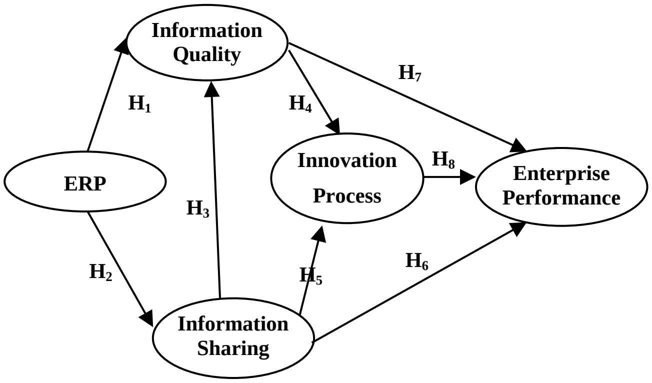


Figure 1. The research conceptual framework

Based on Figure 1. several hypotheses are constructed as follows:

H_1: the implementation ERP system influences the information quality.

H_2: the implementation ERP system influences the information sharing.

H_3: the information sharing influences the information quality.

H_4: the information quality influences the innovation process.

H_5: the information sharing influences the innovation process.

H_6: the information sharing affects the company performance.

H_7: the information quality affects the company performance.

H_8: the innovation process affects the company performance.

3. RESEARCH METHOD

The research is a quantitative research to investigate the causal relationship between independent variables with dependent variables, and dependent variables with other dependent variables. The population of this research is the manufacturing companies in East Java, Indonesia. The respondents are the key users in the companies. The definition of the key users is someone working in a project team and having access in making changes directly on the working procedures in the section or department. Besides, the key users are a person chosen to be the coordinator or project manager who uses the data from the ERP system. To collect the data, questionnaires are distributed to manufacturing companies by visiting each company's ERP key users or departmental managers. After the data are collected, they are analyzed using the SEM PLS with the calculation process assisted by application software Smart PLS [16]. From the returned questionnaires, there are 103 valid questionnaires that can be further processed.

4. FINDING AND DISCUSSION

The evaluation is conducted by using software Smart PLS. The path analysis in PLS describes the relationship between latent variables and indicators within the outer model. The evaluation of the structural models (inner model) is conducted to determine the relationship between variables. Ooutputs from the hypothesis testing is as follows in Table 1.

Table 1. The relationships between variables Inner Model

	original sample estimate	mean of subsamples	Standard deviation	T-Statistic
ERP -> IQ	0.116	0.130	0.125	0.928
IS -> IQ	0.684	0.693	0.102	6.698
ERP -> IS	0.453	0.475	0.096	4.692
IQ -> IP	0.281	0.289	0.089	2.132
IS -> IP	0.225	0.335	0.104	1.883
IQ -> OP	0.363	0.398	0.203	1.989
IS -> OP	-0.107	-0.106	0.193	0.557
IP -> OP	0.507	0.102	0.077	2.252

Based on the results of the data processing shown in Table 1. above, it is obtained the following results. The first hypothesis is accepted, that is ERP having an influence on information sharing with the value of t-statistic (4.692) > 1.65, and the estimated value of direct effect is .453. This is due to the implementation of ERP enabling the company to integrate various data among departments and other departments to utilize various shared data to make decisions. This research supports research by Omar et al., [2] which states that the information sharing requires IT as important tools in manufacturing industries.

The second hypothesis is rejected because there is no influence between ERP and information quality with the value of t-statistic (.928) < 1.65 and the estimated value direct effect is .116. This is due to the fact that ERP in the company is associated with the design of business process and standard operating procedures that are apparently not able to operate well in the whole departments. Sometimes, data are entered into the ERP system with incorrect data, and it is not at the time, and they are integrated with other data in the system which causes wrong analysis. As a result, the data cannot be used by the management to make any decisions. This result, however, is different from research by Omar et al., [2] which states that information quality requires IT in order to get a proper report or analysis requested by the management.

The third hypothesis is accepted as there is a positive and significant influence of information sharing on information quality in manufacturing companies with the value of t-statistic (6.698) > 1.65 and the estimated value of direct effect is .684. The information sharing built by manufacturing industries in East Java is always conducted on the first day of the working week by gathering all department heads who are related to the ERP implementation. In the meeting, they discuss the implementation problems occurred in the previous week. Then the IT department, as the responsible Department in implementing ERP, will explain the interconnected data and the interconnected synchronization so that each related department can fix the data in the ERP system. All department heads will follow up the result of the meeting by revising the wrong data and preventing the similar mistakes by following the already established procedures in the company. This research supports a research done by Marinagi et al. [17] which states there is a positive influence on the information quality on information sharing. This result also supports research by Omar et al., [2] who states that the information sharing and information quality are used together in implementing supply chain management.

The fourth hypothesis is accepted as there is a positive and significant influence between information quality and innovation process with the value of t-statistic (2.132) > 1.65 and the estimated value of direct effect is .281. This happens because the information quality can accelerate innovation processes, especially in creating new business ideas, in manufacturing companies. In this research, information quality covers the data accuracy, data completeness, and data appropriateness. This research is in accordance with the research by Srivardhanna and Pawlowski [18] which reveals that the implementation of ERP from the knowledge-based perspective brings an impact to the sustainability of the business innovation process, especially in implementing new ideas within an organization and in adopting new systems for the operational department.

The fifth hypothesis is accepted as the information sharing gives a positive and significant influence to the innovation process with the value of t-statistic (1.883) > 1.65, and the estimated value of direct effect is .225. This happens because the innovation process will run well if there is some information sharing among departments in a company. The company always conducts coordination and information sharing weekly to ensure the synchronization among departments. This research supports research by Tarafdar and Gordon [19] which describes the cross-functional project teams in doing the collaboration with information sharing to increase the innovation process. This collaboration is achieved through the sharing of project plans and project performance. This research is also in accordance to research by Lotfi et al. [20] that mentions information sharing in a company, within the scope of supply chain management, improving the performance and efficiency of the manufacturing companies.

The sixth hypothesis is rejected because the information sharing has a negative influence and no significant to the operational performance with the value of t-statistic of (.557) < 1.65 and the estimated value of direct effect is -.107. This happens because many key users are distributing the shared data to various departments which still process the data manually. Besides, there are many key users who are not able to comprehend the integrated data because the ERP system is relatively new for manufacturing companies. This result of the research differs from research by Marinagi et al., [17] which states that the information sharing significantly influences the supply chain performance.

The sevenths hypothesis is accepted as the information quality has a positive and significant impact on the operational performance with the value of t-statistic (1.989) > 1.65 and the estimated value of direct effect is .363. This is due to the availability of accurate data and precise time helps the company top managers make an appropriate decision for business development. This research supports the result of Li and Lin (2006) which states that information quality contributes to customer satisfaction. This research also supports research by Marinagi et al., [17] which describes that information quality significantly influences the supply chain performance.

The eighth hypothesis is accepted because the innovation process has a positive and significant impact on the operational performance with the value of t-statistic (2.252) > 1.65 and the estimated value of direct effect is .507. This is due to the innovation of the company that brings satisfaction to the consumer, good product quality, and precise delivery time. This result supports research by Jackson et al., (2016) [21] which mentions that the innovation of the company on goods and processes have a positive impact on the company performance.

5. CONCLUSION

Based on the results of the data processing and analysis, there are several conclusions as follows:

1. The ERP implementation can increase the information sharing in the manufacturing companies in East Java.
2. The implementation of ERP in the companies has not yet improved significantly the information quality because many data entries submitted by the key users are incomplete and late.
3. The information sharing can improve the information quality because there are some data rechecking processes by other departments which use the same data.
4. The information quality brings positive impacts to the innovation process as the needed information can be obtained fast and complete in the company.
5. The information sharing also brings positive impacts to the innovation process because there are meetings and discussions to synchronize the sharing knowledge among departments.
6. The information sharing, however, does not influence directly and significantly to the company performance because the information sharing among departments is still in the stage of synchronizing the data, and not yet in the stage of utilizing and collaborating the data among departments.
7. The information quality gives a direct impact on the company performance in East Java because the accurate, complete, on time data improves the proper decision making in cost reduction, cycle time reduction, productivity improvement, quality management, and customer service improvement.

6. REFERENCES

[1] *Social and Behavioral Sciences*. 99, 1124–1133. Ince, H., Imamoglu, S. Z., Keskin, H., Akgun, A., and Efe, M. N. 2013. The Impact of ERP Systems and Supply Chain Management Practices on Firm Performance: Case of Turkish Companies. *Procedia* http://doi.org/10.1016/j.sbspro.2013.10.586

[2] Omar, R., Ramayah, T., Lo, M. C., Sang, T. Y., and Siron R. 2010. Information sharing, information quality, and usage of information technology (IT) tools in Malaysian organizations. *African Journal of Business Management*. 4, 12 (Sept. 2010), 2486-2499.

[3] Jones, J. L. S., and Linderman, K., 2014. Process management, innovation and efficiency performance: The moderating effect of competitive intensity. *Business Process Management Journal*. 20, 2, 335-358, doi:10.1108/BPJM-03-2013-0026.

[4] Bassellir, G. and Benbasat, I. 2004. Business competence of information technology professionals: Conceptual development and influence on IT-business partnerships, *MIS Quarterly*. 28, 4 (Dec. 2004), 673-694.

[5] Leon, A. 2005. *Enterprise resources planning*. McGraw-Hill Publishing Company Limited, New Delhi

[6] Hatala, J. P. and Lutta, J. G., 2009. Managing information sharing within an organizational setting: A social network perspective. *Performance Improvement Quarterly*. 21, 4 (Jan. 2009), 5-33, doi:10.1002/piq20036

[7] Tarigan, Z.J.H. 2009. Can sharing knowledge as an organization culture accelerate enterprise resources planning implementation? Case study east java manufacture. *Proceeding International Seminar on Industrial Engineering and Management* (Bali, Indonesia, December 10 -11, 2009).

[8] Li, S. and Lin, B. 2006. Accessing information sharing and information quality in supply chain management. *Decision Support Systems*. 42, 3 (Dec. 2006), 1641-1656.

[9] Obeidat, B.Y., Al-Suradi, M.M., Masa'deh, R., and Tarhini, A., 2016. The impact of knowledge management on innovation: An empirical study on Jordanian consultancy firms. *Management Research Review*. 39, 10, 1214-1238, doi:10.1108/MRR-09-2015-0214.

[10] Gloet, M. and Terziovski, M. 2004. Exploring the relationship between knowledge management and innovation performance. *Journal of Manufacturing Technology Management*. 15, 5, 402-409. https://doi.org/10.1108/17410380410540390

[11] Plessis, M. 2007. The role of knowledge management in innovation. *Journal of Knowledge Management*. 11, 4, 20-29. https://doi.org/10.1108/13673270710762684

[12] Simatupang, T.M. and Sridharan, R. 2005. The collaboration index: A measure for supply chain collaboration. *International Journal of Physical Distribution & Logistic Management.* 35, 1, 44-62. https://doi.org/10.1108/09600030510577421

[13] Melville, N., Carroll, W.E., Kreamer, K., and Gurbaxani, V. 2004. Review: Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly* 28, 2 (Jun. 2004), 283-322.

[14] Su, Y.F. and Yang, C. 2010. A structural equation model for analyzing the impact of ERP on SCM. *Expert Systems with Applications*. 37, 1 (Jan. 2010), 456-469

[15] Jones, M.C., Cline, M., and Ryan, S. 2006. Exploring knowledge sharing in ERP implementation: An organizational culture framework. *Decision Support Systems* 41, 2 (Jan.2006), 411-434.

[16] Latan, H. and Ghozali, I. 2012. *Partial Least Square Konsep, Teknik, dan Aplikasi SmartPLS 2.0 M3*, Badan Penerbit Universitas Diponegoro, Semarang.

[17] Marniagi, C., Trivellas, P., and Reklitis, P. 2015. Information quality and supply chain performance: The mediating role of information sharing. *Procedia Social and Behavioral Sciences* 175 (Feb.2015), 473-479. https://doi.org/10.1016/j.sbspro.2015.01.1225

[18] Srivardhana and Pawlowski, S.D. 2007. ERP systems as an enabler of sustained business process innovation: A knowledge-based view. Journal of Strategic Information System 16, 1 (Mar. 2007), 51-69. https://doi.org/10.1016/j.jsis.2007.01.003

[19] Tarafdar, M. and Gordon, S.R. 2007. Understanding the influence of information systems competencies on process innovation: A resources-based view. *Journal of Strategic Information System* 16, 4 (Dec. 2007), 353-392. https://doi.org/10.1016/j.jsis.2007.09.001

[20] Lotfi, Z., Mukhtar, M., Sahran, S., and Zadeh, A.T. 2013). Information sharing in supply chain management. *Procedia Technology* 11, 298-304. https://doi.org/10.1016/j.protcy.2013.12.194

Jackson, S.A., Remani, V.G., Mishra, R., and Napier, R., 2016, Examining the impact of design for environment and the mediating effect of quality management innovation on firm performance. Int. J. Production Economics 173 (Mar. 2016), 142-152. https://doi.org/10.1016/j.ijpe.2015.12.009

Development of IT Risk Management Framework Using COBIT 4.1, Implementation In IT Governance For Support Business Strategy

Jarot S. Suroso
Bina Nusantara University
Jln. Kebon Jeruk Raya No. 27 Jakarta
Indonesia
jsembodo@binus.edu

Bayu Rahadi
Bina Nusantara University
Jln. Kebon Jeruk Raya No. 27 Jakarta
Indonesia
bayurahadi@live.com

ABSTRACT

Extensive use of information technology in companies put IT into a position which is of considerableconcern, especially in large companies that put IT becomes a strategic part of the company. The importanceof IT division, make the companies willing to pay big to get the benefits offered by IT itself, but on the otherhand appears disappointment incurred from investments are not comparable with the results obtained. Untilthe threat appear and disrupt the business of the company. By doing risk management using the IT risk management framework by Cobit 4.1, the combining between business strategy Goals and IT Goals can assist companies in identifying risks that might occur and Companies can design how to mitigate if risks occur. IT governance should be able to support the company's business strategy by managing and memange risks in order to avoid large financial losses to the company due to the lack of identifying and analyzing risks in the company.

CCS Concepts

• **Information systems→Information systems applications→ Enterprise information systems → Enterprise applications.**

Keywords

Risk Management; Cobit 4.1; IT Risk Management Framework; Business Strategy; IT Governance.

1. INTRODUCTION

Extensive use of information technology in companies puts IT into a position which is of considerable concern, especially in large companies that puts IT into a strategic part of the company. Once the importance of IT, companies are willing to pay big to get the benefits offered by IT[1]. However, on the other hand, it appears disappointment incurred from investments that are not compatible with the results obtained. Top management has always wanted an investment that must be issued in accordance with the benefits, regardless of the risks, threats, and weaknesses in the company. Especially on things that are the responsibility of the IT division, which sometimes it is not realized, it will affect the performance of the company's business either directly or indirectly[2].

IT Governance will put the structure around how organizations align IT strategy with business strategy, and then make sure that companies stay on track to achieve their strategies conduct risk management for IT governance, risk identification and risk analysis used to determine the type of risk and the magnitude of the risk if it occurs.

The main objective of IT governance is to ensure that IT investments to support business strategies, but on the other hand can mitigate risks from its use. IT governance or governance of information technology (IT) is a part of corporate governance that focuses on the management of IT in the organization, including IT system performance and risk management. IT governance is the application of governance mechanisms: structure, roles, processes / procedures, and relational mechanisms to ensure that IT is managed in accordance with the needs and strategy of the organization[3].

XYZ is a life insurance company and of course the risk is important, companies should consider the possibility that the risk will occur which can degrade the performance of the company in case of problems in IT, which is currently IT is already used as the company's business strategy. Currently the governance of IT in PT XYZ is not align with Enterprise Risk Management, because it has not had a framework standards, IT governance and ERM still follow the rules of the regional, so the need for a framework that can help companies especially in IT governance to establish IT governance based analysis a strong risk, so that IT organizations can support the company's business strategy.

The company uses COBIT (Control Objectives for Information and Related Technology) version 4.1 for IT governance. COBIT provides a clear policy and good practice for IT governance, assisting senior management in understanding and managing the risks associated with IT. It provides the framework and control objectives detailed instructions to management, business process owners, users and auditors. It defines IT activities in a generic process model within four domains. It contains Plan and Organize, Acquire and Implement, Deliver and Support, and Monitor and Evaluate. They map to IT's traditional responsibility areas of plan, build, run and also monitor[4].

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT '17, July 9–11, 2017, Singapore, Singapore
© 2017 Association for Computing Machinery.
ACM ISBN 978-1-4503-5293-2/17/07…$15.00
https://doi.org/10.1145/3124116.3124134

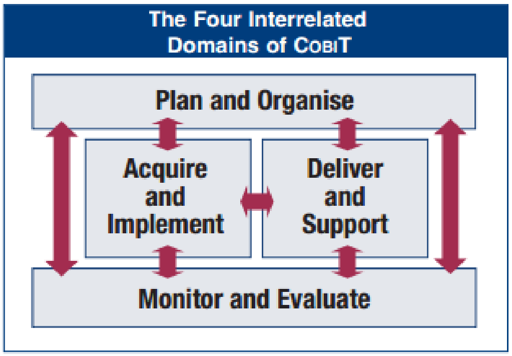

The Four Interrelated
Domains of CobiT
Plan and Organise
Acquire and Implement
Deliver and Support
Monitor and Evaluate

Figure 1. Four Domain of Cobit 4.1

The problems which are summarized in this study include two things. First, how the business dependence on IT, second, how is the implementation of IT Risk Management at PT xyz, third, how effective business strategy that is supported by the implementation of good IT Governance. The study contains theoretical basis related to IT risk management in the implementation of information technology by utilizing the COBIT 4.1 framework.

2. LITERATURE REVIEW

IT Governance is part of the management company and composed of the leaders, all members of the organizational structure and processes - processes yangmempunyai a view to ensuring that existing IT support and then help in achieving the organization's strategies and also its objectives[5].

COBIT has been developed by the IT Governance Institute (ITGI) and the Information Systems Audit and Control Association (ISACA). COBIT is a set of documentation of best practices for the governance of IT that can help auditors, management and the user to bridge the gap between business risks, control needs technical issues. COBIT framework as we know, consists of 34 high-level control objectives and grouped into four domains, four domains are: Planning and Organization (10 processes), Acquisitionand Implementation (7 processes), Delivery and Support (13 processes), Monitoring and Evaluation (4 process).

Risk IT is a framework that based on a set of guiding principles for the effective IT Risk Management. Complement COBIT Framework, a comprehensive framework for the governance and control of IT-based business solutions and services[6].

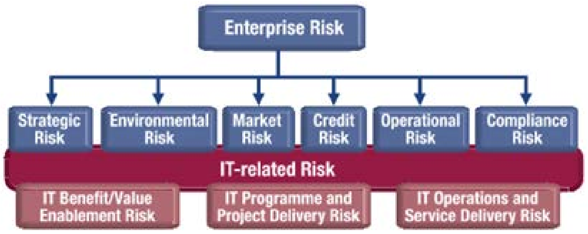

Enterprise Risk
Strategic Risk
Environmental Risk
Market Risk
Credit Risk
Operational Risk
Compliance Risk
IT-related Risk
IT Benefit/Value Enablement Risk
IT Programme and Project Delivery Risk
IT Operations and Service Delivery Risk

Figure 2. Risk Hierarchy

Figure 3 is the risk it framework issued consists of three domains : risk governance, risk response and risk evaluation.
IT Risk Management is a framework based on a set of guiding principles for effective IT risk management. The framework complements COBIT, a comprehensive framework for the governance and control of business-driven, IT-based solutions and services[7].

IS strategy related to what should be done with the information, systems and technology, and how to manage applications from a business standpoint. IS strategy related to what should be done with the information, systems and technology, and how to manage applications from a business standpoint (Figure 4) [8].

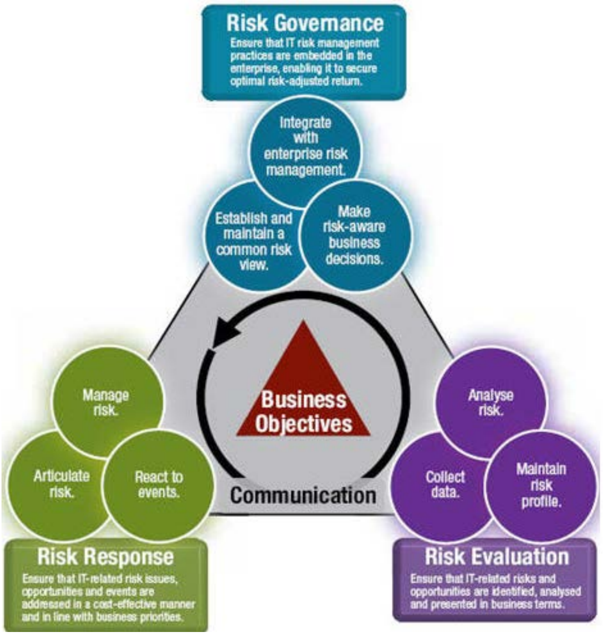

Risk Governance
Ensure that IT risk management practices are embedded in the enterprise, enabling it to secure optimal risk-adjusted return.
Integrate with enterprise risk management.
Establish and maintain a common risk view.
Make risk-aware business decisions.
Business Objectives
Communication
Manage risk.
Articulate risk.
React to events.
Risk Response
Ensure that IT-related risk issues, opportunities and events are addressed in a cost-effective manner and in line with business priorities.
Analyse risk.
Collect data.
Maintain risk profile.
Risk Evaluation
Ensure that IT-related risks and opportunities are identified, analysed and presented in business terms.

Figure 3. IT Risk Framework

3. METHOD

3.1 Methodology

The methodology used in the writing of this case study, the end result will be given on the application form of IT Risk Management by using COBIT 4.1 to endorse the company's business strategy. Here is a schematic framework of thinking that is used in case study research in PT XYZ. The study was conducted by interview and observation. Interviews were conducted to the managerial IT regarding the company's business processes and risk management[9].

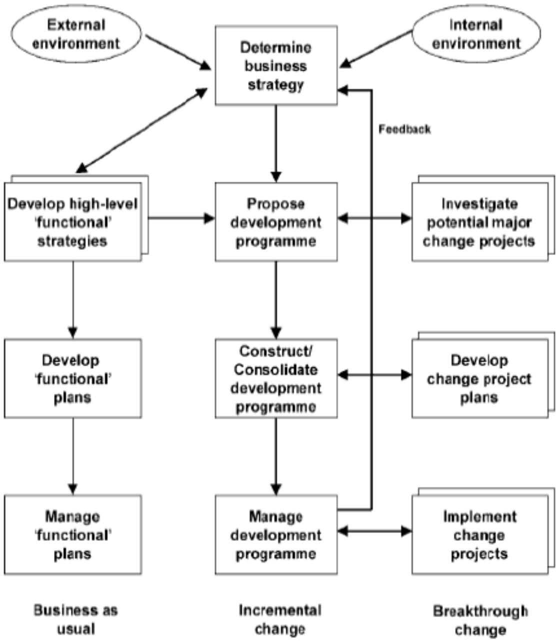

External environment
Determine business strategy
Internal environment
Feedback
Develop high-level 'functional' strategies
Propose development programme
Investigate potential major change projects
Develop 'functional' plans
Construct/ Consolidate development programme
Develop change project plans
Manage 'functional' plans
Manage development programme
Implement change projects
Business as usual
Incremental change
Breakthrough change

Figure 4. Integrated Business Strategy Framework.

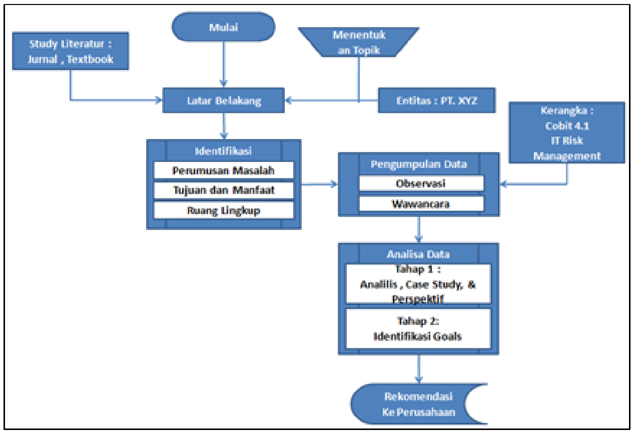

Mulai
Study Literatur : Jurnal , Textbook
Menentukan Topik
Latar Belakang
Entitas : PT. XYZ
Kerangka : Cobit 4.1 IT Risk Management
Identifikasi
Perumusan Masalah
Tujuan dan Manfaat
Ruang Lingkup
Pengumpulan Data
Observasi
Wawancara
Analisa Data
Tahap 1 : Analilis , Case Study, & Perspektif
Tahap 2: Identifikasi Goals
Rekomendasi Ke Perusahaan

Figure 5. Methodology

The issues to be researched, authors collected data relating to ongoing business processes, control has been done, and best practices in the company that is PT.XYZ. The collected data was collected based on interviews, observations, and supporting data obtained from the original company. and in the analysis based on the COBIT 4.1 framework and IT Risk Management[10].

The above picture is the mind map in this case study, linking business strategy with IT governance is then connected also with IT risk management framework that the result is to give recommendations to XYZ about IT risk management framwork by COBIT[11].

3.2 Mindmap

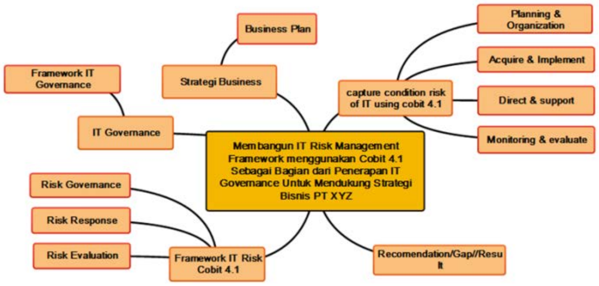

Business Plan
Planning & Organization
Framework IT Governance
Strategi Business
capture condition risk of IT using cobit 4.1
Acquire & Implement
Direct & support
IT Governance
Membangun IT Risk Management Framework menggunakan Cobit 4.1 Sebagai Bagian dari Penerapan IT Governance Untuk Mendukung Strategi Bisnis PT XYZ
Monitoring & evaluate
Risk Governance
Risk Response
Risk Evaluation
Framework IT Risk Cobit 4.1
Recomendation/Gap//Result

Figure 6. Mind Map

4. RESULT AND DICUSSION

First we will describe comparison among risk management, octave, fair dan NIST. Risk management of IT within COBIT is a framework that is based on a set of guiding principles for the effective management of IT risk. Complement COBIT Framework, a comprehensive framework for the governance and control of IT-based business solutions and services[12].

The Factor Analysis of Information Risk (FAIR), these methods apply: (i) a classification of risk factors to compile information; (Ii) a method to measure the factors that increase the risk of information, including the frequency of occurrence of threats, vulnerabilities and disadvantages. This methodology consists of four components: threats, assets, organization and external environment. Thus, the scenario assessment is classified into one category or the factors that have contributed positively or negatively to the risk[13].

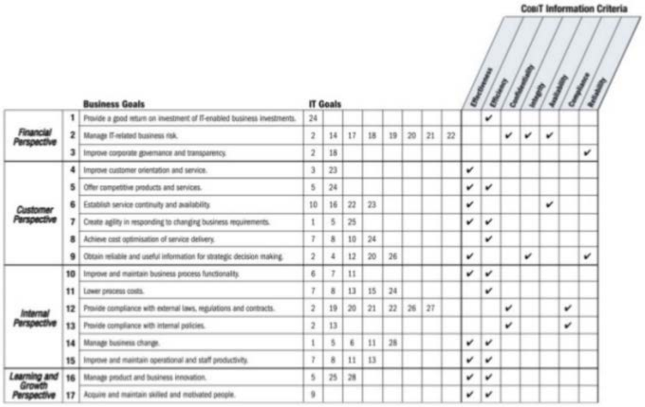
The Operationally Critical Threat, Asset and Vulnerability Evaluation (OCTAVE) Allegro is a methodology to streamline and optimize the process of assessing information security risks so that the organization can obtain enough results with the investment of time pliers short, people and resources are limited in relation to the information, services and business process. This methodology differs from other approaches because its main focus is on asset information is used, in which information is stored, transported and processed, and how the information has an impact on threats, vulnerabilities and disruptions[14].

The National Institute of Standards and Technology (NIST), aims to provide guidance in assessing risks to information systems. This method provides guidelines for conducting the risk assessment process step by step, starting from the preparation of the evaluation, risk assessment, reporting the results of the evaluation and maintenance in the review and how the risk assessment as well as other complementary processes provide each other with each other[15].

Table 1. Comparison in IT Risk Management methods

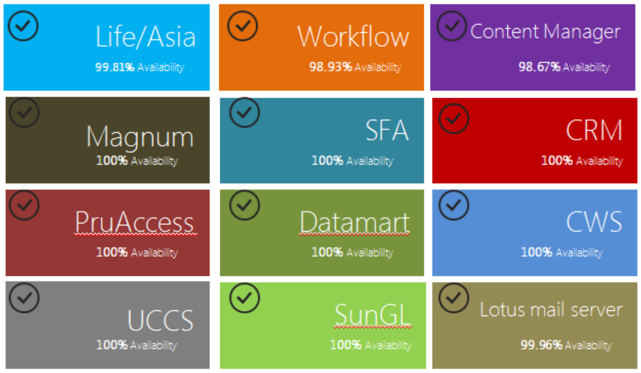
Attribute, characteristic	Octave	Fair	NIST	IT Risk COBIT
Focus	Assement dan risk majemen	Risk assess ment	Not applicable	Risk governance, evaluation and response
Identification risk	Medium	Mediu m	High	High
Risk Analysis	Medium	High	Hiht	High

In this study conducted a risk assessment in accordance with IT risk management framework and based on the data-data that have been obtained from the interview. Before performing the risk assessment information system, the first thing to do is to define the company's business goals and objectives of IT to do an interview to the parties concerned, namely Head of IT Department, Head of IT Governance, IT Risk Management, IT Security, IT Compliance, IT Policy and procedure IT BA, IT Developement, IT Services, IT infastructure. Interviews were conducted to determine the business strategy and IT strategy, then do the assessment of the risks that might occur by searching the risk impact, critical information assets of IT and business, container risk, the risk that potentially occur (area of concern) and the consequences of those risks.



		Business Goals	IT Goals								Effectiveness	Efficiency	Confidentiality	Integrity	Availability	Compliance	Reliability
Financial Perspective	1	Provide a good return on investment of IT-enabled business investments.	24									✔					
	2	Manage IT-related business risk.	2	14	17	18	19	20	21	22			✔	✔	✔		
	3	Improve corporate governance and transparency.	2	18													✔
Customer Perspective	4	Improve customer orientation and service.	3	23							✔						
	5	Offer competitive products and services.	5	24							✔	✔					
	6	Establish service continuity and availability.	10	16	22	23					✔				✔		
	7	Create agility in responding to changing business requirements.	1	5	25						✔	✔					
	8	Achieve cost optimisation of service delivery.	7	8	10	24						✔					
	9	Obtain reliable and useful information for strategic decision making.	2	4	12	20	26				✔			✔			✔
Internal Perspective	10	Improve and maintain business process functionality.	6	7	11						✔	✔					
	11	Lower process costs.	7	8	13	15	24					✔					
	12	Provide compliance with external laws, regulations and contracts.	2	19	20	21	22	26	27				✔			✔	
	13	Provide compliance with internal policies.	2	13									✔			✔	
	14	Manage business change.	1	5	6	11	28				✔	✔					
	15	Improve and maintain operational and staff productivity.	7	8	11	13					✔	✔					
Learning and Growth Perspective	16	Manage product and business innovation.	5	25	28						✔	✔					
	17	Acquire and maintain skilled and motivated people.	9								✔	✔					

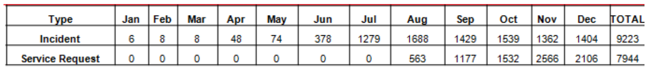
Companies are already having an especially IT procedures service level agreement (SLA) that are listed in the document. The management should be communicated effectively to all stakeholders. IT departments in this regard has been made SLA on any problems and always strive to maintain the quality of service of each of its service.



Life/Asia 99.81% Availability	Workflow 98.93% Availability	Content Manager 98.67% Availability
Magnum 100% Availability	SFA 100% Availability	CRM 100% Availability
PruAccess 100% Availability	Datamart 100% Availability	CWS 100% Availability
UCCS 100% Availability	SunGL 100% Availability	Lotus mail server 99.96% Availability

Figure 7. Service Level Agreement [16]

Automated tools and techniques with the knowledge base already done centralized. Each helpdesk staff can interact so that the solution can be done quickly. Responsible for the team was also able to clearly monitor effectively[17]. The procedure for communicating to resolve incidents are defined and communicated by implementing Help Desk System.



Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Incident	6	8	8	48	74	378	1279	1688	1429	1539	1362	1404	9223
Service Request	0	0	0	0	0	0	0	563	1177	1532	2566	2106	7944

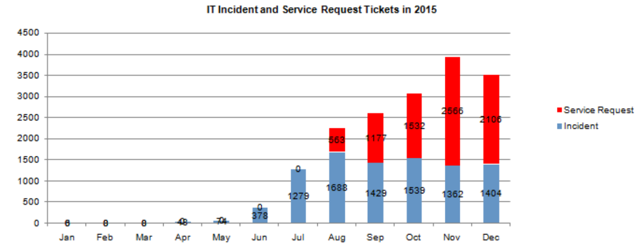


Figure 8. IT Incident and Ticketing System

There is now a special section that handles the incident so that the existing problems can soon look for a solution and looks already implemented and tried to consistently implement effective problem management, where each issue received identified the root cause and then formulated to address the problem.

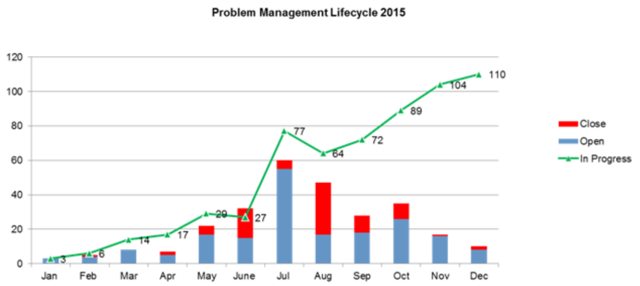
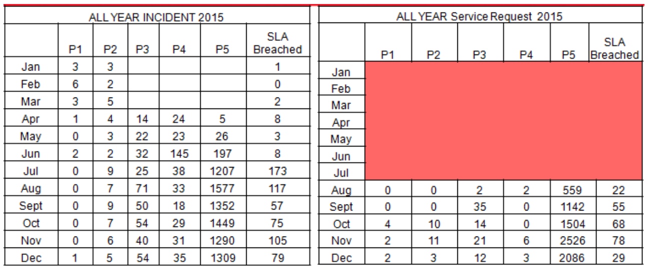


Figure 9. Problem Management Lifecycle

Every project that has been implemented will be monitoring, monitoring in detail about what needs to be repaired or to be evaluated for the system to support the company. Currently the IT performance monitoring and evaluation has been carried out properly, so the entire system can be managed properly



ALL YEAR INCIDENT 2015

	P1	P2	P3	P4	P5	SLA Breached
Jan	3	3				1
Feb	6	2				0
Mar	3	5				2
Apr	1	4	14	24	5	8
May	0	3	22	23	26	3
Jun	2	2	32	145	197	8
Jul	0	9	25	38	1207	173
Aug	0	7	71	33	1577	117
Sept	0	9	50	18	1352	57
Oct	0	7	54	29	1449	75
Nov	0	6	40	31	1290	105
Dec	1	5	54	35	1309	79

ALL YEAR Service Request 2015

	P1	P2	P3	P4	P5	SLA Breached
Jan						
Feb						
Mar						
Apr						
May						
Jun						
Jul						
Aug	0	0	2	2	559	22
Sept	0	0	35	0	1142	55
Oct	4	10	14	0	1504	68
Nov	2	11	21	6	2526	78
Dec	2	3	12	3	2086	29

Figure 10. Monitoring system.

5. CONCLUSIONS

According to the previous explanation, it can be summed up as follows:

1. Standard IT Governance using COBIT, results of mapping between the existing process showed that there are 21domain COBIT that can be mapped into

the business and IT Goals to harmonize between business strategy with IT strategy.

2. Risk communication has been defined based on the framework by mapping each stakeholder into the COBIT 4.1 framework of risk communication.

Goals of key risk activity already are managed and grouped based on the criteria of IT risk management to monitor, evaluate and manage risk. (RG, RE and RR).

6. REFERENCES

[1] Alberts, C., & Dorofee, A. (2003). Introduction to the OCTAVE Approach. … *, PA, Carnegie Mellon …*, (August), 1–37.

[2] Alberts, C. J., & Dorofee, a J. (2002). Managing Information Security Risks: The OCTAVE Approach.

[3] Caralli, R. A., Stevens, J. F., Young, L. R., & Wilson, W. R. (2007). Introducing OCTAVE Allegro : Improving the Information Security Risk Assessment Process, (May), 154.

[4] Haes, S. De. (2006). Information Technology Governance Best Practices in Belgian Organisations, *00*(C), 1–9.

[5] ISACA. (2007). CoBIT 4.1. *IT Governance Institute*, 1–29.

[6] ISACA. (2013). COBIT ® Process Assessment Model (PAM): Using COBIT ® 5.

[7] Jordan, E., & Silcock, L. (2005). Beating IT Risks, 292.

[8] Kouns, J., & Minoli, D. (2010). Information Technology Risk Management in Enterprise Environments: A Review of Industry Practices and A Practical Guide to Risk Management Teams.

[9] Larsen, M. H., Pedersen, M. K., & Andersen, K. V. (2006). IT Governance: Reviewing 17 IT Governance tools and analysing the case of Novozymes A/S. *Proceedings of the Annual Hawaii International Conference on System Sciences*, *8*(C), 1–11. http://doi.org/10.1109/HICSS.2006.234

[10] Laudon, K., & Laudon, J. P. (2013). *Management Information Systems, Global Edition*. http://doi.org/0-273-78997-X

[11] Mechanism, I. T. G. (2008). C OBI T as an IT Governance Mechanism, 1–32.

[12] Mintzberg, H. (1987). the Strategy Concept .1. 5 Ps for Strategy. *California Management Review*, *30*, 11–24.

[13] Neely, M. P. (2008). Accounting Information Systems: A Business Process Approach, Second Edition. *Issues in Accounting Education*, *23*(3), 495–496.

[14] Planas, E., Ronza, A., & Casal, J. (2004). *The Risk IT Framework*.

[15] Turban, E., McLean, E., & Wetherbe, J. (2001). Information Technology for Management. *Improving Quality and Productivity*.

[16] Van Grembergen, W. (2003). Strategies for Information Technology Governance.

[17] Ward, J. L., & Peppard, J. (2002). *Strategic planning for information systems* (Vol. 28).

Author Index

Bana G. Kartasasmita 53
Bayu Rahadi 92
Bin He 14
Cheng Chen 21
Cheng-Yong Huang 8
Chien-Chi Lin 1
Chien-Kuo LI 33
Chien-Yu Lin 1
Chuan-Kai Yang 38
Der-Ching YANG 33
Dexin Hu 21
Fei Yang 70
Guanghui Wu 63
Hajra Rasmita Ngemba 43, 75
Hironori Ito 27
Hsiu-Chia Ko 81
I Nyoman Sutapa 66
Jarot S. Suroso 92
Jenny Mochtar 66
Jian Yang 70
Kanesha Banoraswatii 58
Masatoshi Yoshikawa 27
Meng-Hui HSU 33
Mus Aidah 75
Neng Liu 63
Qiusha Min 63
R. Poppy Yaniawati 53, 58
Rahayu Kariadinata 53, 58
Rong Hu 14
Sautma Ronni Basana 87
Suhansa Rodchua 48
Syaiful Hendra 43, 75
Ting-sheng WENG 33
Wati Susilawati 58
Wei-Jen Chen 1
Wen-Ning Wu 81
Widjojo Suprapto 87
Xinguo Yu 14
Xirong Gao 70
Yasuhito Asano 27
Yiwei Wang 21
Yuan-Bang Cheng 38
Zeplin Jiwa Husada Tarigan 66, 87
Zhenyu Li 14