

Vol. 15 No. 6 November - December 2020



Interdisciplinary Research Review

ISSN 2697-522X (Print)

ISSN 2697-536X (Online)

Interdisciplinary Research Review

Editorial Board of Interdisciplinary Research Review

Yongyudh Vajradul	(Editor)
Pranom Othaganont	(Deputy Editor)
Sommay Peathanom	(Deputy Editor)
Prabhas Chongstitvatana	(Editorial Board)
Orawon Chailapakul	(Editorial Board)
Tuantan Kitpaisalsakul	(Editorial Board)
Kanchana Boonsong	(Editorial Board)
Sayam Aroonsrimorakot	(Editorial Board)
Wilairat Kirin	(Editorial Board)
Wanida Treesawat	(Editorial Board)
Surapong Charasrosjanakul	(Editorial Board)
Sumnieng Ongsupankul	(Editorial Board)
Porntip Andhivarothei	(Editorial Board)
Orapun Metadilokkul	(Editorial Board)
Prasutr Thavornchaisit	(Editorial Board)
Artcha Boongrapu	(Editorial Board)
Phatcharasak Arlai	(Editorial Board and Secretary)
Santi Koonkarnkhai	(Manager)

International Editorial Board of Interdisciplinary Research Review

Muhammad Yunus	(Editorial Board)
Manfred Koch	(Editorial Board)
Jun Yu	(Editorial Board)
Tou Teck Yong	(Editorial Board)
Lance Chun Che Fung	(Editorial Board)
Warren Y. Brockelman	(Editorial Board)
Manfred Hartard	(Editorial Board)

Administrative Committees of Journal

Virat Pingkeaw	(President)
Sommay Peathanom	(Vice President)
Yongyudh Vajradul	(Committee)
Pranom Othaganon	(Committee)
Phatcharasak Arlai	(Committee and Secretary)

Management and Distribution Section

Ladda Khemnark

Publisher : Research and Development Institute, Nakhon Pathom Rajabhat University, 85 Malaiman road, Amphur Muang, Nakhon Pathom 73000, Thailand

Origin : The Interdisciplinary Research Review was established with the cooperation of seven institutes:

1. Nakhon Pathom Rajabhat University
2. The Royal Society of Thailand Committee of Interdisciplinary Research and Development
3. Interdisciplinary Research Foundation
4. Phetchaburi Rajabhat University
5. Muban Chombueng Rajabhat University
6. Kanchanaburi Rajabhat University
7. Rajamangala University of Technology Rattanakosin

Objectives of journal

1. To encourage and publish knowledge and useful opinions in any field of study
2. To support academicians and teachers in creating work beneficial to the academic community
3. To stimulate and support education at the university level

Policies of the journal :

The Interdisciplinary Research Review (IRR) publishes six issues per year. All submitted articles are subject to peer review, and must be approved by two experts in the relevant field prior to acceptance. Prior to review, all articles must pass a screening process which evaluates the articles' appropriateness for the journal, originality, proper formatting, and English proficiency. All material in each article that is not original must be properly referenced to the published literature. The editors reserve the right to modify articles in the interests of clarity and proper English usage. The opinions and views expressed in the journal are those of the authors of the respective articles and not those of the editors or publisher.

Submission of articles :

Articles should be submitted on-line at <https://www.tci-thaijo.org/index.php/jtir>. The website contains full instructions about how to prepare and submit articles. Please contact the journal or editors for information at irr@npru.ac.th, or by phone at +66 3426 1053, or +66 3410 9300 ext. 3909.

Editorial Note

The Interdisciplinary Research Review (IRR) was established with academic cooperation by the Nakhon Pathom Rajabhat University, The Royal Society of Thailand Committee of Interdisciplinary Research and Development, Rajabhat University (Western Group), and Rajamangala University of Technology Rattanakosin. This Issue, Volume 15 Number 6 (November – December 2020). This issue contains of six interesting articles in multidisciplinary fields: (1) Estimation of stature and sex from step length and shoe dimensions for forensic investigation, (2) Examining the urine mitragynine concentration in Thai Kratom abusers and studying the effect of Beta-Glucuronidase in the analysis process, (3) Effect of chemical fertilizer on leaf nutrient concentration and fruit quality of rose apple (*Syzygium jambos* L.) cv. Tabtimjan, (4) Practicum model development for professional educational administration in digital era, (5) The use of semantic field approach to enhance English vocabulary development of Prathomsuksa 4 students at Betty Dumen Border Patrol Police School, Phayao Province, Thailand, and (6) Development of management model for senior citizens school under Chiang Mai City municipality towards Thailand 4.0.

The Editorial Board of the IRR encourages anyone to submit articles for evaluation and review. The processes of submission, review and publication of articles are described on the journal's website, <https://www.tci-thaijo.org/index.php/jtir>. The Editorial Board and Committees of the IRR sincerely thank all peer reviewers who have sacrificed their time to help us produce a better journal, and also wish to thank all teachers, researchers and other academicians for submitting their valuable research to this journal. Finally, we thank readers of our journal who help to spread the knowledge and benefits gained to others. With your feedback and suggestions, we will strive to improve the quality and relevance of the IRR.

Yongyudh Vajaradul
Editor
Interdisciplinary Research Review

Contents

Volume 15, No. 6, November – December 2020

	Page
Estimation of stature and sex from step length and shoe dimensions or forensic investigation Orathai Kheawpum and Sirirat Choosakoonkriang	1
Examining the urine mitragynine concentration in Thai Kratom abusers and studying the effect of Beta-Glucuronidase in the analysis process Phatraporn Chodchoy and Theerin Sinchai	6
Effect of chemical fertilizer on leaf nutrient concentration and fruit quality of rose apple (<i>Syzygium jambos</i> L.) cv. Tabtimjan Pongnart Nartvaranant	10
Practicum model development for professional educational administration in digital era Jiraporn Supising, Somsak Phuvipadawat, Choocheep Puthaprasert, Prapan Thammachai, and Thanat Boonchai	15
The use of semantic field approach to enhance English vocabulary development of Prathomsuksa 4 students at Betty Dumen Border Patrol Police School, Phayao Province, Thailand Phitsinee Sathientharadol	22
Development of management model for senior citizens school under Chiang Mai City municipality towards Thailand 4.0 Thanuttha Wudhiwanich, Choocheep Puthaprasert, Yongyouth Yaboonthong, and Tharn Thong-ngok	31

Estimation of stature and sex from step length and shoe dimensions for forensic investigation

Orathai Kheawpum¹ and Sirirat Choosakoonkriang^{2,*}

¹Forensic Science and Criminal Justice Program, Faculty of Science, Silpakorn University, Nakhon Pathom, Thailand

²Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom, Thailand

Abstract

Footwear impression marks and footwear are among the most commonly found evidence at crime scenes. The aim of this study was to develop a formula for estimation of the stature and gender of an individual if the shoe dimensions and step length of that individual were known. The footwear dimensions (length and width) were collected from 320 subjects, comprising 152 males and 168 females, ranging from 18 to 44 years of age. A statistical model for sex and height prediction was constructed using logistic regression and multiple linear regression analysis, respectively. In general, the stature, shoe width, shoe length and average step length were significantly larger in males than in females ($p < 0.05$). The strongest correlation coefficient (r) was observed in the step length for female and male. While for the pooled sample, the shoe size showed the greatest and strong positive correlation coefficient. The lowest correlation was observed in shoe length in all groups. This study is demonstrated that the dimension of the shoe and the step length can be used to estimate stature and sex of the shoe owner. These models may be useful in the forensic investigation of criminal cases.

Keywords: shoeprint, step length, gender estimation

Article history: Received 28 August 2020, Revised 7 November 2020, Accepted 10 November 2020

1. Introduction

Personal identification plays a critical role in crime scene investigation [1]. In forensic investigations, sex and stature are the most important parameters used to determine the identity of an individual. Identification of the victim's or the defendant's sex alone results in a 50% reduction in the searchable population. Shoeprints and shoes, which are often the only evidence left by a suspect at the scene of crime, are key evidence that can help in personal identification. Information obtained by examination of these prints may help in linking a suspect with the crime scene. The individual morphological structures of shoeprints can be compared to a suspect's shoes or shoeprint [2, 3] to enable a positive identification. The shoe or shoeprint may also provide information on the height (stature) and gender of an individual. Calculation of stature and gender from these prints may support height estimation of the defendants made by eye-witnesses [3]. Moreover, Atamturk intended to determine if the sex of an individual can be identified by foot lengths, shoe length, and/or footprints. Statistical analyses indicated that univariate models correctly assign approximately 67 – 94% of individuals to their correct sex groups [3]. Shoes and shoe prints found in the vicinity of

the incidences may also play an important role in the identification of unknown persons. There have been a very large number of studies on the determination of identity via the individualizing characteristics of foot prints [2, 4 – 6]. And there have been quite a few studies conducted to estimate the stature through shoeprint dimensions [7 – 9]. Yet, the number of studies to estimate sex through shoe dimensions is extremely limited [10].

Developing reliable models to estimate stature and sex from the characteristics of shoes and shoeprints can be critically important to facilitate crime scene investigations. This work presents an investigation of the prediction of stature and gender of an individual based on the step length and shoe dimensions generated in a mixed gender Thai population sample. Multiple statistical formulae for stature and gender estimation were developed with these purposes. The potential error in the sex and stature estimation is also evaluated and discussed.

2. Materials and Methods

2.1 Sampling

Measurements of step length during normal paced walking, maximum shoe length and width, and stature of 320 individuals at Silpakorn University (Nakhon Pathom Province, Thailand) were collected from

*Corresponding author; email: sirirat.157@yahoo.com

Table 1. The descriptive information of male (N = 152) and female (N = 168).

Parameters	Mean \pm S.D.	Min – Max	t-value	p-value
Age (y):				
Male	19.2 \pm 1.6	19.0 – 36.0	-4.490	0.000*
Female	20.4 \pm 2.8	18.0 – 44.0		
Weight (kg):				
Male	70.4 \pm 16.1	40.0 – 150.0	8.897	0.000*
Female	57.4 \pm 8.8	41.0 – 82.0		
Height (cm):				
Male	175.0 \pm 6.2	159.0 – 189.0	16.652	0.000*
Female	163.7 \pm 6.0	150.0 – 177.0		
Shoe size (number):				
Male	42.8 \pm 1.5	38.0 – 46.0	21.474	0.000*
Female	39.2 \pm 1.5	35.0 – 43.0		
Shoe width (cm):				
Male	11.5 \pm 1.2	8.0 – 14.5	13.091	0.000*
Female	9.8 \pm 1.2	7.0 – 17.0		
Shoe length (cm):				
Male	28.7 \pm 2.0	25.0 – 34.0	8.658	0.000*
Female	26.7 \pm 1.9	15.0 – 31.0		
Average step length(cm):				
Male	59.8 \pm 11.9	36.8 – 89.0	3.968	0.000*
Female	55.5 \pm 6.8	37.3 – 76.0		

p* < 0.05

February to November 2019. The sampled population included 152 males and 168 females ranging in age from 18 to 44 years. Adult samples were selected using simple random sampling method. None of the individuals had any abnormality in their walking; subjects who did not meet these criteria were excluded from the analysis. The data set was divided into three sub-groups: the male group, the female group and the mix-gender group or pooled sample.

2.2 Participant consent and general information

Potential participants were provided with an overview of the study included the aim of this research. Each potential participant independently decided whether to participate in the study and communicated their decision to the research lead. After agreeing to participate, each participant provided general information, including gender, age, occupation, height, shoe type, shoe size and weight, using a Google form.

2.3 Measurements

Step length was determined based on a walking pattern recorded smooth white paper with a centimeter scale grid. Participants were requested to walk on the white grid paper for approximately 10 feet in their normal walking manner. Data collection began after the tip of his/her shoe touched the paper, and ended after the volunteer passed the end of the paper, as shown in Fig. 1 (a). The step length of each step was measured as the straight distance between the rear-most point on the heel of two consecutive steps. The first three steps of each individual were measured and the averages of step were included in the study.

Shoe length and width are defined as the maximum distance directly between the two furthest points on the shoe's vertical and horizontal axis, respectively. Each shoe was placed on a sheet of white paper with a 1 cm scale grid and length and width were measured as shown in Fig. 1 (b). Shoes include in this study included canvas shoes (117 and 134 pairs for male and female, respectively), sandals (33 pairs for each male and female), and "other", which included casual (1 pair for female) and leather shoes (2 pairs for male). The shoe type was not significant between male and female group ($p > 0.05$).

The collected data were analyzed using the standard Statistic Package of Social Sciences (SPSS). Data were analyzed for mean, standard deviation, and standard errors of estimate (SEE). To identify evidence of sexual dimorphism in the sample, inferential statistical tests including the Student's (independent) t-test was employed to compare height, shoe length, and shoe width between the males and females. In order to obtain the most accurate estimate, regression formulae were calculated taking multiple parameters into account. The logistic regression analysis was used for sex prediction. The significance level for differences was set to $p < 0.05$ (95% confidence interval). The Pearson's product moment correlation coefficients (r), assumed as the measure of strength of the association between height and the shoe dimensions, was determined for both the male and female subjects, and also for the pooled sample. The adjusted coefficient of determination (R^2) was estimated to determine how much of the variance in the dependent variable could be explained by its relationship to the other variables.



Figure 1: (a) Measurement of step length and (b) Measurement of shoe length and width.

Table 2. The descriptive information of male (N = 152) and female (N = 168).

Group	Parameters	Correlation coefficient (<i>r</i>)	p-value
Males (n = 152)	Shoe dimensions		
	- width	0.514**	0.000
	- length	0.383**	0.000
	- Shoe size (number)	0.575**	0.000
Females (n=168)	Shoe dimensions		
	- width	0.500**	0.000
	- length	0.473**	0.000
	- Shoe size (number)	0.715**	0.000
Pooled sample (n=320)	Shoe dimensions		
	- width	0.701**	0.000
	- length	0.579**	0.000
	- Shoe size (number)	0.827**	0.000
	- Average step length	0.632**	0.000

**p<0.05

3. Results and Discussions

3.1 Descriptive information

The majority of participants were college students (95.6%) with an average age of 19.2 ± 1.6 and 20.4 ± 2.8 years old for male and female respectively. The descriptive and inferential statistics of age, weight, height, shoe size, shoe width, shoe length, and average step length in normal walking manner are summarized in Table 1. When grouped by gender, it was observed that the mean values for the male subgroup was significantly greater ($p < 0.05$) than that of the female subgroup for all variables except for age. The age of male group was significantly less than female group. The outcomes show clear evidence of sexual dimorphism within the study sample.

3.2 Correlation between variables

The subjects in this study were divided into three groups, two groups with gender discrimination, namely male and female group and the other without gender discrimination or mix-gender group (Pooled sample). Table 2 summarizes the Pearson correlation coefficients "*r*" between stature and shoe dimensions, size or average step length for males, females, and the pooled sample. All variables were significantly correlated with stature ($p < 0.05$). The strongest correlation was observed between stature and average step length for both the male and female populations. In

the pooled sample, however, stature correlated most strongly with shoe size ($r = 0.827$).

The linear regression equations for stature estimation based on shoe size, shoe dimensions and step length of the male, female, and the pooled sample groups are shown in Table 3. $Stature = a + bx$, where '*a*' is the regression coefficient of the dependent variable, i.e. stature, '*b*' is the regression coefficient of the independent variable, and '*x*' is the shoe size, shoe dimension or step length measurement. The standard error of estimate (SEE) and adjusted R^2 are also included for each equation.

The linear regression models for stature estimations for the female sample resulted in lower SEE values for all variables modeled, suggesting slightly higher reliability for predicting stature from the study parameters of the males, females and pooled samples. The SEE values for the linear regression equations derived from the pooled sample data, on the other hand, were higher for shoe width, shoe length and step length than those generated for either the male or female data sets. This suggests that stature prediction from these variables may be more reliable when both genders were considered separately. This is supported by work from Krishan, Sharma and Kanchan et al., who reported that the foot length and foot breadth in the female samples of their studies provided the most accurate prediction for stature [6, 11].

In an effort to improve the accuracy of stature es-

Table 3. Linear regression equations for stature estimation from shoe size, shoe dimensions and step length of the males, females, and the pooled sample.

Linear regression equation	Adjusted R square	\pm SEE
Males:		
stature = 72.212 + 2.404(shoe size)	0.326	5.067
stature = 143.717 + 2.728(shoe width)	0.260	5.312
stature = 146.727 + 1.162(shoe length)	0.141	5.722
stature = 153.707 + 0.356(step length)	0.465	4.517
Females:		
stature = 48.148 + 2.994(shoe size)	0.508	4.222
stature = 138.794 + 2.551(shoe width)	0.246	5.228
stature = 124.150 + 1.480(shoe length)	0.219	5.318
stature = 128.190 + 0.640(step length)	0.513	4.202
Pooled sample:		
stature = 46.313 + 3.000(shoe size)	0.682	4.680
stature = 126.580 + 4.019(shoe width)	0.490	5.932
stature = 108.446 + 2.194(shoe length)	0.333	6.780
stature = 138.030 + 0.539(step length)	0.398	6.443

Note: SEE = Standard Error of Estimation, adjusted R^2 coefficient of determination

Table 4. Best fit regression model - males, females, and the pooled sample.

Multi-regression equation	Adjusted R square	\pm SEE
Males:		
Stature = 92.123 + 1.584(shoe size) + 0.258(step length)	0.565	4.075
Females:		
Stature = 58.399 + 0.336(shoe length) + 1.867(shoe size) + 0.416(step length)	0.707	3.280
Pooled sample:		
Stature = 48.970 + 2.566(shoe size) + 0.266(step length)	0.774	3.952

Note: SEE = Standard Error of Estimation, adjusted R^2 coefficient of determination

timation using shoe size, shoe dimensions, and step length measurements, multiple regression models generated using forward analysis for the males, females, and the pooled sample were evaluated. The best multi-variable regression models (in terms of adjusted R^2) including shoe size, shoe width, shoe length, and/or step length and calculated stature are presented in Table 4.

When evaluating shoe size, shoe dimensions and step length measurements using multiple regression analysis, the adjusted coefficient of determination (R^2) between stature and shoe size and step length were found to be 0.774 in the pooled sample. However, the stature estimation formula had a 3 – 4 cm. deviation used according to the gender and both genders. This is a similar standard error of estimate as reported by Fawzy and Kamalin determination of stature for Egyptian males (SEE 3.52 – 4.69 cm) [12]. Gilles and Valandigham suggested that shoe length was more reliable when used for stature estimation than shoe width, preferably as direct measurement but also indirectly as a shoe size indicator [8]. Similarity, Ekezie have shown a strong positive correlation between stature estimation and shoe length trace [13].

3.3 Sex prediction

Logistic regression analysis was conducted to evaluate the estimation of gender based on shoe size, shoe

dimensions and step measurements. The resulting formulae for gender estimation is:

$$\text{Gender} = 0.324(\text{shoelength}) - 2.029(\text{shoesize}) + 74.493 \quad (1)$$

In the formulae, Gender < 0.50 indicates the shoe belongs to a male, while Gender \geq 0.50 indicates the shoe belongs to a female. Correct estimation rates are shown in Table 5. The model correctly estimates the gender in 91.2% of the pooled sample, and 88.8% and 93.5% in the male and female groups, respectively.

Multiple formulae for calculating the gender using one or more measurements have been previously reported in the literature. Smith suggested that gender determination of the unidentified body parts can be made from distal and proximal phalanges with metatarsal bones. Using the models generated, it was observed that the determination of one's sex could be done with an 86 – 98% accuracy ratio [14]. Ozden et al. developed formulae with logistic regression analysis from foot and shoe sizes on the orthopedically healthy adult patients, and emphasized that it was helpful to find one of the shoes at the crime scene [10].

4. Conclusions

In conclusion, regression analysis of shoe size, shoe dimensions and step length measurements obtained from a representative mixed gender population was

Table 5. Percentages of correctly classified for gender prediction.

Groups	Correct	Incorrect	Percentage correct
Male	135	17	88.8
Female	157	11	93.5
Pooled sample	292	28	91.2

successfully used to develop models to estimate the stature and sex of an individual based on the above variables. The stature estimation formula has a 3 – 4 cm. deviation when used according to the gender and both genders, which agreed with other authors. The gender estimation model has an accuracy rate of > 88%. This suggests that that stature and sex estimation can be achieved with shoe size, shoe dimensions and step length measurements in populations similar to those analyzed in this study. The results from this study will have important applications in the identification the disaster victims and formulation of biological profiles during forensic investigations through the providing of the regression equations for stature and sex prediction from shoe dimensions and step length.

Acknowledgment

We would like to thank Dr. Lisa Kueltzo for comments on the manuscripts.

References

- [1] W. M. Krogman, M.Y. Iscan, *The human skeleton in forensic medicine*, Charles C. Thomas, Springfield, IL, 1986.
- [2] P. Hamer, C. Price, Case report: a transfer from skin to clothing by kicking the detection and enhancement of shoeprints, *Journal of the Forensic Science Society* 33(3) (1993) 169 - 172.
- [3] D. Atamturk, Estimation of sex from the dimensions of foot, footprints, and shoe, *Anthropologischer Anzeiger* 68(1) (2010) 21 – 29.
- [4] G. Laskowski, An improved technique for the visualization of footprint impressions in the insoles of athletic shoes, *Journal of Forensic Science* 32(4) (1987) 1075 – 1078.
- [5] M. Liukkonen, H. Majamaa, J. Virtanen, The role and duties of the shoeprint/toolmark examiner in forensic laboratories, *Forensic science international* 82(1) (1996) 99 – 108.
- [6] K. Krishan, A. Sharma, Estimation of stature from dimensions of hands and feet in a North Indian population, *Journal of forensic and legal medicine* 14(6) (2007) 327 – 332.
- [7] H. VanHoven, A correlation between shoeprint measurements and actual sneaker size, *Journal of Forensic Science* 30(4) (1985) 1233 – 1237.
- [8] E. Giles, P. Vallandigham, Height estimation from foot and shoeprint length, *Journal of Forensic Science* 36(4) (1991) 1134 – 1151.
- [9] A. O. Emeka, E. N. Michael, C. I. Euphemia, C. O. Obun, Stature prediction using whole print dimensions of an adult Nigeria, *Arab Journal of Forensic Sciences & Forensic Medicine* 1(8) (2018) 989 – 1003.
- [10] H. Ozden, Y. Balci, C. Demirustu, A. Turgut, M. Ertugrul, Stature and sex estimate using foot and shoe dimensions, *Forensic Science International* 147(2-3) (2015) 181 – 184.
- [11] T. Kanchan, R. G. Menezes, R. Moudgil, R. Kaur, M. S. Kottian, R. K. Garg, Stature estimation from foot dimensions, *Forensic Science International* 179(2-3) (2008) 241.e1 – 241.e5.
- [12] I. A. Fawzy, N. N. Kamal, Stature and body weight estimation from various footprint measurements among Egyptian population, *Journal of forensic sciences* 55(4) (2010) 884 – 888.
- [13] J. Ekezie, G. I. Ndubuka, S. B. Danborn, S. S. Okeke, I. W. Osuchukwu, A study of correlations and estimation of stature from foot trace and shoe trace dimensions, *International Journal of Forensic Sciences* 1(3) (2016) 1 – 13.
- [14] S. Smith, Attribution of foot bones to sex and population groups, *Journal of Forensic Science* 42(2) (1997) 186 – 195.



Examining the urine mitragynine concentration in Thai Kratom abusers and studying the effect of Beta-Glucuronidase in the analysis process

Phatraporn Chodchoy and Theerin Sinchai*

Department of Toxicology, Institute of Forensic Medicine, General Police Hospital, Bangkok, Thailand

Abstract

The objectives of this study were to examine the urine mitragynine concentration in Thai Kratom abusers and to study the effect of Beta-glucuronidase in the Analysis Process. Kratom (*Mitragyna speciosa* Korth) is an addictive plant in Thailand and is classified as a Penal Drug in Category-5 of the Thai Narcotics Act 2522 (1979), hence consuming Kratom in Thailand is still prohibited. Mitragynine is a major analgesic alkaloid in Kratom and it is responsible for the opioid effects of the substance. Cadaver urine samples ($n = 26$) and urine of the Kratom abused suspects ($n = 26$) were obtained from the Institute of Forensic Medicine, Police General Hospital, Royal Thai Police Headquarters from January 2017 to December 2017. All urine samples were divided into 2 groups, the first group was treated with Beta-glucuronidase enzyme before being measured while the second group was non-enzymatic treated. The results found that, in the cadaver group, the average concentration in the enzymatic treated group and the non-enzymatic treated group was 286.83 and 288.10 ng/mL respectively. Moreover, in the Kratom abused suspects group, the average concentration in the enzymatic treated group and the non-enzymatic treated group was 289.23 and 273.65 ng/mL respectively. The paired sample t-test indicated non-significant differences between enzymatic and non-enzymatic treated urine in both groups, and that the enzymatic processes are not necessary for the determination of urine mitragynine.

Keywords: Kratom, Mitragynine, Narcotics, drug abuse, urine, Beta-Glucuronidase

Article history: Received 16 September 2020, Revised 22 October 2020, Accepted 28 October 2020

1. Introduction

Kratom is a native plant found in Southeast Asian countries, especially in Thailand, Malaysia and Indonesia. This plant has a scientific name as *Mitragyna speciosa* Korth. and it is classified in the family Rubiaceae with a medium-sized perennial height of 10 – 15 meters. Kratom has various properties such as stimulating the nervous system resulting in an increase in work efficiency and reducing sleepiness among Thai laborers and farmers.

Although Kratom has some medical benefits, Kratom is still controlled in Thailand and classified as a category 5 substance, according to the Thai Narcotics Act 2522 (1979), which has low control and penalties. A large group of Kratom users often believes that Kratom is less dangerous than using other illicit drugs. Because it is easy to adopt and cheap, moreover, the misuse of Kratom plants in Thailand becomes increasing.

There are many ways to use kratom leaves. For instance, some users like to use simple methods such as chewing only fresh leaves while some prefer using in a dry powder form for smoking or brewing into tea. Recently, adolescence in Thailand tends to use

Kratom in a cocktail form such a recreational beverage as ‘4×100’ (pronounced: sii koon roi), which possesses the main ingredient as Kratom juice, sweet soft-drinks, antihistamine and several psychoactive drugs. Kratom leaves contain an important substance called mitragynine, which has the highest amount approximately of 66 percent by weight of Thai Kratom leaves. Mitragynine can bound to opioid receptors, therefore has the ability to reduce pain, which is similar to opioid analgesic drugs.

According to a systematic review made by Ya et al. [1], 2019, 85 – 95% of mitragynine is bound to plasma proteins and altered in the body via drug metabolism. Phase I metabolism is the main part and more process is in phase II. Phase II metabolism is a process to eliminate or reduce the toxicity of substances by changing the substance to a water-soluble form in order to be easily excreted through urine. During the second phase of biotransformation, xenobiotics reacts with glucuronidation, sulfation, methylation, acetylation, or glutathione and amino acid conjugation in order to obtain water-soluble substances. Ya et al. [1] evaluated from the results of Philipp et al. [2] study and concluded that urine samples also contained 10 – 30% Mitragynine. Philipp et al. [3], 2009 explored the Mitragynine metabolism in human and found those three metabolites were additionally

*Corresponding author; email: tsinchai@hotmail.com

Table 1. Urine mitragynine analysis in 2 groups and 2 conditions.

Group	Condition	N	Mean	S.E.	Range
Cadaver group	Enzymatic treated (A)	26	286.83	62.13	3.61 - 1,155.55
	Non-Enzymatic treated (B)	26	288.10	65.35	1.06 - 1,088.35
Kratom abuse suspected group	Enzymatic treated (C)	26	289.23	150.72	8.51 - 3,769.25
	Non-Enzymatic treated (D)	26	273.65	143.67	1.70 - 3,568.93

Table 2. Four cases of urine that contains more than 1000 ng/mL of mitragynine.

Type	Urine mitragynine concentrations		
	Non-enzymatic treated	With enzymatic treated	%difference
Cadaver	1088.35	1155.55	6.17
Cadaver	1075.27	811.59	-24.50
Kratom abuse suspected	1453.22	1460.26	0.48
Kratom abuse suspected	3568.93	3769.25	5.61

conjugated to glucuronides and three to sulfate.

Analytical Beta-glucuronidase is routinely used for the enzymatic hydrolysis of glucuronides and sulfate bonds of analytes prior to analysis. According to Le et al. [4], who studied about the necessity of enzymatic hydrolysis in the Mitragynine determination process, at Mitragynine concentrations of less than approximately 1,000 ng/mL, most of Mitragynine is excreted without conjugation, but only at concentrations of more than 1,000 ng/mL, the conjugated metabolites play a significant role.

As with other narcotic drugs, the identification method is used with Kratom to identify and determine the amount of the Mitragynine in urine. The Kratom abuse pattern in Thailand with regional characteristics is different from how it is used in European countries and America. To examine Mitragynine concentration in Thai Kratom abusers' urine and to prove the theory of Le et al. [4] are the objectives of this research.

2. Materials and Methods

The sample size for paired t-test analysis was calculated with Rosner's method, [5] equal to 16.68 samples, based on criteria: α (two-tailed) = 0.050, β = 0.100, Effect size = 0.500, $s(\Delta)$ = 0.630, r_{within} = 0.950. Twenty-six cadaver urine samples and twenty-six urine samples from Kratom abuse suspects were obtained from the Institute of Forensic Medicine, Police General Hospital, Royal Thai Police Headquarter from January 2017 to December 2017. Samples were collected in polypropylene tubes without preservative and analyzed within three weeks of the date of collection. Standard mitragynine solution (100 ug/mL in methanol) was purchased from Cerilliant®, Beta-glucuronidase Helix pomatia type HP-2 from SIGMA-ALDRICH®. In enzymatically treated groups, mixed 60 uL of Beta-Glucuronidase to 1 mL Urine in 50 uL of the 2M Sodium acetate buffer, and then incubated at 37 degrees Celsius for 2 hours. After such urine was processed with SPE extraction and sent the eluent to measure with LC-MS/MS (LC: Ultimate3000TM,

MS: TSQ Quantiva™) from Thermo Scientific®. For the ethical consideration, the study was approved by the Ethics Committee on Human Experimentation of Police General Hospital before being conducted. In addition, SPSS version 17 was used for statistical analysis.

3. Result

All cadaver urine samples ($n = 26$) were from male, with an average age of 29.65 years old and S.E. = 2.52. 50% of the cadavers were dead from traffic accident ($n = 13$), 7.7% of them were homicide cases ($n = 2$), 3.8% was a suicide case ($n = 1$) and the remaining 38.5% had the undetermined cause of death ($n = 10$). The urine samples of Kratom abuse suspects were from male ($n = 26$).

Twenty six cadaver urine samples were divided into 2 groups: the first group (group A) was treated with Beta-glucuronidase enzyme before extracting and measuring, and the second group (group B) was not treated with an enzyme. The means of mitragynine concentrations of group A and group B were 286.83 and 288.10 ng/mL respectively (Table 1). Paired t-test was adopted to analyze the difference between the two groups. The data revealed that paired mean differences \pm standard error of mean was 1.26 ± 15.23 and there was no statistically significant difference at the level of 0.01 ($t = 0.083$, $df = 25$, $p = 0.934$).

Likewise, 26 urine samples from the Kratom abuse suspects were applied in the same manner as above (Table 1). Group C was enzymatically treated while group D was a non-enzymatic treated group. The means of mitragynine concentrations of group C and group D were 289.23 and 273.65 ng/mL respectively. Paired t-test was used to analyze the difference between the two groups. The data revealed that paired mean differences \pm standard error of mean was 15.58 ± 8.14 and there was no statistically significant difference at the level of 0.01 ($t = 1.913$, $df = 25$, $p = 0.067$).

In non-enzymatic treat urine, the average mitragynine concentrations of cadavers and suspected groups

were very close. The result of the independent sample t-test of both groups show that the mean anxiety scores did not significantly differ, $t(50) = 0.092$, $p = 0.927$. Therefore, when combining the samples into one set (52 cases), the mean mitragynine in urine was 280.87 ± 78.14 ng/mL. As earlier reported, it is the mean urine mitragynine concentration in Thai Kratom abusers found in this study.

Of 52 cases, there are 4 cases in which urine mitragynine concentrations are greater than 1000 ng/mL (Table 2).

4. Discussion

From Tables 1, the average concentration of mitragynine in non-enzymatic treated of cadaver group was 288.10 ng/mL (range 1.06 – 1,088.35) which was similar to the study of McIntyre et al. [6], who reported that an autopsy of a 24-year-old man was detected Mitragynine in urine with the concentration of 370 ng/mL, while the other two studies provided higher values. For instance, Holler et al. [7] reported that a death involving abuse of propylhexedrine and mitragynine had urine mitragynine concentration of 1,200 ng/mL. Furthermore, Karinen et al. [8] reported that in the urine specimen of a case of fatal mitragynine combined with 3 drugs used (Zopiclone, Citalopram, and Lamotrigine), the concentration of mitragynine was 3,470 ng/mL.

An average mitragynine concentration of living people ($n = 26$) in this study was 273.65 ng/mL (range 1.70 – 3,568.93), which is near to or within the same range as a study of Le et al. [4], which analyzed the urine samples originated from drug court investigations and reported that the mitragynine concentrations ranged from 1.2 ng/mL to greater than 50,000 ng/mL ($n = 50$). Also, Nelsen et al. [9], who reported an unconscious and seizing male patient, the concentration of mitragynine in urine was 167 ng/mL.

Mitragynine concentrations found in both cadaver and the Kratom abuse suspects group in this study were close to the same value and lower than those reported in foreign countries, which may be the results of different addictive forms in different states.

The statistical test results in Table 1 show that the enzymatic processes are not necessary for the determination of mitragynine in a urine sample, which is consistent with the results in Table 2 in cases that the urine samples contain mitragynine with greater than 1000 ng/mL ($n = 4$). This finding is different from the theory of Le et al. [4]. However, the sample size in this group was too small to clarify or prove this theory. This phenomenon may use the work of Trakulsrichai et al. [10] to explain that mitragynine was excreted slightly (0.14%) through urine in unchanged form. Moreover, Philipp et al. [3] reported that six Phase II metabolites were found in human urine, three were additionally conjugated to glucuronides (9-O-demethyl mitragynine glucuronide, 16-carboxy

mitragynine glucuronide and 17-O-demethyl-16,17-dihydro mitragynine glucuronide) and the other three were conjugated to sulfate (9-O-demethyl mitragynine sulfate, 9-O-demethyl-16-carboxy mitragynine sulfate, and 9,17-O-bisdemethyl-16,17-dihydro mitragynine sulfate). Therefore, the enzymatic process supported to increase these six metabolites in a free form, but was worthless to increase the yield of the parent compound (Mitragynine).

5. Conclusion

According to the data obtained in this study, it can be concluded that most of mitragynine in the urine samples of Thai people is not greater than 1000 ng/mL. Considering about the necessity of the hydrolysis process with Beta-glucuronidase enzymes in mitragynine determination procedure, it found that monitoring Kratom or Krypton intake in urine using GC-MS in clinical was not necessary and this process could be skipped which gives an advantage to reduce time and costs. Thus, the enzymatic processes are not necessary for the determination of Mitragynine in urine.

6. Suggestion

This study provides the data of the mean mitragynine concentration in Thai people which is equal to 280.87 ± 78.14 ng/mL. According to Trakulsrichai et al. [10]'s theory, this concentration is equal to 0.14% of all mitragynine and metabolites, and can be checked easily with a basic test kit. Since there is no law specifying a mitragynine cut-off value in urine for a preliminary test kit in Thailand, the relevant committees can take this information into consideration for future legislation. In the following study, because of the samples from the cadaver are rare and the value is not different from the living person, the researcher should collect specimen from Kratom abuse suspects, which is easier and possible to increase the sample size in research and can explore more in detail.

References

- [1] K. Ya, W. Tangamornsuksan, C. N. Scholfield, J. Methanethorn, M. Lohitnavy, Pharmacokinetics of mitragynine, a major analgesic alkaloid in kratom (*Mitragyna speciosa*): A systematic review, *Asian Journal of Psychiatry* 43 (2019) 73 – 82.
- [2] A. A. Philipp, M. R. Meyer, D. K. Wissenbach, A. A. Weber, S. W. Zoerntlein, P. G. Zweipfenning, H. H. Maurer, Monitoring of kratom or Krypton intake in urine using GC-MS in clinical and forensic toxicology, *Analytical and Bioanalytical Chemistry* 400(1) (2011) 127 – 135.
- [3] A. A. Philipp, D. K. Wissenbach, S. W. Zoerntlein, O. N. Klein, J. Kanogunthornrat, H. H. Maurer, Studies on the metabolism of mitragynine, the main alkaloid of the herbal drug Kratom, in rat and human urine using liquid chromatography-linear ion trap mass spectrometry, *Journal of Mass Spectrometry* 44(8) (2009) 1249 – 1261.

- [4] D. Le, M. M. Goggins, G. C. Janis, Analysis of Mitragynine and metabolites in human urine for detecting the use of the psychoactive plant kratom, *Journal of Analytical Toxicology* 36 (2012) 616 – 625.
- [5] B. Rosner, *Fundamentals of Biostatistics*, fourth ed., Boston: Duxbury Press, 1995.
- [6] I. M. McIntyre, A. Trochta, S. Stolberg, S. C. Campman, Mitragynine ‘Kratom’ related fatality: a case report with post-mortem concentrations, *Journal of Analytical Toxicology* 39(2) (2015) 152 – 155.
- [7] J. M. Holler, S. P. Vorce, P. C. McDonough-Bender, J. Magluilo, C. J. Solomon, B. Levine, A drug toxicity death involving propylhexedrine and mitragynine, *Journal of Analytical Toxicology* 35(1) (2011) 54 – 59.
- [8] R. Karinen, J. T. Fosen, S. Rogde, V. Vindenes, An accidental poisoning with mitragynine, *Forensic Science International* 245 (2014) e29 – 32.
- [9] J. L. Nelsen, J. Lapoint, M. J. Hodgman, K. M. Aldous, Seizure and coma following Kratom (*Mitragynina speciosa* Korth) exposure, *Journal of Medical Toxicology* 6(4) (2010) 424 – 426.
- [10] S. Trakulsrichai, K. Sathirakul, S. Auparakkitanon, J. Krongvorakul, J. Sueajai, W. Wananukul, Pharmacokinetics of mitragynine in man, *Drug Design, Development and Therapy* 9 (2015) 2421 – 2429. (in Thai)



Effect of chemical fertilizer on leaf nutrient concentration and fruit quality of rose apple (*Syzygium jambos* L.) cv. Tabtimjan

Pongnart Nartvaranant*

Division of crop production technology, Faculty of Science and technology,
Nakhon Pathom Rajabhat University, Nakhon Pathom, Thailand

Abstract

The effect of chemical fertilizer on leaf nutrient concentration and fruit quality of rose apple (*Syzygium jambos* L.) cv. Tabtimjan was studied in Ratchaburi Province, Thailand. The different chemical fertilizer doses applied to the rose apple tree by soil application was used as treatment, 2 kg/tree and 0.5 kg/tree of 17-17-17 chemical fertilizer formula. Both of chemical fertilizer doses were based on the farmer used in on and off season. The results showed that the different chemical fertilizer doses did not statistically affect ($t > 0.05$) to leaf nutrient concentration of rose apple. The leaf nitrogen (N) concentration was 1.51-1.79% and 1.47- 1.77% for 2 kg/tree and 0.5 kg/tree, respectively. The leaf phosphorus (P) concentration was 0.11-0.17% and 0.13-0.17% for 2 kg/tree and 0.5 kg/tree, respectively. The leaf potassium (K) concentration was 1.06-1.98% and 1.04-1.52% for 2 kg/tree and 0.5 kg/tree, respectively. While, there was significant difference in soil N, P and K concentration in some period of the study which 2 kg/tree gave the higher soil N, P and K concentration than those in 0.5 kg/tree ($t < 0.05$). For fruit quality, there was no significant difference in fruit quality but using 2 kg/tree gave the lower TSS:TA in December and February than those in 0.5 kg/tree ($t < 0.05$). From the results, it was concluded that the higher chemical fertilizer dose (2 kg/tree) applied to the rose apple trees did not significantly increase the leaf nutrient concentration as the optimum leaf nutrient concentration had met by the low chemical fertilizer dose (0.5 kg/tree) applied to the rose apple tree. Therefore, the 0.5 kg/tree chemical fertilizer dose should be optimum for the rose apple production.

Keywords: chemical fertilizer, leaf nutrient concentration, fruit quality, rose apple, *Syzygium jambos* L.

Article history: Received 28 June 2020, Revised 8 November 2020, Accepted 10 November 2020

1. Introduction

Rose apple (*Syzygium jambos* L.) is one of the economic fruit crops in Thailand that can be exported to many countries and has generated good income for farmers especially the cultivar Tabtimjan. However, chemical fertilizer has been extremely used for rose apple production which it was unsuitable dose of chemical fertilizer applied to the rose apple trees. This situation occurred because farmers lacked the farmers' knowledge about the appropriate amount of chemical fertilizers. Those may result in the residual effect to the soil and make soil deterioration. [1] reported that the over-use of chemical fertilizer decreased soil microbial population and imbalance soil nutrient occurred due to salt stress which according to [2] reported that the long-term use of inorganic fertilizers without organic supplements damages the physical, chemical and biological properties of soil and causes environmental pollution. Moreover, unsuitable chemical fertilizer used would make the high cost in rose apple production resulted in the decreasing income. The change of farmer behavior in using chemical fertilizer would be successful if the suitable chemical

fertilizer dose was established and distributed to the farmer. Therefore, the objective of this study was to investigate effect of chemical fertilizer on leaf nutrient concentration and fruit quality of rose apple (*Syzygium jambos* L.) cv. Tabtimjan.

2. Materials and Methods

Ten rose apple cultivar Tabtimjan orchards in Damnoen Saduak District, Ratchaburi Province, Thailand were selected for this study during August 2017 to February 2018. The sites were located in north latitude N 13 3105.515800 and east longitude E 99 57017.592600. The tropical climate is characterized by average annual temperature of 27 C and average annual rainfall of 1000-1250 mm. Ten orchards were separated into 2 groups (five orchards each group) with the different chemical fertilizer dose used. Thus, the treatment of this study was as followed:

Treatment 1 low dose of chemical fertilizer (0.5 kg/tree)

Treatment 2 high dose of chemical fertilizer (2.0 kg/tree)

Both treatments were the chemical fertilizer dose used by the farmer. All treatment used 17-17-17 chemical fertilizer formula applied to the soil. In each

*Corresponding author; email: pongnart@webmail.npru.ac.th

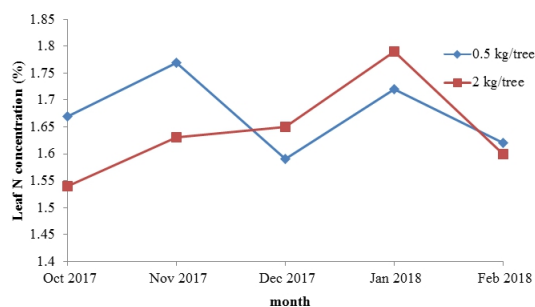


Figure 1: Effect of chemical fertilizer on leaf N concentration (%) in rose apple.

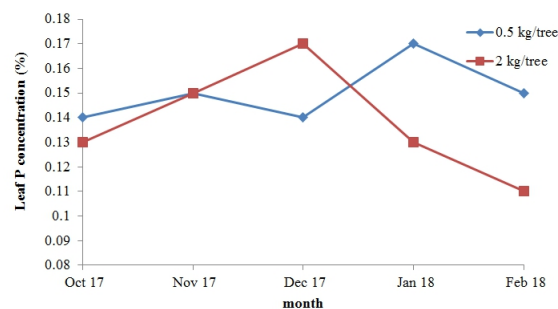


Figure 2: Effect of chemical fertilizer on leaf P concentration (%) in rose apple.

orchard, 5 uniform sizes and ages (approximately 5 year old trees) of rose apple trees were chosen for leaf sampling. The 2nd, and 3rd leaf position from the growing tip of the first flush after harvest from around the canopy (four directions, North, East, West, and South) were sampled at one month intervals [3]. Four exposed leaves of each leaf position from around canopy in each tree were collected to make composite samples nutrient analysis. The rose apple trees were watered every 23 days. The leaf N, P and K concentrations were determined in rose apple leaves following the method mentioned below. Soil and plant samples were taken to laboratory for soil physical property analysis, soil pH analysis, soil nutrient analysis and plant nutrient analysis by methods as describe below.

2.1 Plant nutrient concentration analysis

The sampled leaves were washed with distill water and dried at 70 C for 72 hr. The dried leaves were ground to pass a 0.40 mm diameter (40 mesh) screen before taking for plant nutrient analysis. From this dried material the N, P and K concentration were determined. The subsample of leaves was digested with sulfuric acid (H_2SO_4)-hydrogen peroxide (H_2O_2). Levels of N were determined using the MicroKjeldahl Method. P and K were extracted by nitric acid (HNO_3)-perchloric acid ($HClO_4$) (5:1) then the solution was left to cool down. Phosphorus in solution was determined calorimetrically by the Molybdate-vanadate yellow color method. Potassium was determined using an atomic absorption spectrophotometer. All plant nutrient analysis was done at the Soil Plant and Agricultural Material Testing and Research Unit, Central Laboratory, Kasetsart University, Kamphaeng Saen Campus.

2.2 Soil property analysis

Composite soil samples were collected at 0 - 15 cm depth below the surface near fruit trees using auger at the edge of canopy. The soil samples were collected avoiding the applied fertilizer site. The samples were collected and taken to the laboratory for soil chemical property testing included pH, soil ECe, N, P and

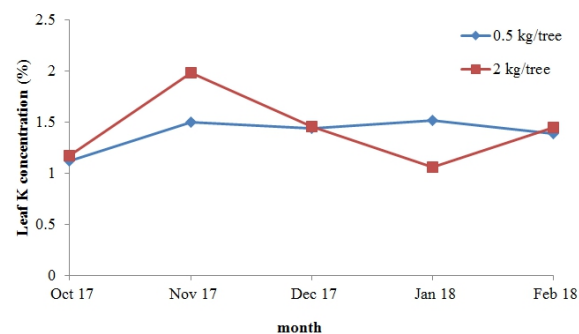


Figure 3: Effect of chemical fertilizer on leaf K concentration (%) in rose apple

K concentrations. The methods used for soil chemical property analysis and soil nutrient analysis were identified in Table 1.

2.3 Fruit quality measurement

5 fruits from each tree were collected for fruit quality measurement totally 125 fruits per treatment (25 fruits each orchard). Total soluble solid (TSS), Total acidity (TA), fruit texture and fruit color were measured at fruit harvest in December 2017, January 2018 and February 2018.

2.4 Statistical analysis

Statistical analysis of the data was performed by t-test at 0.05 significant levels.

3. Results and Discussion

Effect of chemical fertilizer on leaf N, P and K concentration was studied and found that using 2 kg/tree chemical fertilizer gave no significant difference in leaf N, P and K concentration compared to using 0.5 kg/tree chemical fertilizer ($t > 0.05$). The leaf nitrogen (N) concentration was 1.51-1.79% and 1.47-1.77% for 2 kg/tree and 0.5 kg/tree, respectively. The leaf phosphorus (P) concentration was 0.11-0.17% and 0.13-0.17% for 2 kg/tree and 0.5 kg/tree, respectively. The leaf potassium (K) concentration was 1.06-1.98% and 1.04-1.52% for 2 kg/tree and 0.5 kg/tree, respectively (Fig. 1 - Fig. 3).

Table 1. Effect of chemical fertilizer on soil N concentration (mg.kg^{-1}) in rose apple orchard.

Treatment	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
0.5 kg/tree	71.05	53.29	71.05	52.10	84.07	122.50	132.53
2.0 kg/tree	80.52	97.10	142.10	74.60	138.55	165.78	184.73
t-test	ns	*	*	ns	ns	ns	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

Table 2. Effect of chemical fertilizer on soil P concentration (mg.kg^{-1}) in rose apple orchard.

Treatment	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
0.5 kg/tree	856.58	776.39	1,128.76	1,378.23	1,380.84	672.26	2,501.01
2.0 kg/tree	1,668.22	1,364.75	3,770.12	1,246.78	1,285.28	2,508.51	1,504.13
t-test	ns	ns	ns	ns	ns	*	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

Table 3. Effect of chemical fertilizer on soil K concentration (mg.kg^{-1}) in rose apple orchard.

Treatment	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
0.5 kg/tree	603.20	517.72	736.97	665.91	668.14	395.65	883.35
2.0 kg/tree	825.02	781.38	700.47	670.76	704.85	1,074.53	901.32
t-test	ns	ns	ns	ns	ns	*	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

Table 4. Effect of chemical fertilizer on Soil pH in rose apple orchard.

Treatment	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
0.5 kg/tree	6.76	7.08	6.77	6.31	6.32	7.00	6.48
2.0 kg/tree	4.79	4.93	5.41	6.05	5.47	4.74	5.50
t-test	*	*	ns	ns	ns	*	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

Table 5. Effect of chemical fertilizer on Soil ECe in rose apple orchard.

Treatment	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
0.5 kg/tree	2.32	1.43	1.38	3.59	3.39	2.91	3.29
2.0 kg/tree	2.27	2.06	2.51	4.09	3.71	4.27	4.46
t-test	ns	ns	ns	ns	ns	*	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

Effect of chemical fertilizer on soil N, P and K concentration was also studied and found that different chemical fertilizer dose used had affected on soil N concentration (Table 1). Using 2.0 kg/tree had the higher soil N concentration than those in 0.5 kg/tree in September and October 2017 ($t < 0.05$). While, chemical fertilizer gave significant difference in soil P concentration in January 2018. As 2.0 kg/tree had the higher soil P concentration ($2,508.51 \text{ mg.kg}^{-1}$) than those in 0.5 kg/tree ($672.26 \text{ mg.kg}^{-1}$) (Table 2). Also, chemical fertilizer gave significant difference in soil K concentration in January 2018. 2.0 kg/tree had the higher soil K concentration ($1,074.53 \text{ mg.kg}^{-1}$) than those in 0.5 kg/tree ($395.65 \text{ mg.kg}^{-1}$) (Table 3).

Moreover, effect of chemical fertilizer on soil pH and Ec was studied. The results indicated that using 2.0 kg/tree chemical fertilizers had effect on soil pH

which gave the significantly lower soil pH than those in 0.5 kg/tree in Aug 2017 Sep 2017 and Jan 2018 (Table 4). While, using 2.0 kg/tree chemical fertilizers tended to give the higher soil Ec than those in 0.5 kg/tree but there was no significant difference ($t < 0.05$) except in January 2018 (Table 5).

For fruit quality, there were no significant difference in fruit color (a,b, L value), fruit texture, TSS and TA of rose apple harvested in December 2017, January 2018 and February 2018 (Table 6-8) but there was significant difference in TSS:TA. Using chemical fertilizer at 0.5 kg/tree gave the higher TSS:TA (16.57 and 13.84) than those in 2.0 kg/tree (8.29 and 11.20) in December 2017 and February 2018, respectively (Table 6 and 7).

The results from this study indicated that the different chemical fertilizer dose (2.0 kg/tree and 0.5

Table 6. Effect of chemical fertilizer on fruit quality of rose apple harvested in December 2017.

Treatment	a*	b*	L*	Texture (kg.)	TSS (°Brix)	TA (mole/L)	TSS:TA
0.5 kg/tree	21.15	8.76	27.12	2.03	8.45	0.51	16.57
2.0 kg/tree	20.42	8.83	28.09	1.96	7.96	0.96	8.29
t-test	ns	ns	ns	ns	ns	ns	*

ns indicated non -significant difference at the significant level of 0.05.

*indicated significant difference at the significant level of 0.05.

Table 7. Effect of chemical fertilizer on fruit quality of rose apple harvested in January 2018.

Treatment	a*	b*	L*	Texture (kg.)	TSS (°Brix)	TA (mole/L)	TSS:TA
0.5 kg/tree	22.45	9.27	27.62	2.51	8.57	0.55	15.58
2.0 kg/tree	23.14	8.93	25.95	2.24	8.06	0.53	15.20
t-test	ns	ns	ns	ns	ns	ns	ns

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

Table 8. Effect of chemical fertilizer on fruit quality of rose apple harvested in February 2018.

Treatment	a*	b*	L*	Texture (kg.)	TSS (°Brix)	TA (mole/L)	TSS:TA
0.5 kg/tree	23.30	9.83	26.83	1.90	7.89	0.57	13.84
2.0 kg/tree	23.88	9.99	29.75	2.08	7.28	0.65	11.20
t-test	ns	ns	ns	ns	ns	ns	*

ns indicated non -significant difference at 0.05 significant level as analyzed data by t-test.

*indicated significant difference at 0.05 significant level as analyzed data by t-test.

kg/tree) gave no significant difference in leaf N, P and K concentrations. Using 2.0 kg/tree gave 1.511.79%, 0.11-0.17% and 1.061.98% for N, P and K respectively and using 0.5 kg/tree gave 1.47-1.77%, 0.13-0.17% and 1.04 1.52% for N, P and K respectively. However, leaf nutrient concentrations found in this study were in suitable range for rose apple except K which was very high level. [3] reported that standard leaf nutrient concentrations in rose apple were 1.45 1.85%, 0.08 - 0.18% and 0.41- 0.79% for N, P and K, respectively. From those results, it indicated that using the high dose of chemical fertilizer (2.0 kg/tree) did not result in higher nutrient absorption of rose apple than those in low dose (0.5 kg/tree). This is due to the concentration of nutrient absorbed from the soil occurred as much as it's necessary for plant growth. Therefore, the over use of chemical fertilizer would make the residual effect to the soil and make soil deterioration [7]. For fruit quality, using the high dose of chemical fertilizer did not effect to fruit quality compared to the low dose. Thus, the dose of 0.5 kg/tree should be suitable for plant growth and development in rose apple cv. Tabtimjan in this study.

For soil nutrient concentration, using 2.0 kg/tree trend to give the high soil nutrient concentration as there was significant difference in some months. These may be that using 2.0 kg/tree resulted in the residual effect of chemical fertilizer and soil deterioration could be occurred. The consideration of leaf nutrient concentration showed that there was no significant difference in leaf nutrient concentration between the different chemical fertilizer doses. These indicated that nutrient absorption for plant growth and development in both using dose was similar. The residual ef-

fect of chemical fertilizer could be occurred in the 2.0 kg/tree using dose. Moreover, the using 2.0 kg/tree dose gave the lower soil pH than those in 0.5 kg/tree with significantly different in August 2017 September 2017 and January 2018. These could be the effect of unsuitable used chemical fertilizer. While, using 2.0 kg/tree tend to give the higher soil E_{ce} (2.01 5.51 dS/m) than those in 0.5 kg/tree (1.38-3.59 dS/m). [5] reported that the suitable soil E_{ce} was < 2 dS/m which this level will not have any effect to plant growth. Therefore, using 2.0 kg /tree has an increased chance of increasing soil E_{ce} which adversely affects plant growth and development of more than 0.5 kg / plant.

The results from this study according to [8] who reported that using chemical fertilizer decreased soil pH compared to using organic fertilizer in yellow poplar (*Liriodendron tulipifera* Lin.). [2] reported that using high dose of NPK fertilizer can decrease soil pH in soybean growing area and the chemical fertilizers at higher doses have deleterious effects on plant growth and development. In apple, it has been reported that using more chemical fertilizer increased soil acidity [9]. While, [10] revealed that the application of only organic manures maintained the good health of soil, they were slow to release adequate nutrients timely and only inorganic fertilizers application could affect the soil health, which in turn may affect flowering and fruiting. [11] determined that high doses of complex NPK fertilizers broadcast annually across the rows in pear, blackberry and strawberry plantings, induced disturbances in mineral nutrition, primarily due to the accumulation of higher amounts of K and increases in the soil acidity. While, the low dose of chemical fertilizer did not have any effect on fruit quality but in-

duced the high TSS:TA compared to those in the high dose of chemical fertilizer. These revealed that the 0.5 kg/tree was suitable dose for rose apple production in this study.

From all of the results, using high dose of chemical fertilizer (2.0 kg/tree) trended to give the residual effect to the soil and could make the soil deterioration in the long term. Soil pH from the orchard used the high dose of chemical fertilizer was lower than the suitable level and high soil acidity in many period of time. Moreover, using 0.5 kg/tree could give the suitable nutrient concentration for plant growth and fruit quality very similar to those from using 2.0 kg/tree. Thus, using low dose of chemical fertilizer (0.5 kg/tree) would be able to decrease the cost, to maintain soil fertility and to meet the nutrient need of rose apple.

4. Conclusions

From all results it can be concluded that using 0.5 kg/tree of chemical fertilizer should be the appropriate dose of chemical fertilizer used for rose apple production because it gave no significant difference in leaf and soil nutrient concentration compared to using 2.0 kg/tree. Whereas, using 2.0 kg/tree of chemical fertilizer showed the higher soil pH and lower soil ECe than those in using 0.5 kg/tree of chemical fertilizer. Moreover, using 0.5 kg/tree of chemical fertilizer also gave the higher TSS:TA than those in using 2.0 kg/tree. Finally, the optimum leaf nutrient concentration could be met by using 0.5 kg/tree.

References

- [1] M.S. Coyne, Soil microbiology: An Exploratory Approach - Laboratory Workbook, Delmar Publishers Inc. Albany, NY, 1999.
- [2] M. A. Sheikh, P. Dwivedi, H. S. Dwivedi, Impact of Chemical Fertilizer and Organic Manure on the Germination and Growth of Soybean (*Glycine max* L.), *Advances in Life Science and Technology* 31 (2015) 73 – 77.
- [3] P. Nartvaranant, Determination suitable sample method of rose apple (*Syzygium jambos* L.) for evaluation of plant nutrient status, *Journal of Plant Nutrition* 41(20) (2018) 2741 – 2748.
- [4] M. Peech, Hydrogen-Ion Activity. In: Black CA, editor, *Methods of soil analysis part 2*, USA: American society of Agronomy, Inc., Publisher, 1965.
- [5] R. Beck, *Soil analysis handbook of reference methods*, USA: Soil and Plant Analysis Council, Inc., CRC Press, 1999.
- [6] R. H. Bray II, L. T. Kurtz, Determination of total, organic and available forms of phosphorus in soils, *Soil Science* 59 (1945) 39 – 45.
- [7] Y. Osotsapha, A. Wongmaneeroj, C. L. Hongprayoon, *Fertilizer for sustainable agriculture*. Bangkok, Thailand: Kasetsart University Press, 2008.
- [8] S. H. Hana, J. Y. Anb, J. Hwangc, S. B. Kima, B. B. Park, The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (*Liriodendron tulipifera* Lin.) in a nursery system, *Forest Science and Technology* 12(3) (2016) 137 – 143.
- [9] T. Milosevic, N. Milosevic, The effect of zeolite, organic and inorganic fertilizers on soil chemical properties, growth and biomass yield of apple trees, *Plant soil and environment* 55(12) (2009) 528 – 535.
- [10] M. S. Ullah, M. S. Islam, M. A. Islam, T. Haque, Effects of organic manures and chemical fertilizers on the yield of brinjal and soil properties, *Journal of Bangladesh Agricultural University* 6(2) (2008) 271 – 276.
- [11] P. I. Glisic, M. T. Milosevic, S. I. Glisic, T. N. Milosevic, The effect of natural zeolites and organic fertilizers on the characteristics of degraded soils and yield of crops grown in Western Serbia, *Land Degradation and Development* 20(2009) 33 – 40.



Practicum model development for professional educational administration in digital era

Jiraporn Supising^{1,*}, Somsak Phuvipadawat², Choocheep Puthaprasert³,
Prapan Thammachai³, and Thanat Boonchai³

¹Educational Administration, Graduate School, Western University, Kanchanaburi, Thailand

²Faculty of Education, Chiang Mai University, Chiang Mai, Thailand

³Educational Administration, Graduate School, Chiang Mai Rajabhat University, Chiang Mai, Thailand

Abstract

The objectives of this research were 1) to analyze professional standards, practicum, and competencies for educational administration, 2) to investigate problems, guidelines for solution, and factors supporting to practicum, 3) to draft, verify, and evaluate a practicum model and model user's guide, and 4) to implement and study the practicum model and model user's guide. Key informants were selected by purposive sampling. Instruments used were a structured interview form, an open-ended question, and a 5 rating-scale questionnaire. Data were analyzed by percentage, mean, standard deviation, content analysis, and summarizing. Results were as follows: 1. The professional standards, practicum, and competencies had suitability and feasibility into practice; 2. The most important problem was the practicum preparation, a guideline for solution was to prepare a practicum calendar, and a factor supporting to practicum was there should be a Memorandum of Understanding (MoU); 3. A draft model of practicum consisted of 5 elements, the verification results in accuracy was at 98.07 percent, and suitability was at 98.06 percent; and the evaluation results in possibility was at a high level and utility was at the highest level; 4. The students' satisfaction were at highest level. The faculty supervisors recommended that the students should have more time for practicum. The complete model of practicum for professional educational administration in digital era was 'ROOGC (western) +M' model.

Keywords: Practicum, model, professional educational administration, digital era

Article history: Received 21 August 2020, Revised 3 November 2020, Accepted 4 November 2020

1. Introduction

According to the National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002) [1], stipulated in section 53 that there should be an Organization for Teachers, Educational Institution Administrators, and Educational Administrators. The organization should have the powers and duties for setting professional standards; issuing and withdrawal of licenses; overseeing maintenance of professional standards and ethics; and developing of the profession of teachers, educational institution administrators, and educational administrators. Teachers, administrators of educational institutions, educational administrators and other educational personnel of both the state and private sectors shall have professional licenses as provided by the law. Moreover, Teachers and Educational Personnel Council Act B.E. 2546 (2003) [2], which was a law regarding educational professions stipulating in section 43 that the educational profession was a controlled profession, consisting of profession of teachers, school administrators, and educational administrators that should be a

licensed profession under this act, and other licensed professions should be stipulated in ministerial regulations.

In terms of practicum (also called work placement) is a course involving activities emphasizing the practical application of the field of school administration and educational administration during studying according to the curriculum authorized by Professional Standard Bureau [3]. The certified criteria had stipulated a compulsory course description in the curriculum, consisting of standards, knowledge, and competencies in each standard not less than the determination of Teachers Council of Thailand, have activity management lesson plans enhancing school administrative leadership and educational administrative leadership periodically throughout courses.

While education in the age of globalization became into a borderless education with the influence of digital technology development, educational administrators should had the ability to use information and communication technology as a tool for educational development in order to increase the efficiency of educational administration, create professional advancement of teachers, school administrators and the school

*Corresponding author; email: supising.jiraporn@gmail.com

quality consistent with Suphat [4]. mentioned in the 20-Year Long Range Plan on Higher Education of Thailand (2018 - 2037) that proposed the higher education reform to determine the role of higher education institutions as a service provider and the Higher Education Commission as a regulator and facilitator to be clearly that could be viewed as all dimensions of development consisting of the quality products that were produced by higher education, built a network of partnerships with all sectors including digital technology was used in learning and teaching as well as administrative management in higher education institutions seriously. Additionally, Teera [5], gave suggestions for the development of administrators to have an international vision, proactive administration, responsibility, the changes, and educational reforms, including professionalism in educational administration the age of educational reforms that required to develop standards and control the profession and promoted continuous professional development.

The profession of school administrators and the educational administrators are one of the high professions. The educational administration practicum was a supervised administrative experiences in several role specialization areas. The general purpose of the practicum was to give students an opportunity to experience diverse working situations. Therefore, it was duties, responsibilities of the higher education institutions as production sectors to develop administrators and relevant agencies had the cooperation in production and development graduates in educational administration to have quality in accordance with Regulation of the Teachers Council of Thailand on Professional Code of Conduct [2] that certified a practicum in school administration and educational administration to have competencies in digital era.

However, the educational administration had the dynamics of change rapidly in digital era affected to the experiences of students in school administration and educational administration. The exist practicum model was not still fit in digital era, the researcher gave the priority of the practicum for educational administration in digital era for students studying major in educational administration, Graduate School, Western university who were all over Thailand and must have direction for practicum model which was in the different school context and practicum sectors. In addition, the researcher must develop a practicum model for professional educational administration in digital era belonging to Western university to be more efficiency and the other higher education institutions could applied for practicum.

2. Research Questions

2.1 What are the suitability and possibility into practice of the professional standards, practicum standards, and practicum competencies for educational administration?

2.2 What are problems, guidelines for solution, and factors supporting to practicum for professional educational administration?

2.3 What are the results of drafting, verifying, and evaluating a practicum model and model user's guide for professional educational administration in digital era?

2.4 What are the implementation results of the practicum model and model user's guide for professional educational administration in digital era?

3. Research Objectives

3.1 To analyze the professional standards, practicum standards, and practicum competencies for educational administration.

3.2 To investigate problems, guidelines for solution, and factors supporting to practicum for professional educational administration.

3.3 To draft, verify, and evaluate a practicum model and model user's guide for professional educational administration in digital era in digital era.

3.4 To implement and study the practicum model and model user's guide for professional educational administration in digital era.

4. Materials and Methods

The research process was divided into three phases as follows:

Phase 1: Analyzing the professional standards, practicum standards, and practicum competencies for educational administration was divided into 2 steps:

Step 1.1: The documents and the related researches were studied, analyzed, and synthesized in terms of the professional standards, practicum standards, and practicum competencies for educational administration, data were analyzed by content analysis.

Step 1.2: The record of a structured interview was summarized in terms of the suitability and possibility by twelve key informants consisting six directors or representatives of directors under Chiang Mai Primary Educational Service Area and six school directors as students' employers, data were analyzed by content analysis.

Phase 2: Investigating problems, guidelines for solution, and factors supporting to practicum for professional educational administration was divided into 3 steps:

Step 2.1: The documents and the related researches were studied, analyzed, and synthesized in terms of problems, guidelines for solution, and factors supporting to practicum for professional educational administration.

Step 2.2: The record of a structured interview was summarized in terms of 1) Plan (P), 2) Do (D), 3) Check (C), and 4) Act (A) by nine students studying

major in educational administration, Western university in academic year 2019.

Step 2.3: The obtained data were synthesized and selected issues to draft a model.

Phase 3: Drafting, verifying, and evaluating a practicum model and model user's guide for professional educational administration in digital era were divided into 3 steps:

Step 3.1: The researcher used the analysis results from phase 1 and phase 2 to draft a model by applying the concepts of Teera [5], consisting of 5 model elements as follows: 1) rationale, 2) objectives, 3) operations and activities, 4) guidelines for evaluation, 5) conditions for achievement. A manual of model implementation was drafted consisted of 5 elements, as follows: 1) introduction, 2) objectives and activities, 3) guidelines: the beginning, during, and termination, 4) how to write a report, and 5) evaluation.

Step 3.2: A draft of practicum model and model user's guide for professional educational administration in digital era were verified the accuracy and appropriate by nine experts to participate in connoisseurship, data were analyzed by frequency and summarizing the important issues.

Step 3.3: A draft of practicum model and model user's guide for professional educational administration in digital era were evaluated the possibility and utility by nine school administrators as students' employers, data were analyzed by mean and standard deviation.

The draft of practicum model and model user's guide for professional educational administration in digital era were developed according to experts from connoisseurship by the researchers.

Phase 4: Implementing and studying the practicum model and model user's guide for professional educational administration in digital era were divided into 3 steps:

Step 4.1: The developed practicum model and the developed model user's guide were implemented at North-Chiang Mai University, informants were fifteen students, selected by purposive sampling who were studying master's degree major in educational administration major and practicum in academic year 2020 to be inquired concerning the satisfaction of practicum model and model user's guide for professional educational administration in digital era with a five-rating scale questionnaire, data were analyzed by mean and standard deviation.

Step 4.2: Six faculty supervisors participated in focus group discussion for recommendations concerning the practicum model and model user's guide for professional educational administration in digital era, data were analyzed by summarizing in issues.

Step 4.3: The practicum model for professional educational administration in digital era researchers were developed again according to recommendations and summarizing to be a complete model.

5. Results and Discussion

Phase 1: Analyzing results of interviewing in terms of the suitability and feasibility of into practice professional standards, practicum standards for school administration and educational administration, and competencies for school administration and educational administration, it was found as follows:

1.1 Concerning professional standards were suitability and feasibility into practice, the recommendations were that the Teachers Council of Thailand should certify to the universities that the curriculum had been certified by the Ministry of Higher Education, Science, Research and Innovation. There should be the coordination to set criteria and to stipulate the number of students together in order to be able to be used the educational qualification in applying for a professional license of a school administrator and an education administrator.

1.2 Concerning practicum standards were suitability and feasibility into practice, the recommendations were that there should be clear regulations for practicum sectors to cooperate in preparation of mentors with administrative knowledge including coordination of the school administrators of students to request for consideration to allows students for practicum as a duty without being regarded as a business leave.

1.3 Concerning competencies for school administration and educational administration were suitability and feasibility into practice, the recommendations were that there should be the competency stipulations as announced by the Teachers Council of Thailand Board according to the Teachers Council of Thailand regulations on professional standards B.E. 2556 (2013).

On the other hand, National Center on Education and the Economy [7] mentioned teacher and principal quality in South Korea concerning Ministry guidelines specify that these programs should be 180 hours over 30 or more days and that the content was 70-80 percent related to school administration/management, with the remaining courses focused on broader education topics. There was also training for vice-principal qualifications.

Phase 2: Concerning problems, guidelines for solution, and factors supporting to practicum for professional educational administration in terms of 1) Plan (P), 2) Do (D), 3) Check (C), and 4) Act (A), the obtained data were selected in issues to draft a model. The details were shown in Table 1.

The problems, guidelines for solution, and factors supporting to practicum in Thailand might be quite different from the study of Beatriz et al. [4] because other countries might provide several types of training, but through different government levels, depending on governance contexts, so it is not a coherent model of provision. In Norway and Denmark, for example, pre-service and induction training might be carried out by

Table 1. Synthesized results of problems, guidelines for solution, factors supporting to practicum, and selected issues to draft a model.

Aspects	Problems	Guidelines for solution	Factors supporting to practicum	Selected issues to draft a model
1. Plan (P) refers to the readiness preparation, building knowledge and understanding, explanation of objectives, consulting, work planning, the cooperation in guidelines of working and plan checking.	- Students were not notified in advance, so they did not prepare to take leave, exchanged for teaching periods in order to practicum for professional educational administration.	- Send documents to students several days in advance in order to prepare to ask for permission. -prepare a practicum calendar -notify practicum sectors in advance.	- Organize a meeting to explain the details of the practicum for professional educational administration, such as the objectives of the practicum and the schedule in accordance with the regulations of the Teachers Council of Thailand. - Coordinate with practicum sectors for the preparation the practicum for professional educational administration in advance.	- Practicum planning and notifying students in advance. - Building a positive attitude in practicum for students. - Providing a meeting to explain the practicum details for students. - Cooperation with practicum sectors in advance.
	- Students lacked of knowledge, understanding, and readiness in practicum for professional educational administration.	- There should be the activities building awareness regarding practicum and attitudes towards the professional educational administration.		
2. Do (D) refers to the coordination and creating friendship with practicum sectors, perform duties as assigned, team working, volunteering, working to achieving objectives / goals.	- Notified letter of practicum was delayed, some areas, some schools had a lot of mission, there was not enough personnel, which made it not convenient for practicum.	- Coordinate with the Educational Service Area Office which was practicum sectors in advance.	- Create a friendly relationship between Western university and the Educational Service Area Office which was a practicum sector for professional educational administration. - Have a Memorandum of Understanding (MoU) among Western University and practicum sectors. - Supervising of students' practicum and giving students' suggestions on daily.	- Graduates in the major of educational administration must have qualifications in accordance with professional standards in practicum for professional educational administration and practicum competencies as the regulations by the Teachers Council of Thailand. - Have a cooperation among universities (Graduate production sections), school Administrators (Graduate employers), educational administrators, educational sectors (Educational Service Area) and other sectors that cooperated with students development. - Participation from the beginning, such as constructing practicum model and model user's guide for professional educational administration. - A memorandum of understanding (MoU) should be established among relevant sectors to use digital technology for supervision, following-up, and evaluation the practicum.
	- Students had problems with administrators of their own schools.	- Building a good relationship of supervision between faculty supervisors and school administrators of students.	- Building confidence and self-improvement, realize values and meaning of practicum for professional educational administration including love and faith in the profession.	
	- Students did not realize the importance of practicum only doing practicum for graduation.	- Helping, advising, creating encouragement and promoting the professional progress of students.		
	- Students did not study new knowledge or innovation development of practicum for professional educational administration.	- Building competencies, skills, and potential of professional administrators.	- Supporting the practicum skills, management system, and the process of the professional educational administration.	
3. Check (C) refers to the summary of working, supervision, following-up, and evaluation by faculty supervisors, mentors or assigned persons.	Students were not able to practicum full time.	The faculty supervisors always asked for problems of practicum sectors.	Accept student problems and solve problems immediately.	- Studying problems, guidelines for solution, and factors supporting to practicum model for professional educational administration. - Providing activities for preparation to build knowledge and understanding for students regarding practicum. - Providing a meeting among relevant sectors.
	-Students did not have permission from the parent school to practicum.	-Adjust the schedule to match with the practicum center.	Follow-up on practicum for educational administration.	
	- Students did not obtain all-round knowledge of educational administration from practicum sectors and practicum schools.	Building an understanding among practicum sectors, practicum school, parent schools of students, and faculty supervisors.	- Providing a meeting for preparation before practicum. - Providing meetings, seminars, and lessons learned.	
4. Act (A) refers to the operational improvement, correction, and work improvement, the achievement analysis, the use of digital technology to help in supervision, monitoring, evaluation and extension.	- There was no daily progress report form of practicum for professional educational administration.	- Prepare a daily progress report form of practicum for professional educational administration.	- Report the progress of practicum for professional educational administration to Western University.	- The readiness of establishments and had potential to provide good professional experiences for students. - The graduate employers who were the coordinators for graduate production were supported and developed graduates to have professional qualifications. - The students who had practicum to have a professional characteristics in digital era.
	- Students who lived in the remote area, the faculty supervisors could not visit for supervision.	- The use of digital technology for supervision, follow-up and evaluation of practicum for professional educational administration to Western University was a must.	- Prepare an agreement between the Teachers Council of Thailand and faculty supervisors to use digital technology for supervision, follow-up and evaluation of practicum for professional educational administration.	

the municipality, but it was not documented at the national level. In Finland as well, the three types might be available for principals at the municipal level.

Phase 3: Draft, verify, and evaluate a practicum model and model user's guide for professional educational administration in digital era was divided into 3 steps as follows:

Step 3.1: The researcher used the results from phase 1 and phase 2 to draft or develop The researcher used the results from phase 1 and phase 2 to draft or develop the model by applying the concepts of Teera [5], consisting of 5 model elements and the model user's manual which consisted of 5 elements.

Step 3.2: A draft of practicum model and model

user's guide for professional educational administration in digital era were verified by nine experts to participate in connoisseurship consisted of 5 elements, data were analyzed by frequency and summarizing the important issues.

The verification results of the draft of practicum model in terms of accuracy was at 98.07 percent, and suitability was at 98.06 percent; and the verification results of the draft of model user's guide in terms of accuracy was at 94.72 percent, and suitability was at 97.89 percent.

Step 3.3: The practicum model and model user's guide for professional educational administration in digital era were evaluated the possibility and the utility by nine school administrators as students' employers, data were analyzed by mean and standard deviation.

The evaluation results of the draft of practicum model in terms of possibility was at a high level (Mean = 4.35, S.D. = 0.60) and utility was at the highest level (Mean = 4.77, S.D. = 0.43) and the evaluation results of the draft of model user's guide in terms of possibility was at the highest level (Mean = 4.50, S.D. = 0.54) and utility was at the highest level (Mean = 4.83, S.D. = 0.38).

However, the practicum model and model user's guide were developed for giving students an opportunity to experience diverse working situations and develop graduates in educational administration to have quality in accordance with the Teachers Council of Thailand regulations on Professional Code of Conduct B.E. 2556 (2013) [6] that certified a practicum in school administration and educational administration to have competencies in digital era.

Phase 4: Implement and study the implementation results of the practicum model and model user's guide for professional educational administration in digital era was divided into 3 steps:

Step 4.1: The practicum model and model user's guide were implemented at North-Chiang Mai University, informants were fifteen students studying master's degree major in educational administration and practicum in academic year 2020 to be questioned concerning the satisfaction of practicum model and model user's guide for professional educational administration in digital era with a five-rating scale questionnaire, data were analyzed by mean and standard deviation. It was found that the inquire results concerning the satisfaction of practicum model and model user's guide for professional educational administration in digital era were overall at the highest level (Mean = 4.78, S.D. = 0.82).

Step 4.2: Six faculty supervisors participated in focus group discussion for recommendations concerning the practicum model and model user's guide for professional educational administration in digital era, data were analyzed by summarizing issues.

The problems of implementing the practicum model and model user's guide were found that the students

had less time for practicum, there should be more time for practicum and students could learn more concerning knowledge contents and professional competencies in the practicum for professional educational administration in digital era.

Step 4.3: Correcting according to recommendation and summarizing to be a complete model was 'ROOGC (western) +M' consisted of

1. Rationale consisted of

1.1 Graduates in the major of educational administration must have qualifications in accordance with professional standards in practicum for professional educational administration and practicum competencies as the regulations by the Teachers Council of Thailand.

1.2 It is a collaboration among universities (Graduate production sections), school Administrators (Graduate employers), educational administrators, educational sectors (Educational Service Area) and other sectors that cooperated with students' development.

2. Objectives consisted of

2.1 Practicum planning and notifying students in advance.

2.2 Building a good attitude in practicum for students.

2.3 Providing a meeting to explain the practicum details for students.

2.4 Cooperation with practicum sectors in advance.

3. Operations and activities consisted of

3.1 Studying problems, guidelines for solution, and factors supporting to practicum model.

3.2 Providing activities for knowledge preparation for students regarding practicum.

3.3 Providing a meeting among relevant sectors.

3.4 Determining criteria and guidelines for student development to have the characteristics of being a professional administrator in digital era.

3.5 There was a supervision to follow up the development of students to have the characteristics of being a digital professional management consistently and throughout the practicum.

3.6 Evaluation for improvement for next implementation.

4. Guidelines for successful evaluation consisted of

4.1 Participation from the beginning, such as constructing practicum model and model user's guide for professional educational administration in digital era.

4.2 Providing activities for building knowledge and understanding of professional educational administrators regarding the content knowledge, and competency for students.

4.3 There was a practicum model of cooperation among relevant sectors.

4.4 A Memorandum of Understanding (MoU) should be established among The Teachers Council of Thailand, universities, and faculty supervisors to use digital technology for supervision, following-up, and evaluation the practicum for professional educational administration.

4.5 Students had knowledge and understanding of professionals in educational administrators regarding the content knowledge and competencies.

4.6 Student satisfaction concerning the implementation of the practicum model and model user's guide.

5. Conditions for achievement consisted of

5.1 W = Work place referred to the readiness of establishments and had potential to provide good professional experiences for students according to the curriculum philosophy.

5.2 E = Employers referred to graduate employers who were the coordinators for graduate production and developed graduates to have professional qualifications.

5.3 S = Students referred to the students who had practicum to have a professional characteristics in digital era.

5.4 T = Teamwork referred to the cooperation among relevant sectors.

5.5 E = Evaluation referred to all-rounded of the student development with full of potential suitable with the roles in digital era.

5.6 R = Reflection referred to the reflection of positive attitude to practicum for professional educational administration.

5.7 N = Network referred to the network among relevant sectors.

6. Model user's guide consisted of

6.1 Introduction consisted of reviewing the objectives and ethics of practicum for professional educational administration in digital era; explaining the usage and benefit of model.

6.2 Objectives and activities consisted of the compulsory of practicum according to the Teachers Council of Thailand as well as how to use practicum model.

6.3 Practicum guidelines: the beginning, during, and termination consisted of how to choose a workplace, ask permission from the relevant sectors, and how build the cooperation among relevant sectors, suggest how to build relationships, and the practicum details.

6.4 How to write a practicum report consisted of how to record daily and what we gain from this practicum.

6.5 Practicum evaluation consisted of the criteria of university evaluation form and relevant sectors.

Likewise, Phubet and Choocheep [9] who studied a model of work-integrated learning to prepare educational administrators for Thailand, the model con-

sisted of 8 components: principles, objectives, system, operational methods (requirement analysis, integration, and assessment), conditions for achievements, definitions and description, evaluation and measurement, and manual of model implementation.

It may be because the shortage of administrative position during digital era in Thailand, therefore the process to product administrators is necessary to recruit educational personnel for the accession seriously in order to select the qualified administrators. As a result, there are a variety of models for practicum to develop the administrators to keep up with the digital era.

6. Conclusion

It could be said that this practicum model for professional educational administration was more suitable in digital era. In many countries, a high qualification of academic was not enough to qualify for professional educational administration in digital era, the practicum was provided an opportunity for graduates to earn real hands-on experience with the best practice schools. Moreover, the use of social media for communication in the relevant groups was very advantageous during supervision. It could be save time in terms of face-to-face interaction. However, the social media in digital era was potential for faculty supervisors to do their duty.

7. Recommendations

From this research, the recommendations are made as follows:

7.1 This practicum model for professional educational administration in digital era is a model for applying in digital era especially for supervision in remote area.

7.2 The university partnership network can apply for supervision for the next semester.

7.3 The Teachers Council of Thailand should realize on the duration of practicum for professional educational administration to be suitable in digital era and create the instruments for practicum evaluation.

8. Recommendation for Further Research

8.1 There should be the studying of the practicum model for professional educational administration in digital era in order to share the achievement, the failures and the problem solutions to develop the practicum model.

8.2 There should be a Memorandum of Understanding (MoU) should be established among The Teachers Council of Thailand, universities, and faculty supervisors to use digital technology for supervision, following-up, and evaluation this practicum for professional educational administration to keep on with changes.

Acknowledgment

I would like to express to thank you university partnership network, North-Chiang Mai University, The Far Eastern University, Chiang Mai Rajabhat University, and Chiang Mai University for cooperation.

References

- [1] Office of the National Education Commission, Office of the Prime Minister, National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545). <http://www.moe.go.th/main2/plan/p-r-b42-01.htm>, (accessed 9 February 2019).
- [2] Royal Thai Government Gazette, Teachers and Educational Personnel Council Act B.E. 2546. <https://person.mwit.ac.th/01-Statutes/TeacherPersonnelAct.pdf>, (accessed 9 February 2019)
- [3] Professional Standard Bureau, Secretariat Office of the Teachers Council of Thailand, The conduct of certifying the degrees of educational certificates for professional practice license B.E. 2557.
- [4] J. Suphat, 20-Year Long Range Plan on Higher Education of Thailand, B.E. 2561–2580 (2018-2037). <http://www.mua.go.th/users/bpp/main/download/plan/plan20yrs.pdf>, (accessed 9 February 2019)
- [5] R. Teera. Professional in educational management and administration in educational reform era. Bangkok: Khaofang Publishing, 2007.
- [6] Royal Thai Government Gazette, Regulation of the Teachers Council of Thailand on Professional Code of Conduct B.E. 2556. <http://site.ksp.or.th/download.php>, (accessed 9 February 2019)
- [7] National Center on Education and the Economy. South Korea: Teacher and Principal Quality. <https://ncee.org/what-we-do/center-on-international-education-benchmarking/top-performing-countries/south-korea-overview/south-korea-teacher-and-principal-quality>, (accessed 9 February 2019)
- [8] P. Beatriz, N. Deborah, M. Hunter, Improving school leadership. <http://www.oecd.org/education/school/44374889.pdf> (accessed 9 February 2019)
- [9] P. Phubet, P. Choocheep, A model of work-integrated learning to prepare educational administrators for Thailand, *Interdisciplinary Research Review* 15(3) (2020) 7 – 13.



The use of semantic field approach to enhance English vocabulary development of Prathomsuksa 4 students at Betty Dumen Border Patrol Police School, Phayao Province, Thailand

Phitsinee Sathientharadol *

School of Liberal Arts, University of Phayao, Phayao, Thailand

Abstract

This research aimed to analyze numbers of English vocabulary proficiency in Prathomsuksa 4 students after using the semantic field instruction, to present semantic field teaching instruction contributing to the development of the students' English vocabulary retention proficiency, and to analyze the students' satisfaction towards the teaching instruction. The participants of the research were 12 Prathomsuksa 4 students, at Betty Dumen Border Patrol Police School. The instruments of this study included lesson plans using semantic fields to develop students' vocabulary proficiency, pre-test and post-test, and a questionnaire. The study found that the English vocabulary proficiency of the participants had a statistically significant increase ($p = 0.01$) after the use of the English vocabulary instruction process through the semantic field and the relations between words in the semantic field could contribute to the students' vocabulary retention with the statistical better performance in recalling the meaning of the vocabulary. Furthermore, the students' attitude towards learning and teaching English were labeled as "Extremely Satisfied".

Keywords: Semantic field application, English vocabulary teaching and learning

Article history: Received 26 June 2020, Revised 6 November 2020, Accepted 10 November 2020

1. Introduction

English as an international language has been widely promoted in every level of education for decades including in Thailand. However, the Department of Education reported that in 2018, there were 13.24% (23,015 of 173,837 students) of the primary school students in Bangkok who could not read or write in English. As well as Bangkok's primary students, the students nationwide have encountered the same problem. It is undeniable that one of many factors claimed by the public as a cause of this problem is a traditional teaching method which focuses on passive learning or teacher-centered that views teacher as a controller whereas students are listeners which is ineffective [1]. For 21- century students who need communication, collaboration, critical thinking, and creativity skills, using the only traditional method in a classroom does not "allow students to express themselves, ask questions, and direct their learning", then make them bored and may miss important issues [2]. As a result, many worldwide types of research on teaching English as a foreign language have been developing to ameliorate the problem such as Khatib (2011) [3], Khalid and Azeem (2012) [4], Gang (2014) [5], Esbri (2014) [6], etc.

Linguistics as the scientific study of language also takes part in this responsibility in the way that Syarif (2016) [7] said "Linguistics as the scientific study of language has a very crucial role in running language instruction. Changes in language teaching-learning methods reflect the development of linguistic theories." For linguists, they view language in terms of a system of symbols for communication and to transfer information, vocabulary plays a significant role corresponding to Wilkins (1972: 111-112) who stated "Without grammar, very little can convey. Without vocabulary, nothing can be conveyed" [8]. In language teaching and learning, the more vocabulary the students know, the more proficiency they could attain. Besides, the indispensableness of vocabulary in language teaching and learning is also emphasized by Kanoksilapatham and Khamkhian (2012) that to succeed in studying English, vocabulary skill development is necessary [9]. Common European Languages Framework of Reference in Languages (CEFR) which is an international standard for describing language ability also uses vocabulary size for communication to measure levels of English proficiency from breakthrough to mastery. Therefore, learning vocabulary is a necessary key to achieve language proficiency.

A semantic field is a linguistic approach proposed for explaining interrelations between words or vocabulary in a particular category such as synonym-

*Corresponding author; email: phitsineesai@gmail.com

antonym, and superordinate-subordinate. It has been applied to English vocabulary teaching and learning several times by many researchers in different levels of subjects. For example, Guo (2010) conducted research with Chinese college students [10]. Phuriudomseth (2010) studied in Thai secondary school students [11]. All of them found that applying the semantic field to vocabulary teaching and learning is more effective than the traditional way. Later, Gao and Xu (2013) [12], Wangru (2016) [13], and Boran, (2018) [14] proposed the application of the semantic field to EFL vocabulary teaching.

Betty Dumen Border Patrol Police School is one of the border patrol police schools. It is located in Phayao Province, northern Thailand. It is a boarding school with 110 students and 12 teachers in 2018. With approximately 1 teacher per 9 students, it seems sufficient for an effective classroom, yet most teachers are border patrol polices – they are not professional teachers. The problem towards Thai and English learning and efficiency are arisen and cause the students' illiteracy in Thai and English because most of the students (about 80%) are ethnic groups who study Thai and English as their 2nd and 3rd languages. Many problems are obstructing the students' English learning development such as insufficiency of instructional media and teachers, the difficulty for both teachers and students to reach resources of knowledge because of its remote location. Then, the students' English proficiency is affected as the O-NET (Ordinary National Educational Test) score in English of Prathomsuksa 6 students in 2015 was 24.79% while the national scores were 40.31%. Under these conditions, one way to resolve the illiteracy of the students is starting with finding an appropriate vocabulary instruction method which is simple but effective in terms of vocabulary learning processes. Since the semantic field is a model presenting how the human brain organizes information naturally, and several related research studies have proved that it is effective for EFL vocabulary learning. However, Phuriudomseth (2010) suggested that it would be effective for intermediate or high proficient students and most research conducted the experiments with the secondary and college students. This research is therefore influenced by these semantic field studies and vocabulary teaching and learning [15, 16] to develop English vocabulary instruction process through the use of semantic field and analyze numbers of English vocabulary proficiency in Prathomsuksa 4 students at Betty Dumen Border Patrol Police School after using the semantic field.

2. Objectives of the Study

The objectives of this study included the following:

1. To present semantic field teaching instruction that could develop the students' proficiency.
2. To analyze numbers of English vocabulary proficiency in Prathomsuksa 4 students after using the in-

struction.

3. To analyze the students' satisfaction towards the teaching instruction.

3. Literature Review

Two fields are integrated into this research: vocabulary learning and semantic field approach.

3.1 Vocabulary teaching and learning

Several scholars suggested ways to enhance the students to master English skills as a foreign language by starting with learning vocabulary words such as Brown and Payne (1994), Nation (2001), and others.

Brown and Payne (1994) propose 5 steps in learning vocabulary in a foreign language: (1) encountering new words, (2) getting a clear image, either visual or auditory or both of the forms of the new words (3) learning the meaning of the words (4) making a strong memory connection between the forms and the meanings of the words, and (5) use the words.

While Brown and Payne (1994) presented effective teaching and learning vocabulary procedures, Nation (2001), Frost (2019) [17], and Kanoksilapatham and Khamkhian (2012) provide 3 essential things of word knowledge needed to be learned: (1) form including the words' pronunciation and their spelling, (2) meaning including the words' concepts and semantic relations or mind mapping, (3) use of words including grammatical functions, collocations, and contexts of word used.

These suggestions on vocabulary teaching and learning could be grouped into 5 aspects that the instructors should be aware of. They include word form, pronunciation, meaning and the connections or relations to other words, and its use in a real-world situation.

3.2 Semantic field and vocabulary teaching-learning

"The vocabulary of a language is not simply a listing of independent items, but is organized into areas (of fields) within which words inter-relate and define each other in various ways." [18].

From this statement, the semantic field could be viewed in broad and narrow definitions. With the broad definition, Crystal (2011) defined "An area of human experience or perception, like color, that is delimited and subcategorized by a set of interrelated vocabulary items in a language." [19]. Besides, the semantic field could be prospective in a more specific meaning as Lehrer (1985) defined it as "A set of lexemes which cover a certain conceptual domain and which bear certain specifiable relations to one another." [20]. Moreover, Nordquist (2017) stated that the field is usually expressed by the theme of words that share some common properties such as body parts, colors, and food [21].

In teaching and learning vocabulary Tanner and Green (1989: 29) said that vocabulary should be taught in lexical sets mentioned in their statement that “We don’t store words in our brains in alphabetical order like a dictionary does [22]. Research into memory has shown that we store words in our brain in groups of related words (or lexical sets). Words that are related are joined together in our brains; if a new word can be hooked to words which are already stored, it might be easier to remember it. It would seem logical therefore that we should teach words in lexical sets to our learners, so that it is easier for them to retain and store the words in their memory”

Examples of semantic or lexical relations connecting those vocabularies consist of synonymy, antonymy, hypernymy, hyponymy, holonymy and meronymy. These relations link vocabulary in various ways:

By synonymy or the similar meaning such as pretty-cute, test-exam

By antonymy or the opposite meaning such as good-bad, up-down, light-dark

By hypernymy-hyponymy or the generic-specific meaning such as tree-oak, institute-school, country-Thailand

By holonymy-meronymy or the whole-part image as shown in bus-wheels, table-legs, hand-fingers

Boran (2018) emphasized the systematic interrelation of vocabulary and suggested that “EFL/ESL teachers should always remember that, human brain stores words in relation to other. If words are taught in relation to each other as semantic fields of sense relations, EFL/ESL teachers facilitate students’ learning of English vocabulary.”

3.3 *Applications of Semantic field to vocabulary teaching and learning*

There are several research studies applying the semantic field to vocabulary teaching and learning.

Guo (2010) compared the development in learning English vocabulary of the 104 second-year non-English majors from Jiangxi University of Science and Technology students instructed by two teaching methods: Grammar Translation for the control group and application of semantic field for the experiment group. According to Zimmerman (2003), it focuses on translating new vocabulary with native-language equivalents and a test [24]. With this traditional teaching method, Chen (2010) transcribed it into the following methods [25].

1. The teacher reads aloud the new words, and students repeat after the teacher.

2. The teacher explains some keywords chosen from the material, usually by offering meanings and sentence examples.

3. The teacher interprets vocabulary exercises.

4. The teacher gives dictations to check whether students have mastered the new words.

At the same time, the experiment group was instructed with a semantic field that follows Brown and Payne’s steps of teaching vocabulary:

1. Pre-reading brainstorming of the words in the same field. For example, learners are asked to do the brainstorming concerning romance.

2. Getting the pronunciation, spelling and meaning of the new words. The students read the passage and guess the meaning of new words from the context in which they are used.

3. Constructing semantic fields based on various semantic relations. The teacher should find appropriate words to set up semantic fields of the new items, and at the same time make the presentation procedure an interesting learning process for the students.

4. Consolidation during passage analysis. The students were asked to analyze the paradigmatic and syntagmatic relations between words in the reading passage with the semantic fields constructed previously.

5. Revision of word knowledge. Exercises with stimulus words to the students newly learnt words were provided.

The study took two hours a week and lasted 15 weeks in total. The results of this study revealed that there was a significant difference in the post-test between the experimental and control groups.

As mentioned earlier, Phuriudomseth (2010) studied English Vocabulary Achievement and Retention of 49 Mathayomsuksa 3 Students (Grade 12) of Patumwan Demonstration School Srinakharinwirot University Learning through the Use of Semantic Field Approach. The study took 1 hour and 40 minutes a week and lasted 8 weeks. The findings presented that by applying a semantic field to English vocabulary learning the students could achieve a significantly higher score from their pre-test ($p = 0.01$) and they still remembered the vocabulary they have studied for 2 weeks at least. The research applied the semantic field to her teaching plans and followed them step by step as summarized below.

1. Determine the scope of teaching by considering the appropriate vocabulary for the study and categorize them by semantic relations such as synonymy and antonymy.

2. Analyze the semantic features of each group of words.

3. Establish lesson plans.

4. Introduce each lesson by giving the students some keywords, then asking them to write the shared meaning of those words in worksheet 1, and then the instructor gives the correct answer and asks the students to pronounce each word after her.

5. Discuss the meaning of each word presented in worksheet 2 with the students and asks them to analyze the semantic features of each word.

6. Discuss collocations of the words and gives the students some examples.

7. Ask the students to work in a group discussing

synonymy and antonymy, then fill the correct word in worksheet 3, and present them the correct answer.

8. Ask the students to create their sentences using the new word learnt previously.

Wangru (2016) applied the semantic relations to the semantic network linking new words and known words of the English vocabulary of 120 Chinese students from the school of Mathematics at Henan Polytechnic University. The instruction method was transcribed into the following steps:

1. Determine the scope of teaching based on objectives of each lesson, for example, learn about understand friendship.

2. Learn some useful words and sentences such as trust, respect, affection, and life without a friend is death.

3. Describe people's appearances, clothes, characters, and hobbies.

4. Introduce the lesson by a free talk with the students and follow up questions, for example, "Who is the impressive person in your mind?" and "What impressed you most?"

5. Present the students the prepared words to describe persons and their semantic network through the teaching media.

6. Practice using those words in context by letting the students ask their friends about people's characters such as "Who is he in the picture?", "Why do you choose him as your friend?", "What is his figure?", "And how about his stature?"

7. Give the students some homework by asking them to make up a new dialogue and write a short passage related to the topic.

The results of the research showed that the students were satisfied with the learning and they believed that they had better learning achievement in basic knowledge, reading, writing, and vocabulary acquisition.

However, all these research studies were conducted with the students in secondary school and higher education who can read and write, and have sufficient background knowledge in English vocabulary to study semantic relations such as synonymy, or antonymy. In contrast, the target group of this study is Prathomsuksa 4 or grade 7 students who are illiterate. Therefore, it is the teacher's job to analyze semantic relations of the words and create networks to show the semantic field, then create a story based on the networks as an example for the students.

4. Research Methodology

To achieve the research objectives, the researcher divided the research methodology into 2 processes: developing the semantic field application processes, and research experiment.

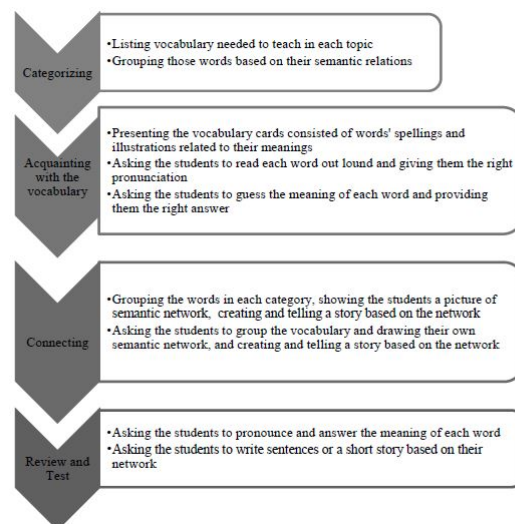


Figure 1: The vocabulary instruction processes by using the semantic field ((Hantrakul, A. et al., 2019: 19) [26].

4.1 Synthesizing and developing the semantic field application processes from the related researches

At this stage of the research, the researcher reviewed the related researches on the application of the semantic field approach to vocabulary teaching and learning. Then synthesized those instruction processes into 5 steps as followed.

These steps include (1) Preparing the vocabulary by categorizing them first based on their semantic relations to create semantic fields (2) Warming up by guiding the students about the topic of the lesson (3) Listing the vocabulary about the topic (4) Demonstrating the meaning of each word, semantic network of the words listed, and stating semantic relations (5) Practicing the use of each vocabulary in the real context or situation. These steps seemed to be effective to enhance the ability in memorizing the vocabulary if the students can read and already know the meanings of the words they have learned. However, these 5 steps are still not completed in terms of vocabulary teaching processes because they skipped the step of acknowledging the vocabulary pronunciation and their images based on Brown and Payne (1994).

Then, the researcher has developed the semantic field instruction processes by considering Brown and Payne (1994), Nation (2001), and Kanolsilapatham and Khamkhien (2012) who propose the teaching English vocabulary methods. It was shown in Fig. 1.

The vocabulary learning processes through the semantic field proposed here include a total 4 steps: categorizing, acquainting with the vocabulary, connecting, and test as explained below step by step.

4.1.1 Categorizing

Before teaching, a teacher has to list all needed vocabulary in each topic and then categorize them into

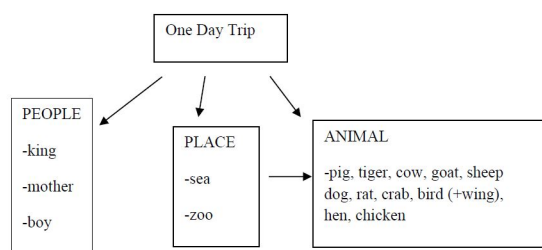


Figure 2: A Semantic Network on the topic “One Day Trip”.

groups by considering their semantic relations within the group such as hypernymy and hyponymy, and holonymy and meronymy. Then designed the lesson plan by teaching each group at a time. For example, an animal group is consisted of the word “cow”, “dog”, “tiger”, “pig”, and “sheep”. A place group is composed of “sea” and “zoo”. The relation connected with these groups is hypernymy and hyponymy.

4.1.2 Acquainting with the vocabulary

At this step, the teacher showed each vocabulary card of a group. In each card, there must be an illustration of each word’s meaning with its spelling. Then the teacher pronounced each word clearly and asked the students to repeat it loudly or let the students try to pronounce it themselves. Later, let them guess the meaning of each word by its picture, and the teacher gave them the correct answer. Next, the teacher repeated this step until the students had learned every word in the group.

4.1.3 Connecting

List all vocabulary in the group, and gave the students an example of a semantic connection. Then show the students a picture of a semantic network as illustrated in Fig. 2, create and tell a story based on the network as the example. Next, ask the students to group the vocabulary and drawing their semantic network, and creating and telling a story based on the network.

The illustration presents the semantic network on the topic “One Day Trip” which presented the vocabulary about people, place, and animal. After presenting the picture, the teacher will let the students work in groups and created their own networks and stories.

4.1.4 Review and test

After practicing to a group and connect each group of words, the teacher will review the students’ vocabulary knowledge by asking them to tell the meaning of each word by looking at its spelling. If they could not give the right answer, then the teacher pronounced that word and asked them again. If they still could not give the right answer, then the teacher showed them the picture of that word and asked them again. If they

could not give the right answer, then the teacher gave them hints from the stories or network they created and asked them again. Finally, test the students by showing a list of words and asking them to tell the meaning of each word.

After developing these instruction processes, the researcher conducted one group experiment research to test the teaching model mentioning in the next topic.

4.2 Research experiment

This part of the research was divided into 4 parts: participants, instruments, data collection, and data analysis.

4.2.1 Participants

The participants were 12 Prathomsuksa 4 students at Betty Dumen Border Patrol Police School. They are comprised of 4 females 8 males who were taught by the traditional teaching method due to the insufficiency of the professional teachers. The reason why the Prathomsuksa 4 students became the subjects or participants of the research is that the students at this level of education are expected to achieve at least 3 aspects of learning standards declared by the Ministry of Education of Thailand (2008) include pronunciation, reading competence at the sentence level, and providing some personal information, yet the students here could not read and write in English. To fulfil these expectations, the students have to know the numbers of vocabulary first. Besides, Prathomsuksa 4 students were purposively selected because Prathomsuksa 5-6 students are unavailable since the school has to prepare them for the ONET.

4.2.2 Research instruments

The instruments used in this research included:
1. Lesson plan using semantic fields to develop students’ vocabulary proficiency
2. Pre-test and post-test
3. Questionnaire.

4.2.1.1 Lesson Plan using semantic fields to develop students’ vocabulary proficiency

Using the semantic field for categorizing data is a guideline for the teacher to help the students categorize the meanings of the vocabulary they have learned and provide them some linking concept that might help them to remember the meanings easier. The vocabulary was purposively selected based on English alphabet sound system matched sight words from English Glossary for Primary School (Office of the Basic Education Commission, 2016) because this research is a part of the Development of English Abilities of Prathomsuksa 4 Students through an Integration of Phonics, Semantic Fields, and Syntax for an Invention of Personal Narratives on Local Experience project. The process of the project was started with the English sound system to develop the students’ pronunciation, then moved onto this semantic process by applying the semantic field to enhance the vocabulary memorizing

Table 1. Outline of Lesson Plan.

Period/40 minutes	Category	Vocabulary	Materials & Activities
1	People	People: mother, boy Organs: ear, nose, legs	-Flashcards -Semantic Mapping
	Verbs	breathe, watch	-storytelling
2	Animals	pig, tiger, cow, goat, sheep, dog, rat, carb	
	Animals with wings	bird, duck, chicken, hen	
3	Number, Thing	Number: five Thing: mop, dish, ball	
	Review	Semantic mapping	

of the students. Finally, the syntax was used to create sentences.

With these steps of the integration, the semantic process plays an important role as a cognitive connection of sounds, words, and sentences. That's the reason why the researcher decided to use these vocabularies.

The example presented people, animals, things, and events that could be found in a village and school. The semantic relations illustrated in the figure included holonymy and meronymy, and hypernymy and hyponymy. After grouping data into fields, the brief outline of the lesson plans could be written as shown in Table 1.

This lesson plan was used for 1 week or 3 times. Each time took 40 minutes after classes. Since the participants were Prathomsuksa 4 students and many of them couldn't read or spell English words, a total of 44 vocabularies learnt in 40 minutes would be overloaded. Therefore, about 3-5 groups of words or not more than 15 words in a time seemed to be more appropriate.

4.2.1.2 Pre-test and Post-test

Written pre-test and post-test were all 44- vocabulary listed in random order. Only criterion used for scoring is the correct meaning (written in Thai) of each word. The tests were examined in terms of the IOC (Item-Objective Congruence Index) valued of 0.94 by 3 experts in linguistics before using it with the participants.

4.2.1.3 Questionnaire

The questionnaire was used to survey the teacher and students' satisfaction towards the semantic field instruction process. There were 3 questions asked in Thai which could be translated as 1. Learning English vocabulary via this method (the semantic field) is appropriate for the students' level 2. Learning English vocabulary via this method helps the students to acquire the vocabulary's meanings easier 3. I like Learning English vocabulary with this method.

4.2.3 Data collection

The researcher collected the pre-test score a month before starting the research because based on the project, the students had to pass the pronunciation process first. The post-test was conducted after finishing the instruction processes for a week since it is an

appropriate period for testing the retention (Hawhan, 1979).

4.2.4 Data analysis

Analysis of the data has been done by using mean, standard derivation, and t-test for mean scores.

5. Results

The results of the tests were analyzed and revealed in 2 parts: the vocabulary proficiency test and Students' and Teacher's attitude towards semantic field application shown in Table 2, 3, and 4 respectively.

5.1 Pre-test and post-test scores

From the test, the result showed that the increase in the students' scores was statistically significant as presented in Table 2.

Table 2. Results of the vocabulary tests.

44 Voc.	n	\bar{x}	S.D.	t	p
Pre-test	12	34.58	4.42	-6.45*	0.000
Post-test	12	41.25	3.74		

*0.05 ($p < .05$)

Table 3. Teacher's Attitude towards Semantic Field Application.

Questions	Teacher (1)		
	\bar{x}	S.D.	Label
1. Learning English vocabulary via this method is appropriate for the students' level.	4	0	Satisfied
2. Learning English vocabulary via this method helps the students to acquire the vocabulary's meanings easier.	5	0	Extremely Satisfied
3. I like Learning English vocabulary with this method.	5	0	Extremely Satisfied

The data presented in Table 2 illustrated that the students could recall more vocabulary with a mean score of 41.25 after learning the vocabulary. Besides, the t-score was -6.45 and the p value presented a statistically significant increase at 0.01.

These results implied that applying the vocabulary learning processes through the semantic field could enhance the students' proficiency in learning English vocabulary.

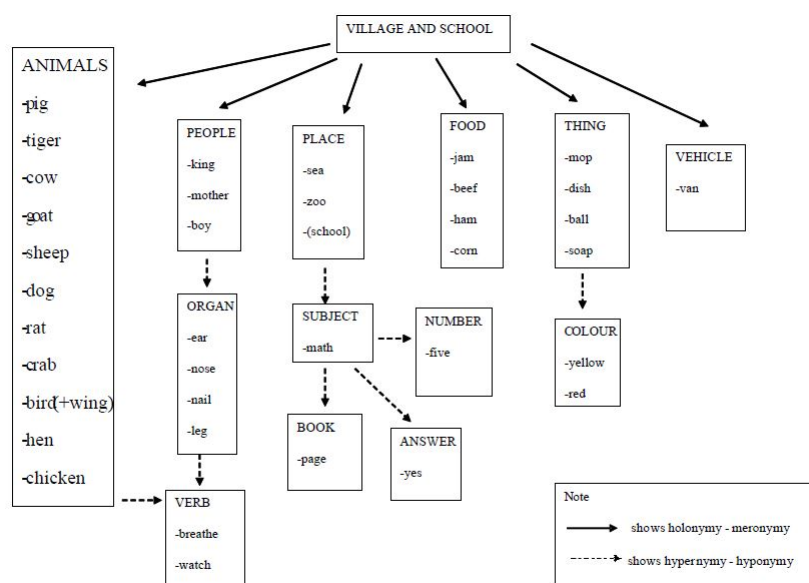


Figure 3: A Semantic Network on the topic “My Village and Scholl”.

Table 4. Teacher’s Attitude towards Semantic Field Application.

Questions	Students (12)		
	\bar{x}	S.D.	Label
1. Learning English vocabulary via this method is appropriate for the students’ level.	4.67	0.49	Extremely Satisfied
2. Learning English vocabulary via this method helps the students to acquire the vocabulary’s meanings easier.	4.58	0.51	Extremely Satisfied
3. I like Learning English vocabulary with this method.	4.67	0.49	Extremely Satisfied

5.2 Students’ and Teacher’s Attitude towards Semantic Field Application

In the questionnaire with 1-5 rating scale surveying the attitude of the students and teacher towards the integrated model, 3 questions about the semantic field application revealed that they liked the semantic field application to English vocabulary study and teaching.

The answers from the questionnaires illustrated the positive attitude of both teacher and students participating in the research. With the appropriateness of the fields to the level of the students’ learning ability, the teacher labelled 4 “Satisfied” while the students said 4.67 “Extremely Satisfied”. Asking whether the fields help the students in acquiring the meaning easier, both the teacher and the students placed “Extremely Satisfied” with $\bar{x} = 5$ and 4.58. The last question was about their satisfaction with the semantic field application in learning English vocabulary, and the result showed that they were “Extremely Satisfied” with $\bar{x} = 5$ and 4.67 respectively.

6. Discussion

Because knowing vocabulary is the most important factor to achieve linguistic competence for language learners, it is essential for teaching and learning vocabulary to establish a connection between sound, word, meaning, and its use. The semantic field approach integrated into the teaching methods presented in this research could encourage the students to create these connections and achieve their language competence as explained below.

The results of this study show consistent with Guo (2010), Phuriudomseth (2010), Thuy (2010) [25] Gao and Xu (2013), and Wangru (2016) applied semantic fields to their English teaching and found that the students’ English proficiency was improved and the students enjoyed this kind of teaching rather than the traditional method by writing that they liked learning vocabularies on their comments in the questionnaires.

Even these studies share a similar theoretical framework, there are differences in population and teaching methodology. While Guo (2010), Phuriudomseth (2010), Thuy (2010), and Gao and Xu (2013) conducted the research with secondary school, high school and college students and encouraged their students to elaborate vocabulary connected to the fields by considering the semantic relations they have taught, this study focused on the primary students and one who was responsible to gain knowledge about semantic fields and relations was the teacher. In this research, the teacher still plays an important role as a demonstrator and facilitator to present examples of fields to the students without lecturing them on what kind of relations they had seen. The students were encouraged to practice categorizing vocabulary into groups or fields and then draw their semantic maps connecting those categories based on their thinking.

By following the semantic field processes proposed in this study, the students were evoked to memorize and recognize the meanings of vocabulary concerning their fields, pronunciation, and spellings repeatedly. From the researcher's observation, it was noticeable that the students could recall the meaning of the vocabulary found in their stories better and faster than the students who didn't use those words. Additionally, if the students got some hints showing semantic fields of the words, they were getting stuck on, they could recall the correct word faster. Furthermore, it was shown that the participants could remember concrete and familiar words such as chicken and cow better than abstract and unfamiliar words such as (to) breathe and goat. The word breathe presents abstract meaning and it is quite difficult for them to find a keyword or a relation to hook their memory. While, the word goat is concrete but unfamiliar for them because they hardly see any goats in their real lives to recall their memory. Therefore, this proposed semantic field teaching process might be effective for low proficiency students as Gang (2014) found that the fewer proficiency students in L2 vocabulary depend more on repetition and association learning strategy.

Above all, Tanner and Green (1989) said "... Research into memory has shown that we apparently store words in our brain in groups of related words (or lexical sets). Words that are related are joined together in our brains; if a new word can be hooked to words which are already store, it might be easier to remember it. It would seem logical therefore that we should teach words in lexical sets to our learners, so that it is easier for them to retain and store the words in their memory." Brown and Payne (1994), Nation (2001), and Kanolsilapatham and Khamkhien (2012) also suggested that vocabulary teaching and learning need a connection between meaning and sound, word, use or story, and illustration to encourage experiences related to the unknown or unfamiliar vocabulary. There is the correspondence between these suggestions and what Boers and Lindstromberg (2008) said as semantic and structural elaboration which operate in deep mental processes affecting longer-lasting memory trace that repetition [27]. Hence, it could be indicated that the most necessary key in the application of the semantic field to vocabulary teaching and learning is the "connection" and "repetition" that could help the students enhance their English vocabulary proficiency.

7. Conclusion

Applying the semantic field to vocabulary teaching and learning could be an alternative to enhance the learners' ability in studying vocabulary effectively as assumed from the result of this research. After 1 month of applying the semantic field to teach English vocabulary for Prathomsuksa 4 students, it was found that the students performed statistically better in the post-test. The questionnaires also showed their

satisfaction with the method as they said that they were happy when they learned vocabularies and they wanted to learn more vocabularies.

8. Suggestion

The semantic network instruction processes could be further applied as experimental research to find out whether it would be more effective on high or low proficiency students.

Moreover, to develop English competence as the second or foreign language of illiteracy students more effectively, it might be necessary to apply the whole model of the integration of phonics, semantic fields, and syntax to English teaching and learning.

Acknowledgment

This research is a part of "The Development of English Abilities of Prathomsuksa 4 Students through an Integration of Phonics, Semantic Fields, and Syntax for an Invention of Personal Narratives on Local Experience" project granted by Thailand Science Research and Innovation. The researcher would like to present her gratitude to the committee of Thailand Science Research and Innovation, Faculty of Liberal Arts, University of Phayao, Assoc. Prof. Poonpong Ngarmkasem, and the team consisting of Assoc. Prof. Dr. Phanintra Theeranon, Assist. Prof. Dr. Phen-apa Klaisingto, Dr. Darinthorn Inthabthim, Dr. Narisa Paichareon, Apinya Hantrakul, and Chaloephan Kaewkanta, and Assist. Prof. Dr. Sukanya Koawiwatthanakul.

References

- [1] R. M. Mapesos, Traditional approach. https://www.researchgate.net/publication/321134079.Traditional_Approach (accessed 23 January 2020).
- [2] [2] Which is best: Teacher-Centered or Student-Centered Education?. <https://resilienteducator.com/classroom-resources/which-is-best-teacher-centered-or-student-centered-education/> (accessed 23 April 2020).
- [3] M. Khatib, A New approach to teaching English poetry to EFL students, *Journal of Language Teaching and Research* 2(1) (2011) 164 – 169.
- [4] A. Khalid, M. Azeem, Constructivist vs traditional: Effective instructional approach in teacher education, *International Journal of Humanities and Social Science* 2(5) (2012) 170-177.
- [5] X. Gang, A study on English vocabulary learning strategies used by Chinese college students, *Studies in Literature and Language* 9(1) (2014) 111 – 116.
- [6] M. Esbrí, Applying semantic frames to effective vocabulary teaching in the EFL classroom, *FÓRUM DE RECERCA* (2014) 743 – 752.
- [7] H. Syarif, Linguistics and the English language instruction, *Lingua Didaktika* 10(1) (2016) 50 – 59.
- [8] D. A. Wilkins, *Linguistics in language teaching*, London: Arnold, 1972.
- [9] B. Kanoksilapatham, A.Khamkhien, English vocabulary instruction via educational TV programs in retrospect, *Referred Journals of Language Teaching and Learning* 27(2012) 69 – 88.
- [10] C. Guo, The Application of semantic field Theory in college English vocabulary instruction, *Chinese Journal of Applied Linguistics* 33(3) (2010) 50 – 62.

- [11] T. Phuriudomseth, The study of English vocabulary achievement and retention of Mathayomsuksa 3 students of Patumwan Demonstration School Srinakharinwirot University leaning through the use of semantic field approach, Master Degree Thesis, Srinakharinwirot University, 2010.
- [12] C. Gao, B. Xu, The application of semantic field theory to English vocabulary learning, *Theory and Practice in Language Studies* 3(11) (2013) 2030 – 2035.
- [13] C. Wangru, Vocabulary teaching based on semantic field, *Journal of Education and Learning* 5(3) (2016) 64 – 71.
- [14] G. Boran, Semantic fields and EFL/ESL teaching, *International Online Journal of Education and Teaching* 5(2) (2018) 391 – 399.
- [15] C. Brown, M. E. Payne, Five essential steps of processes in vocabulary learning, A paper presented at the TESOL Convention, Baltimore, 1994.
- [16] I. S. P. Nation, *Learning vocabulary in another language*, Cambridge: Cambridge University Press, 2001.
- [17] R. Frost, Presenting vocabulary. <https://www.teachingenglish.org.uk/article/presenting-vocabulary> (accessed 23 December 2019)
- [18] E. Nida, *Componential analysis of meaning: An introduction to semantic structure*, Berlin: De Gruyter Mouton Publisher, 1975.
- [19] Crystal, *A dictionary of linguistics and phonetics*, UK: Blackwell Publishing, 2011.
- [20] A. Lehrer, *The influence of semantic fields on semantic change, historical semantics historical word-formation*, Amsterdam: Mouton de Gruyter, 1985.
- [21] R. Nordquist, Semantic field definition. <https://www.thoughtco.com/semantic-field-1692079> (accessed 25 April 2017)
- [22] R. Tanner, R. Green, *Tasks for teacher education: A reflective approach*, Harlow: Pearson Education Ltd., 1989.
- [23] C. B. Zimmerman, *Historical trends in second language vocabulary instruction*, Cambridge, UK: Cambridge University Press, 1997.
- [24] L. Chen, A survey of English vocabulary instruction to non-English majors in Chinese common colleges and universities, Unpublished MA Dissertation, Huazhong Normal University, 2003.
- [25] N. N. Thuy, The effect of semantic mapping on vocabulary memorizing, *Asian EFL Journal Quarterly* (2010) 628 – 659.
- [26] A. Hantrakul, et al., *The manual of an integration of phonics, semantic fields, and syntax*, Faculty of Liberal Arts, University of Phayao, 2019.
- [27] F. Boers, S. Lindstromberg, *How cognitive linguistics can foster effective vocabulary teaching, Cognitive Linguistic Approaches to Teaching Vocabulary and Phraseology*, Berlin: Mouton de Gruyter, 2008.



Development of management model for senior citizens school under Chiang Mai City municipality towards Thailand 4.0

Thanuttha Wudhiwanich*, Choocheep Puthaprasert, Yongyouth Yaboonthong,
and Tharn Thong-ngok

Education Program, Educational Administration, Faculty of Education, Chiang Mai University, Chiang Mai, Thailand

Abstract

This research aimed to 1) to study and synthesize the management components of school for senior citizens in Thailand, 2) to investigate the feasibility and guidelines for the management of school for senior citizens under Chiang Mai city municipality towards Thailand 4.0, 3) to develop and verify a pre-model of school management for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0. Instruments used in this research were a component synthesis, an open-ended question, and a 5 rating-scale questionnaire. Data were analyzed by percentage, mean, standard deviation, content analysis, and descriptive analysis. Results of the research were found as follows: 1. Results of studying and synthesizing the management components in step 1 consisted of 6 components and 31 sub-components, step 2 consisted of 6 components and 39 sub-components. 2. The investigation results of the feasibility and guidelines consisted of 6 components and 36 sub-components. 3. Results of developing a pre-model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0 was named ROO(pdca)MCF model, consisting of 6 components and 36 sub-components and verifying the management model in section 1, the correction was average at 99.38 percent and the suitability was average at 95.99 percent, in section 2 was concerning the evaluation results, the possibility and the utility were at the highest level.

Keywords: management model, school for senior citizens, Chiang Mai city municipality, Thailand 4.0

Article history: Received 21 August 2020, Revised 2 November 2020, Accepted 2 November 2020

1. Introduction

According to the educational management policy and lifelong learning for senior citizens were reviewed again, it was found that the government had realized on the situation of aging society in Thailand. The policies and measures were implemented related to the senior citizens to be a mechanism to drive the senior citizens' work to be suitable for the current situation. This importance could also be seen that the Constitution of the Kingdom of Thailand, B.E. 2560 (2017, [1] mentioned in chapter 5 concerning duties of the government in section 54 stipulated the State shall ensure that every child received quality education for twelve years from pre-school to the completion of compulsory education free of charge.

Ageing is the process of various components such as experiences, life skills, happiness and sadness, success or failure, social participation, etc. School for senior citizens is another form of education that requires the importance and power of the senior citizens which focus on activities that enable the senior citizens to attend easily and give priority to set up stage for learning exchange among senior citizens with community members in line with the research of Archanya [2]

concerning on the future image of a third-year university model for lifelong learning. According to the Thai elderly, it was found that the model of the school for the elderly will be the principle of the format of the University of the Third Age (U3A) to promote the potential of the elderly, making the elderly to enjoy and enjoy learning.

Therefore, the 2nd. National Plan on the Elderly 2002-2021, 1st. Revised of 2009 [3] mentioned in strategy 1 concerning on readiness preparation of the people for their quality ageing on education and lifelong learning, encouraged the access to and develop the education service and lifelong learning in either the formal, adult education or learning by preference to provide correct knowledge and understanding of life and ageing aiming at readiness preparation for quality ageing.

Additionally, Thailand's Implementation of the Madrid International Plan of Action on Ageing: MIPAA, 2002-2016 [4], the declaration on the Thai Elderly in 2000, Thailand proclaimed at the same year that the United Nations proclaimed to be the international year of older persons to drive explicit and exact implementation of action on ageing as clearly especially about the protection of the elderly to access to education and learning as well as social participation.

*Corresponding author; email: teacherpui007@hotmail.com

Besides, Linda and Jeff [5] worried that seniors today were faced with a dilemma. They did not grow up during the era of computers and the internet, yet this age group now depended on this technology. As a result, seniors were learning more and using technologies for the first time. In general, technology was helping to give senior citizens an improved quality of life through increased connectivity and a sense of community.

Concerning the above reasons, to achieve success according to the policies and objectives, the researcher as an administrator in schools under the Local Government Organization used a management model to direct the organization to provide educational services to citizens of all ages while the number of students was steadily decreasing but the buildings and school personnel were still the same. Therefore, I would like to develop a management model for senior citizen schools under Chiang Mai city municipality in order to support the national educational policy keeping up towards Thailand 4.0. In addition, the researchers expected that the management model for senior citizen schools under Chiang Mai city municipality that was developed, could be used as guidelines for policy proposals and to be a model for other educational institutions or schools.

2. Research Questions

2.1 What are the results of studying and synthesis the management components of school for senior citizens in Thailand?

2.2 What are the feasibility and guidelines for the management of school for senior citizens under Chiang Mai city municipality towards Thailand 4.0?

2.3 What should be the results of the development and verification a management model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0?

3. Research Objectives

3.1 To study and synthesize the management components of school for senior citizens in Thailand.

3.2 To investigate the feasibility and guidelines for the management of school for senior citizens under Chiang Mai city municipality towards Thailand 4.0.

3.3 To develop and verify a management model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0.

4. Materials and Methods

The research process was divided into three phases as follows:

Phase 1: Study and synthesize the management components of school for senior citizens in Thailand was divided into 2 steps:

Step 1.1: The researchers studied the documents, concepts, theoretical papers and related researches for synthesizing the components concerning the management components of school for senior citizens in Thailand. The obtained data were studied from 20 schools awarded the best practice, or participating activities with Thai Health Promotion Foundation, or interesting agencies from public and media in all regions of Thailand; instrument used was a component synthesis table, and data were analyzed by content synthesis.

Step 1.2: The confirmation of components concerning the management components of school for senior citizens in Thailand. Key informants were 7 experts in the focus group discussion, instrument used was a confirmation form for correction, suitability, and completion of core components and sub-components, data were analyzed by content analysis.

Phase 2: Investigate the feasibility and guidelines for the management of school for senior citizens under Chiang Mai city municipality towards Thailand 4.0. Key informants were divided into 3 groups consisting of 2 policy administrators, 2 coordinator administrators, and 15 practitioners, for a total of 19 respondents, instrument used was an in-depth interview, and data were analyzed by content analysis.

Phase 3: Develop and verify a management model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0 was divided into 2 steps as follows:

Step 3.1: Develop a management model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0, key informants selecting by purposive sampling consisted of 6 groups of school relevant personnel, for a total of 21 respondents, instrument used was a model draft, and data were analyzed by descriptive analysis.

Step 3.2: Verify a developmental model for senior citizen schools under Chiang Mai city municipality towards Thailand 4.0, key informants consisted of experts in terms of senior citizens, faculty lecturer, Chiang Mai city municipality's administrators, principals of schools for senior citizens, for a total of 9 respondents in connoisseurship, instrument used was verification form of correction and suitability, evaluation form of possibility and utility of a management model for senior citizen schools under Chiang Mai city municipality deriving from step 3.1, data from verification form were analyzed by percentage and data from evaluation form were analyzed by mean and standard deviation.

5. Results and Discussion

The results of this research were as follows:

Phase 1: Results of studying and synthesizing the management components of school for senior citizens in Thailand was divided into 2 steps:

Step 1.1: The management components of school for senior citizens in Thailand consisted of 1)

rationale/ background, 2) objectives, 3) operational procedures, 4) management structures and mechanism, 5) curriculum and learning management, 6) factors for achievement/focus points as shown in Table 1.

From Table 1, results of synthesizing the core components and sub-components of school for senior citizens in Thailand from 20 school administrators consisting of 6 core components and 31 sub-components.

Step 1.2: The confirmation of components concerning the management components of school for senior citizens in Thailand, 7 experts in the focus group discussion agreed to delete background and focus points from core components. In terms of component 1 concerning rationale, adding to approach Thailand 4.0; component 2 concerning objectives, adding to promote the use of technology in Thailand 4.0 to increase management efficiency; component 3 concerning operational procedures, adding the curriculum development and instructional process by using technology and innovation to increase efficiency including the reflective thinking; component 4 concerning management structures and mechanism, adding network committee and student council; component 5 concerning curriculum and learning management, adding to prepare lesson plans and learning management activities; component 6 concerning factors for achievement, adding the use of technology and innovation to increase efficiency continuously and writing in the Chiang Mai municipality's strategic plan including reviewing, improving, and developing the school management for senior citizens under Chiang Mai municipality, for a total of 6 core components and 39 sub-components.

Regarding the core components, it was similar to Aungkana [1] stated that due to the global trend was moving towards the 'aging century' which was the era of advanced technologies and an aging society, caring for elderlies in this era requires an adequate understanding of the current state of elderly care, environment and their lifestyles in reality. Additionally, positive thinking and a meaningful-life attitude were crucial to support older people.

Besides, Linda and Jeff [5] worried that seniors today were faced with a dilemma. They did not grow up during the era of computers and the internet, yet this age group now depended on this technology. As a result, seniors were learning more and using technologies for the first time. In general, technology was helping to give senior citizens an improved quality of life through increased connectivity and a sense of community. On the other hand, a comparative insights of ageing elderlies from Chiang Mai (highland) and Nakhon Pathom (lowland) provinces by Kampanad et al. [6], the findings provided insights of the important indicators as family or neighborly support, community participation, health care improvement and social security to improve the well-being of elderly and con-

cluded with the need of innovative policies and public services.

Phase 2: Results of investigating the feasibility and guidelines for the management of school for senior citizens under Chiang Mai city municipality towards Thailand 4.0, 19 respondents were in depth interview, it was concluded that all of components were feasibility. Concerning the guidelines: in terms of policy implementation, there should be the participation of all ages and all religions and the children behaviors should be promoted according to Thais' values such as gratefulness to benefactors, being obedient and respectful to senior citizens while they were passing on the local knowledge, wisdom, and cultural heritage. Similarly, Kyu-taik [7] studied the elder respect among young adults: A cross-cultural study of Americans and Koreans, the findings revealed the comparison groups cited care respect, acquiescent respect, linguistic respect, consultative respect, salutatory respect, and precedential respect as the most often practiced and highly important forms.

Phase 3: Results of developing and verifying a pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 were as follows:

Step 3.1: Results of developing a pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0, the pre-model was examined by 6 groups of 21 experts, the descriptive analysis results showed that the development of the pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 was named ROO(pdca)MCF model, consisting of 6 components and 36 sub-components, the details were as follows:

1. R-Rationale consisted of:

1.1 Due to be a developed model to prepare for approaching the ageing society of Chiang Mai City Municipality.

1.2 It is based on the principles of lifelong learning as stipulated by the Constitution of the Kingdom of Thailand B.E. 2560 (2017).

1.3 Adhere to the theoretical concepts of participation and integration.

1.4 As a model to promote the life quality development for senior citizens and build good relationships among the senior citizens and school children.

1.5 As a model to pass on knowledge, experience, and wisdom to be a local identity and heritage.

1.6 In accordance with Thailand 4.0 policy to achieve the 20-year national strategy: stability, prosperity, and sustainability.

2. O=Objectives were to

2.1 To promote the life quality development for senior citizens and lifelong learning for senior citizens. 2.2 To encourage self-development in caring and protection rights and career promotion for senior citizens.

Table 1. Results of studying the core components and sub-components of school for senior citizens in Thailand.

Core components	Sub-components
1. Rationale/background	1.1 Approaching an aged society. 1.2 Government roles. 1.3 The community's participation. 1.4 The development of quality of life for senior citizens. 1.5 Educating local knowledge, wisdom and culture.
2. Objectives	2.1 To promote the life quality development and lifelong learning for senior citizens. 2.2 To promote self-development in caring and protection rights and career promotion for senior citizens. 2.3 To enhance good health for senior citizens in physical, mental and social development. 2.4 To encourage the senior citizens to participate activities, create a senior citizens' network of exchanging and learning together creatively. 2.5 To pass on the local knowledge, wisdom, and cultural heritage.
3. Operational procedures	3.1 Meeting with related parties. 3.2 Appointment of a working group. 3.3 Creating an operational / action plan. 3.4 Preparation of curriculum and class schedule. 3.5 Teaching and learning. 3.6 Evaluation and following up.
4. Management structures and mechanism	4.1 Advisory committee. 4.2 Administrative committee. 4.3 Management committee. 4.4 Operational committee.
5. Curriculum and learning management	5.1 Course title. 5.2 Principles of the curriculum. 5.3 Goals. 5.4 Learning requirements. 5.5 Curriculum structure. 5.6 Course description.
6. Factors for achievement/focus points	6.1. Having leaders who are creative thinkers, dedication, and hard working. 6.2 Having clear goals and activity management continuously. 6.3 Participation with multi-sectors social networks. 6.4 Improvement of operational development continuously. 6.5 Budget was supported from other agencies and local administrative organizations.

2.3 To enhance good health for senior citizens in physical, mental and social development.

2.4 To build good relationships among the senior citizens and school children by participating activities, learning exchanging, creatively.

2.5 To promote the senior citizens' network, learning exchanging, and do activities to pass on the local knowledge, wisdom, and cultural heritage.

2.6 To support the use of technology in the Thailand 4.0 to increase management efficiency.

3. Operational procedures could be classified by

3.1 Plan (P): An Operational plan consists of

3.1.1 The use of investigation results of the requirements of student parents that the schools have to provide activities to promote learning concerning the use of essential technology in the current society or Chiang Mai City Municipality have a policy to proceed.

3.1.2 School directors have a meeting with basic school board committee and teachers.

3.1.3 The school directors note and report to

the municipality administrators.

3.1.4 Appointing a working group consists of an advisory committee, administrative committee, and operational committee. (According to the structure and management mechanism)

3.1.5 Preparing the project of school for senior citizens to include in the educational development plan B.E. 2563 (2020) (5 years) to be used as guidelines in the allocation of annual budgets.

3.2 Do (D): Learning and teaching management

3.2.1 Establishing a school for senior citizens.

- Preparing a curriculum, lesson plan, class schedule, study requirements, and defining the registration fee rate.

- Contacting and coordinating the resource persons to educate.

- Public relations for the project of school for senior citizens.

- Enrolling senior citizens.

- Preparing the building, areas, and environment for learning activity management to be suitable

for the senior citizens.

3.2.2 Implement learning activity management according to the action plan.

3.3 Check (C): Evaluation and following-up the operational results are monitored at all stages by the evaluation committee.

3.4 Act (A): Practical reflections and development recommendations by school board meeting, teachers, supporting personnel to summarize the reflective results, give suggestions for the further improvements.

4. Management structures and mechanism In a case of operations by educational institution)

4.1 The advisory committee consists of Chiang Mai municipality administrators, monks, basic school board committee, community leaders, Village Health Volunteer (VHV), resource persons, and network partners are responsible for advising, supporting, determining policies.

4.2 The management committee consists of the school principal for senior citizens (School Director) and assistant principal (Deputy Director of Educational Institution) are responsible for appointing an operational committee, advising, supporting, supervising, monitoring the practical to be achievement.

4.3 The operational committee consists of

4.3.1 Planning and budget department is responsible for including the project in the educational development plan B.E. 2563 (2020) (5 years) to be used as guideline for budget allocation, assist for disbursements correctly, on time.

4.3.2 Building department is responsible for the readiness of the building, area, and environment for learning activity management to be safe, clean, beautiful, suitable for the senior citizens.

4.3.3 Academic department is responsible for

- Investigating the needs of learners (senior citizens).

- Preparing a curriculum, lesson plan, class schedule, study requirements

- Contacting and coordinating the resource persons to educate.

- Carry out learning activities according to the action plan.

- Evaluation of senior citizens.

4.3.4 Administrative department is responsible for

- Public relations for the project of school for senior citizens.

- Enrolling senior citizens.

- Preparing certificates.

4.3.5 The evaluation department is responsible for

- Evaluation of operational results and storing the achievement results.

- Meeting, summarizing the operational results, and disseminating to public.

4.3.6 Student council consists of a president, vice president, and treasurer (money keeper) to be responsible for coordinating among the students and the operational committee.

5. Curriculum and learning management.

5.1 Course title: Life Quality Development for Senior Citizens towards Thailand 4.0.

5.2 Course principles:

5.2.1 A course is emphasized on learning contents concerning the use of essential technology towards Thailand 4.0 in everyday life to make the senior citizens to learn, adapting to social changes, and having a better quality of life

5.2.2 A course is focused on the exchange of knowledge, experience, professional skills among the senior citizens and school children by participating activities making the senior citizens to have self-esteem

5.3 Course objectives

5.3.1 Knowledge (K): Knowledge and understanding of changes in the current society.

5.3.2 Attitudes (A): Having self-esteem and good relationships with people of all ages

5.3.3 Process/Skills (P): Having skills and abilities for adapting to live in a changing society.

5.4 Course requirements:

5.4.1 Studying duration 30 hours / 1 time per week on Saturdays, duration 3 hours (9.00 - 12.00 hrs.)

5.4.2 Studying both theory and practice at least 24 hours (80

5.4.3 Each room consists of 24 learners (12 senior citizens and 12 school children)

5.4.4 Senior citizens aged 60 years and over who can read, write or communicate in Thai. School children aged 10 years old or more.

5.5 Course structure consists of 3 learning units:

Unit 1: Technology towards Thailand 4.0 and daily life (4 times per 12 hours).

Unit 2: Useful Laws and Privileges (3 times per 9 hours)

Unit 3: Pass on Local Wisdom through Life-long Learning (3 times per 9 hours)

5.6 Course description consists of

Unit 1: Technology towards Thailand 4.0 and daily life (4 times per 12 hours).

- Health caring with online information via facebook, line appropriately and safely.

- Online financial transactions.

- Online food order.

- Grab Assist for travel.

Unit 2: Useful Laws and Privileges (3 times per 9 hours)

- Various forms of wills.

- State allowance and welfare. - Benefits under the 2nd. National Plan on the Elderly 2002-2021

Unit 3: Pass on Local Wisdom through Life-long Learning (3 times per 9 hours)

- Exchange knowledge and various local wisdom which can be further developed into a career

promotion.

5.7 Lesson plan and learning activity management consist of learning management, learning area, learning activity management, learning media and equipment, learning evaluation, and duration of both theory and practice.

5.8 Course evaluation

5.8.1 Course implementation evaluation consists 3 phases as follows:

1) Evaluation before implementation is to evaluate the course by instructors.

2) Evaluation during implementation is to evaluate instructional activity management.

3) Evaluation during implementation is to evaluate learners.

5.8.2 Course evaluators consist of resource persons who provide instructional activity management, administrators, and teachers in schools, the senior citizens and the school children.

6. Factors for achievement (In the operational case by educational institutions)

6.1 Making an understanding with relevant parties.

6.2 Having leaders who are creative thinkers, dedication, and hard working.

6.3 Having a working group and responsible persons clearly.

6.4 Having determined goals and activities are organized continuously and sustainably.

6.5 Participation with multi-sectors social networks.

6.6 Budgets are supported from other agencies and local administrative organizations.

6.7 Technology and innovation were continuously used to increase work efficiency.

6.8 School management for senior citizens was included in the educational development plan of the educational institutions.

6.9 Continuous reviewing and improvement of school management for senior citizens under Chiang Mai City Municipality.

Step 3.2: Results of verifying the a pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 were divided into 2 sections as follows:

Section 1: A pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 was examined by 6 groups of 21 experts, the results of verifying the pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 from 6 groups of 21 experts were found that the correction was average at 99.38 percent and the suitability was average at 95.99 percent

Section 2: A pre-model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 was evaluated by 6 groups of 21 experts, the results of evaluating the pre-model in

terms of the possibility was at the highest level (Mean = 4.72, S.D. = 0.53) and the utility was at the highest level (Mean = 4.80, S.D. = 0.48).

According to the 2nd. National Plan on the Elderly 2002-2021, 1st. Revised of 2009 [3] realized on the readiness preparation of the people for their quality ageing on education and lifelong learning, encouraged the access to and develop the education service and lifelong learning in either the formal, adult education or learning by preference to provide correct knowledge and understanding of life and ageing aiming at readiness preparation for quality ageing. Besides, Churairat et al. [2] suggested the guideline for sustainable development of the community involvement in the care of elderly required individual health awareness, strong sense of voluntarism of health volunteers, great collaboration among related organizations.

6. Conclusion

It could be said that the school for senior citizens has been regarded as an essential and integral part of school administration towards Thailand 4.0. In many countries, schools want their classrooms to be full of senior citizens regardless of age to attend of continuing education, even Thailand has approached one of the fastest-growing ageing societies but the government are still discussing how best to help the ageing population. Therefore, the developed model could be applied to use of school for senior citizens over Thailand.

7. Recommendations

From this research, the recommendations are made as follows:

7.1 This developmental model of school management for senior citizens under Chiang Mai city municipality towards Thailand 4.0 can be used as a master model for senior citizen schools. The municipalities or other relevant sectors over Thailand should realized on the important of senior citizens who increase in Thai society seriously.

7.2 There should be the intention to support the potential of senior citizens to lead active and participatory lives through education and to recognize the benefits of their local knowledge and wisdom, experiences, and competencies.

8. Recommendation for Further Research

8.1 There should be the studying of school management for senior citizens in the other regions in order to share the achievement, the failures and the problem solutions to develop Thai ageing society.

8.2 There should be the studying of school management for senior citizens in order to be linked to the senior resource persons as an innovator for school management for senior citizens to be an organization of innovation to keep on with changes.

Acknowledgment

I would like to express to thank you to mayor of Chiang Mai City municipality and Emeitus Professor Pongsiri Prathnadi for your insight, support, and guidance.

References

- [1] S. Aungkana, New perspective of elderly care in Thailand 4.0 era: Roles of nursing administrations, *Journal of The Royal Thai Army Nurses* 19(2) (2018).
- [2] D. Churairat, T. Sathapon, S. Achara, Outcomes and sustainability of community participation in elderly health promotion, *Interdisciplinary Research Review* 11(3) (2016) 54 – 61.
- [3] R. Archanya, Proposal for operational improvement regarding senior citizen's potential enhancement, *Silpakorn Education Research Journal* 11(1) (2019).
- [4] The National Committee on the Elderly, The Ministry of Social Development and Human Security, Thailand, The 2nd. National Plan on the Elderly 2002-2021, 1st. http://www.dop.go.th/download/laws/law_th_20161107091458_1.pdf (accessed 20 July 2019)
- [5] S. Linda, H. Jeff, Technology for seniors and the elderly. <https://www.seniorliving.org/tech> (accessed 20 July 2019)
- [6] B. Kampanad, A. Sayam, L. Meena, M. Orapun, K. Shantibala, Indicators of active ageing for sustainable development: A comparative insights of ageing elderlies from Chiang Mai (highland) and Nakhon Pathom (lowland) Provinces, Thailand, *Interdisciplinary Research Review* 14(5) (2019) 39 – 46.
- [7] S. Kyu-taik, Elder respect among young adults: A cross-cultural study of Americans and Koreans, *Journal of Aging Studies*, 18(2) (2004) 215 – 230.