

## Designing and Implementing of a Learning Management Process for Enhancing Health Literacy among Nursing Students: An Application of Design-Based Research

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The research objectives were: to design and develop a learning management process to enhance nursing students' health literacy by applying the social cognitive theory with design-based research; and 2) to study the post implementation results of the learning management process on health literacy among nursing students. The sample consisted of 60 undergraduate nursing students. The research instruments included the use of learning management plans based on the social cognitive theory with design-based research; and the health literacy of the nursing student's scale. The data was analyzed utilizing descriptive statistics, Hotelling T<sup>2</sup>, and MANCOVA. The findings were: 1) the learning management processes to enhance the health literacy of nursing students by applying design-based research consisted of five steps: (i) learning and understanding of self and others, (ii) inquiry and exchange, (iii) consideration and decision making, (iv) modifying the actions, and (v) reflections and transfers; 2) The health literacy scores of nursing students in the experimental group after intervention were significantly higher than for the control group at a level of .05 and the health literacy scores of nursing students in the experimental group on the posttest after manipulation were significantly higher than for the control group at .05 .

**Keywords:** design-based research, health literacy, learning management, nursing students, social cognitive theory

The rapid social, political, economic, technological changes and also the pandemic are currently affecting the health of the population and might lead to health risks, sickness and non-communicable diseases that people can protect themselves if they illustrate health promoting behaviors and take chance of the ability to access, understand, and implement health information to make their health and well-being better (Bhutani & Bhutani, 2014; Yusefi et al., 2022). A lot of empirical evidence has been found to indicate the important factor contributing to people having literacy is education (Webb & Williams, 2018). On the other hand, education is not the only one factor to ensure that people have enough skills or literacy to access, understand, and implement health information to make themselves healthier and have a better well-being (WHO, 1998). Therefore, health literacy can be defined as significant health issue that many countries across the world are starting to give priority to (Trezona, Rowlands & Nutbeam, 2018).

The development of the health literacy of people for the strengthening of human potential and well-being is an essential solution to solve the health problems directly and it is also considered a sustainable solution that is recognized worldwide (Kaedumkoeng, 2018;

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Nammontri, 2018). Nutbeam (2000) stated that the concept of health literacy was a new part of health promotion. The concept of health literacy can also be defined as ensuring that the people who are targeted, possess the relevant cognitive and social skills to deal with accessible healthcare services, are able to understand and are well-educated on health media, possess self-management skills, and have the skills to interpret health-related issues and make appropriate decisions based on them (Nutbeam, 2008).

Healthcare providers are one category of people for who it is deemed necessary that they encounter an enhancement in their health literacy because the healthcare providers who have health literacy can share the health information with other people and encourage them to implement it, protect themselves, and care for their health effectively (Voigt-Barbarowicz & Brütt, 2020; Voigt-Barbarowicz et al., 2022). Registered nurses can be defined as one type of main healthcare providers who work closely with people in both normal and abnormal health conditions. The scope of the health and nursing practice covers individual, family and community level care across primary, secondary and tertiary health care centers. The registered nurses might be one of the most important healthcare providers who be able to are able to develop the health literacy among people and older adults to make their health better (Tachavijitjaru, 2018; Smith et al., 2022). Therefore, it is essential to include health literacy issues in the nursing curriculum, as through learning and teaching the nurses, from the time they start as nursing students, they can foster awareness and encourage health literacy among them (McCleary-Jones, 2016).

Nursing education is the beginning point for professional nurses in the nursing practice because they receive a schooling from an educational institute that trains nursing students to have the knowledge, skills and various professional experiences required for the nursing industry including attitudes they should depict towards the nursing profession and healthcare service recipients. With regards to the learning processes of nursing students, it is imperative that the Bachelor of Nursing Science program should offer training to learners to develop their critical thinking abilities as well as their self-management skills to be able to use and apply them to the nursing practice to take care of the healthcare service recipients, and provide health education to patients or any healthcare service recipients (Chung & Prato-Lefkowitz, 2015) which includes encouraging people to gain health literacy and offering access to healthcare service recipients who have low health literacy (Nammontri, 2018). Moreover, the training of nursing students that focuses on teaching the students the skills of using tools to assess people's health literacy is also an important aspect that should be included in the teaching and learning of nursing students to enable the students to use these tools for the assessment of patients after they have registered as registered nurses (Kennard, 2016; Smith et al., 2022).

Therefore, registered nurses should enhance their health literacy from being a nursing student onwards (Sarnkhaowkhom & Suwathanpornkul, 2021). If nursing schools are able to develop professional nurses into people with a high level of health literacy from the moment they are nursing students through training and including health literacy issues into the teaching, learning and practical experiences, the registered nurses will have the skills, awareness of health literacy and the ability to be a vital force in the healthcare profession to solve today's major health problems of low health literacy among people (Johnson, 2014; Johnson, 2015) However, the empirical evidences shows that 30.2 percent of health science students, or an overall mean of  $36.52 \pm 7.73$ ), had inadequate or limited health literacy (Rueda-Medina et al., 2020). Moreover, when looking at the level of health literacy among nursing students, their

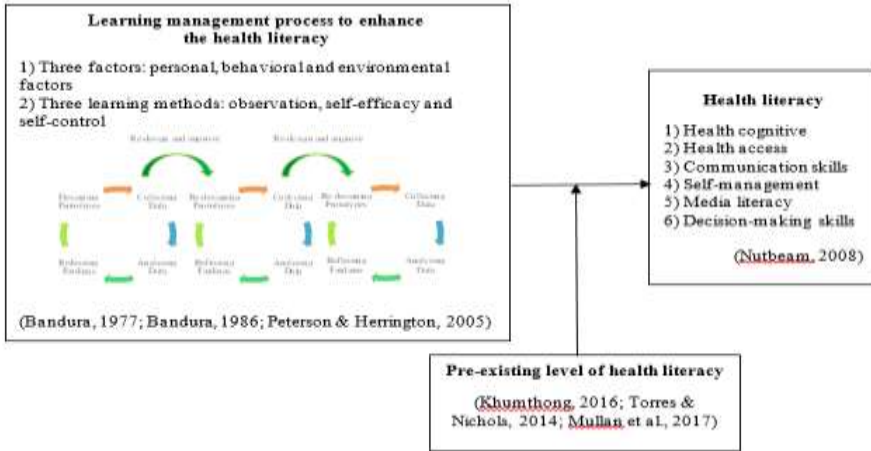
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health literacy was classified as limited in health literacy due to a lack of clinical experiences to practice their communication skills and health literacy assessments (McCleary-Jones, 2016). This was related to Williamson & Chopak-Foss's (2015) that indicated senior nursing students had insufficient knowledge and experiences of health literacy. This is the major reason why the nursing students as registered nurses of the future should be concerned about increasing their health literacy levels (Saunders et al., 2019; Holt et al., 2020; Vamos et al., 2020; González-López & Rodríguez-Gázquez, 2022).

Accordingly, the researchers were interested in designing and developing a learning management process to enhance the health literacy of the nursing students by applying the social cognitive theory of Bandura (1977; 1986). The theory focuses on the internal changes of people's behaviors across personal, behavioral and environmental aspects that are considered as reciprocal determinism through the three learning methods (i.e., observation, self-efficacy and self-control) that can result in good results or understandings. In this study, the social cognitive theory of Bandura (1977, 1986) consists of the three factors (i.e., personal, behavioral and environmental factors) and the three learning methods (i.e., observation, self-efficacy and self-control) for learning activities. Design-based research (DBR) was used as the base for designing the activities during the study and when studying the results from the learning management process to enhance the health literacy of the nursing students (Peterson & Herrington, 2005; Christensen & West, 2018; Kaanklao & Suwathanpornkul, 2020). The covariate variable was the pre-existing level of health literacy in the sampled subjects of Khumthong (2016); Torres and Nichols (2014) Mullan et al., (2017) concluded that the students with different levels of existing health literacy had different levels of health literacy after seeing an improvement in their health literacy levels. The foundation of the existing health literacy was the factor causing the different levels of health literacy. Consequently, the learning management process was designed and improved based on the unique contexts of the nursing students and also determined to generate new findings either new learning management process which was adjusted during and after implementation of prototypes along with the purposes of the design-based research (DBR) to enhance the appropriateness of the specific context i.e., nursing students or generated new interesting finding which is the effectiveness of the intervention that differed from previous studies as they focused particularly on the effectiveness of intervention. This was done by health care providers or professionals who were from the target population and focused on developing the health literacy in order to improve the health literacy levels of the nursing students by actually promoting and developing their health literacy.

The objectives of this research were: 1) to design and develop a learning management process to enhance health literacy among undergraduate nursing students by applying the social cognitive theory with design-based research; and 2) to study the results from the implementation of the learning management process to enhance health literacy among undergraduate nursing students by applying the social cognitive theory. The conceptual framework of this study has been depicted in figure 1 below.

**Figure 1**  
*Conceptual Framework*



## Methods

This study was completed through design-based research consisting of two phases. The first phase included the design and development of the learning management process to enhance the health literacy of nursing students by applying the social cognitive theory. The second phase was the studying of the results of using the learning management process.

### Sample

The population sample for this study consisted of second-year students from the Bachelor of Nursing Science program at the Faculty of Nursing of Saint Louis College, who were second-year students in the second semester of the academic year of 2019. The sample comprised of 60 second year nursing students selected by using the simple random sampling method. The sample size was specified by using G\*Power Version 3.1.9.2 which helped calculate the appropriate sample size. The effect size was specified based on a study by Borrero (2018), with the effect size being 1.08 for this project. As a result, the total size sample size was 60 nursing students of which 30 students belonged to the experimental group and 30 belonged to the control group. Matched pairs were applied when comparing two groups that had very similar characteristics. These similar characteristics included gender, age and the grade average point (Torres & Nichols, 2014). The groups consisted of Group 1 and Group 2, of which one was the experimental group, and the other was the control group. In this study, the control group was a passive control group due to this study was developed under the special activities of the nursing curriculum which not determined to compared with other curricular activities or intervention.

The characteristics of the samples were analyzed by using descriptive statistics including the frequency, percentage, mean and standard deviation for three variables consisting of gender, age and the grade average point as aforementioned. Most of the nursing students who were included in the learning management process implementation were female. The percentage of female students was 96.7%, and that of the male students was 3.3%, respectively. By considering their ages, it was found the average age of the students in the experimental group was 21. Most grade average points were 3.01 – 3.50 (40 percent). Most of the students in

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the control group were female. The percentage of the female students was 96.7%, and that of the male students was 3.3%, respectively. By considering their ages, it was found the average age of the students in the control group was 20.77. Most grade average points were 3.01 – 3.50 (40 percent) as shown in Table 1.

**Table 1**  
*Characteristics of the Experimental and Control Groups*

Characteristics	Group				Total	
	Experimental		Control		N	%
	N	%	N	%		
<b>1. Gender</b>						
1) Male	1	3.3	1	3.3	2	3.3
2) Female	29	96.7	29	96.7	58	96.7
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>60</b>	<b>100</b>
<b>2. Grade Point Average (GPA)</b>						
1) less than 2.00	0	0	0	0	0	0
2) 2.00 – 2.50	6	20	4	13.3	10	16.7
3) 2.51 – 3.00	11	36.7	13	43.4	24	40
4) 3.01 – 3.50	12	40	12	40	24	40
5) 3.51 – 4.00	1	3.3	1	3.3	2	3.3
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>60</b>	<b>100</b>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<b>3. Age</b>	21.00	1.84	20.53	1.46	20.77	.21

### *Data collection and analysis*

The learning management process was designed and developed by the researchers and implemented with the randomized control group pretest posttest design (Leedy & Ormrod, 2013; Suwathanpornkul, 2020). The experiments were conducted in the second semester of the academic year of 2019 from March to April 2020, during which six experiments were conducted, which lasted for six hours. The total time it took for the researcher to conduct the experiments was 36 hours. The prototype for the learning management process that was designed and developed by the researchers from the first phase was implemented in the experiments and adjusted during the research period.

There were two types of research instruments: ( 1) The prototype of learning management plans to enhance the health literacy of the nursing students that applied the social cognitive theory following the design-based research approach, and (2) the health literacy of the nursing student scale developed by the researchers which covered three types of questions, which were focused on; the demographic data, 30 multiple choice questions, and 48 questions with five rating scales answers. The prototype of learning management process was verified and validated the appropriateness by five experts which indicated the details in the prototype development section below. For the content validity of the health literacy of nursing students scale was checked by five experts, who discovered that the index of the item objective congruence (IOC) was 0.60 - 1.00. The scale was tried out with 40 nursing students in order to come up with the difficulty index (p) that came out as 0.38 - 0.80 and the discrimination rates (r) were 0.20 - 0.73. The discrimination rates from the total item correlation came out as 0.22 - 0.80. The reliability was examined with Cronbach's alpha coefficient and showed results of 0.84 - 0.92.

The scores from the assessment of health literacy were analyzed by using descriptive statistics (i.e., frequency, percentage, average and standard deviation), Hotelling T<sup>2</sup>, and the

multivariate analysis of covariance (MANCOVA) which the foundation of the existing health literacy was the factor causing the different levels of health literacy (Khumthong, 2016; Torres & Nichols, 2014; Mullan et al., 2017).

***Prototype development***

Prior to designing and developing the learning management process to enhance the health literacy of nursing students by applying the social cognitive theory in the first phase, a prototype of the learning management process was designed and developed by the researchers. The documents and studies related to promoting the health literacy, the social cognitive theory, and the design-based research were reviewed and studied by the researchers in order to synthesize the documents, after which they applied the synthesis results to the social cognitive theory to develop the prototype of the learning management process. The learning management plans were also developed as subcategories of the learning management process by applying the social cognitive theory of Bandura (1977; 1986) that consisted of the three factors (i.e., the personal, behavioral and environmental factors) and the three methods (i.e., observation, self-efficacy and self-control) from the prototype.

The results from the mixed methods research synthesis (MMRS) with regards to the related pieces of literature were applied to the design of the learning management process by applying the social cognitive theory ( Sarnkhaowkhom & Suwathanpornkul, 2020; Sarnkhaowkhom & Suwathanpornkul, 2021) . The prototype of the learning management process consisted of the six following steps; (i) the first step was the “observation of self and others” step. The students mutually discussed observing themselves and their surrounding people or role models regarding their health across the personal, environmental and health behavior aspects. This involved the process of learning from observations, experiences of others as well as self-observations; ( ii) the second step included the “learning and understanding” step. The students mutually tried to understand and learn about their own personalities, their surrounding people’s or role models’ personalities, their environments and own health behaviors as part of the memorization process and how the experiences of these people are applied to their successes; ( iii) the third stage comprised of the “inquiry and exchange” step. The students must mutually inquire about and exchange information from their observations, and they must learn and understand the information from the previous steps with regards to the personal, environmental and health behavior aspects. The actions and words covered in the observations from their personal, environmental and health behavior aspects were used to encourage the learning and receiving of the health information among students; (iv) the fourth step consisted of the “consideration and decision making” phase. The students considered the information and made decisions based on the acquired health information regarding the personal, environmental and health behavior aspects. This decision-making step led to the next step; (v) the fifth step was the “modifying the actions” step. After the students had considered the information and had made their health decisions in the previous step, in this step, the students would change their actions, motivations, and emotional stimulation with regards to the personal, environmental and health behavior aspects after making their decisions; and (vi) the sixth step included the “reflections and transfers” step. This step was the last step in which the students looked back at their motivations, emotional stimulations, and reactions to reflect on their health actions across the personal, environmental and health behavior aspects.

Once these steps were completed, the aforementioned design of the learning management process was used for the specification of the sub-topics for each learning

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management unit relevant to the provided definition of health according to the concepts of Brook et al., (1979) and WHO (1998) who stated that health is the physical, mental and social fitness of a person without any disease or disability. This led to the creation of a learning management unit named “Nursing Students with Health Literacy”. It consisted of three sub-units: Sub-Unit 1 – Physical Fitness, Sub-Unit 2 - Healthy Mind, and Sub-Unit 3 – Good Society. Each sub-unit consisted of six learning management plans. The total number of plans was eighteen.

The prototype for the learning management process was verified and validated by five experts (two nursing education experts and three health literacy experts) who focused on the following issues: (1) the components of the learning management process, (2) the learning topics, (3) the objectives of the learning management process, (4) the learning content, (5) the learning management plan, and (6) the learning materials. The results, after an evaluation of the appropriateness of the prototype by the experts, were interpreted. There were then amendments and improvements made based on their suggestions and opinions by piloting it in with the samples. During the implementation, the reflections from the learning management process were used by the researchers for the purpose of revising the learning management process. There were also discussions held with researchers, experts and instructors of the Bachelor of Nursing Science program in order to improve the learning management process to achieve a greater focus on the actual and specific contexts the nursing students taking part in the study had to face.

### *Ethical consideration*

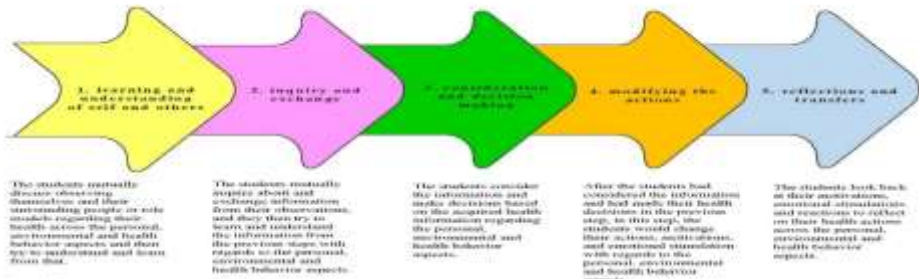
This research was conducted after approval of the ethical review committee. Informed consent was obtained from participants prior to participation in this research. This research was approved by the Human Research Ethics Committee of Srinakharinwirot University (SWUEC-G-115/2562X) and the ethical committee of Saint Louis College (Code: E.022/2562).

### **Results**

1. The designing, adjusting and developing of the prototype for the learning management process consisted of the following six steps in the beginning: (i) observation of self and others, (ii) learning and understanding, (iii) inquiry and exchange, (iv) consideration and decision making, (v) modifying the actions, and (vi) reflections and transfers. During the mentioned learning management process, the process was designed, improved, revised and developed based on the contexts and real experiences of the students. After implementing each plan, the following findings regarding the activities were established. For example, for the sixth learning management plan, it was found that the first (the personal and self-observation step) and the second step (the learning and understanding step) were the steps when the students learned about actual cases in their communities and took actions. Therefore, the first and second steps were combined into a new first step. As a result, the number of steps was reduced from six to five. The first step was called “learning and understanding of self and others”. Then, the five steps were used to implement the 18 learning management plans. It was found that the five steps were suitable for the contexts and the real situations of the students. Consequently, in the end, the learning management processes consisted of the following five steps: (i) learning and understanding of self and others, (ii) inquiry and exchange, (iii) consideration and decision making, (iv) modifying the actions, and (v) reflections and transfers as summarized in the Figure 2.

**Figure 2**

*The learning management process to enhance health literacy among nursing students*



2. When looking at the implementation of the learning management process, after analyzing the data, it was found that the experimental group had a significantly higher level of health literacy after completing the learning management process than before at a significant level of .05. The Hotelling  $T^2$  gained from using the critical value table was 46.16 (Pillai's Trace  $F = 22.28$ , Wilks' Lambda  $F = 22.28$ , Hotelling's Trace  $F = 22.28$ , Roy's Largest Root  $F = 22.28$ ,  $p = .00$ ). By considering the multivariate, it was found that the score for the cognitive health after completing the processes was significantly higher than before the processes were completed with a significance level of .05 ( $F = 105.00$ ,  $p = .00$ ). The score for having access to health information after the processes were finished was significantly higher than that before the process at a significance level of .05 ( $F = 58.98$ ,  $p = .00$ ). The score for health communication after the processes were completed was significantly higher than that before the process at a significance level of .05 ( $F = 41.62$ ,  $p = .00$ ). The score for self-management after completing the processes was significantly higher than that before the process at a significance level of .05 ( $F = 58.73$ ,  $p = .00$ ). The score for media literacy was significantly higher than that before the processes were completed at a significance level of .05 ( $F = 37.30$ ,  $p = .00$ ). The score for decisions making skills was significantly higher than that before the processes were conducted at a significance level of .05 ( $F = 33.10$ ,  $p = .00$ ) as shown in Table 2. In addition, the effect sizes of the experiments were compared with the Effect Size Calculator program, and it was found that the effect sizes of the experiments for the health literacy were very large (Glass's  $\Delta = 1.85$ , Cohen's  $d = 1.84$ , Hedges's Unbiased  $d = 1.82$ ). This showed that the health literacy after the learning management process was better than that before the processes were conducted.

**Table 2**  
*Results of Using Hotelling  $T^2$  on The Health Literacy Scores*

Effect	Multivariate Tests	Value	F	Hypothesis df	Error df	p
Treatment	Pillai's Trace	0.85	22.28*	6.00	24.00	.00
	Wilks' Lambda	0.15	22.28*	6.00	24.00	.00
	Hotelling's Trace	5.58	22.28*	6.00	24.00	.00
	Roy's Largest Root	5.58	22.28*	6.00	24.00	.00
Tests of Within-Subjects Effects						
Sources of variance	Dependent variables	SS	df	MS	F	p
Treatment	Health cognitive	176.82	1	176.82	105.33*	.00
	Health access	1033.35	1	1033.35	58.98*	.00
	Communication skills	792.07	1	792.07	41.62*	.00
	Self-management	627.27	1	627.27	58.73*	.00
	Media literacy	1016.82	1	1016.82	37.30*	.00
	Decision-making skills	686.82	1	686.82	33.10*	.00

Hotelling  $T^2$  (calculated) = 46.16, df = 24 (Hotelling  $T^2$ table > 19.92)

Bartlett's Test of Sphericity: Likelihood Ratio = .00,  $\chi^2 = 234.98$ ,  $p = .00$ ,  $*p < .05$



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When analyzing the results of the multivariate analysis of covariance (MANCOVA) of the experimental group and the control group by using the pre-existing health literacy level as the covariate, it was found that the experimental group had a significantly higher level of health literacy than that of the control group if the health variables were controlled at a significance level of .05 ( $F = 21.23, p = .00$ ) as shown in Table 3. Moreover, the effect sizes of the experiment were compared by the Effect Size Calculator program, and it was found that the effect sizes for the experiment on health literacy were high (Glass's  $\Delta = 0.93$ , Cohen's  $d = 0.81$ , Hedges's Unbiased  $d = 0.80$ ). This showed that the health literacy of the experimental group after the processes had been completed was at a higher level than that of the control group.

**Table 3**

*Results of Using the Multivariate Analysis of Covariance (MANCOVA) on the Health Literacy Scores*

Effect	Multivariate Tests	Value	F	Hypothesis df	Error df	<i>p</i>
Treatment	Pillai's Trace	0.73	23.94*	6	52	.00
	Wilks' Lambda	0.27	23.94*	6	52	.00
	Hotelling's Trace	2.77	23.94*	6	52	.00
	Roy's Largest Root	2.77	23.94*	6	52	.00
Sources of variance	Dependent variables	SS	df	MS	F	<i>p</i>
Treatment	Health cognitive	342.56	1	342.56	149.92*	.00
	Health access	70.04	1	70.04	4.97*	.03
	Communication skills	54.84	1	54.84	2.18	.15
	Self-management	57.04	1	57.04	4.20*	.04
	Media literacy	42.84	1	42.84	1.67	.20
	Decision-making skills	33.88	1	33.88	1.40	.24

Box's  $M = 39.12, F = 1.66, df_1 = 21, df_2 = 12372.79, p = .03$

Levene's Test: Health cognitive  $F = 3.39, p = .07$ ; Health access  $F = 2.58, p = .11$ ; Communication skills  $F = .16, p = .70$ ; Self-management  $F = .25, p = .62$ ; Media literacy  $F = .15, p = .70$ ; Decision-making skills  $F = .39, p = .54$

Bartlett's Test of Sphericity:  $\chi^2 = 239.09, df = 20, p = .00$

\* $p < .05$

## Discussion

The learning management process was developed, re-designed and synthesized after implementation by the nursing students. The prototype for the learning management process consisted of six steps: (i) observation of self and others, (ii) learning and understanding, (iii) inquiry and exchange, (iv) consideration and decision making, (v) modifying the actions, and (vi) reflections and transfers. During the implementation, the learning management process was designed, improved, revised and developed according to the feedback, contexts and the real experiences of the students after implementation. It was comparable to the strategy and approach of design-based research used by the researchers focused on developing, adjusting and applying a certain theory or design when creating educational innovations (Peterson & Herrington, 2005; Christensen & West, 2018). Therefore, the design-based research findings can be utilized to improve the theory or design and expand the knowledge foundation of the developers so that it can lead to more effective innovation developments based on the design framework that was used as a systematical guideline to solve certain problems. As a consequence, this will result in successful designs suitable for the contexts of the nursing students that took part in this study (Edelson, 2002; Wongwanich, 2020; Tinoca et al., 2022).

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After implementing each learning management plan, there were certain findings regarding the activities the students had to complete in each step. In the six-step learning management plan, it was found that the first step (i.e., observation of self and others) and the second step (learning and understanding) of the process were the steps simultaneously taken by the students when performing actual care in the communities. Therefore, the first and the second step were combined into a new step of the adapted learning management process. As a result, the number of processes was reduced from six to five processes. The new first step was called “learning and understanding of self and others”. Therefore, the five steps were (i) learning and understanding of self and others, (ii) inquiry and exchange, (iii) consideration and decision making, (iv) modifying the actions, and (v) reflections and transfers. After considering the social cognitive theory (Bandura, 1977), it was found that self-learning by the nursing students still occurred but that it at times was affected by internal factors (i.e., reciprocal determinism) including the involved person, one’s behavior and the environment. The students had to learn from the training sessions and develop themselves until they could meet their goals with the learning management process (Khammani, 2021; Ullah, Kaleem, & Aamir, 2020; Zahra, Rosheen, & Fatima, 2022). When considering the social cognitive theory (Bandura, 1977; Bandura, 1986), it was found that the six steps of the process were reduced to five steps by combining the first and second step (i.e., personal and self-observation as well as learning and understanding). Reducing the number of the steps was consistent with the principle of observational learning and its four sub-processes: (1) attentional processes, (2) retention processes, (3) production processes and (4) incentive and motivational processes. This was also consistent with the principle of perceived self-efficacy which looked at using mastery experiences and vicarious experiences or modeling for improvements (Bandura, 1977; Bandura, 1986). It was also connected to the principle of self-regulation that followed the following three sub-processes: (1) self-observation, (2) self-judgment and (3) self-reaction. In other words, the first step being renamed to “learning and understanding of self and others” was still consistent with the social cognitive theory as the three learning methods of theory were integrated (Bandura, 1977; Bandura, 1986). The three remaining methods included observational learning, self-efficacy and self-regulation. Each method had specific processes. Some processes were integrated by the researchers based on the specific contexts and real situations of the students.

By comparing the average scores regarding the health literacy of the nursing students before and after the learning management process applied the social cognitive theory according to the design-based research approach, it was found that the experimental group had a higher score completing the process than that before the process at a significance level of .05. This was consistent with Thongnopakun (2017) who looked at the results after comparing the health literacy average scores before and after the program by applying the social cognitive theory. It was found that the experimental group had a higher average score for health literacy after the program than before the program at a significance level of .05. This was also consistent with the studies by Piwatphungkul & Therawiwat (2018); Khoonkongmee et al., (2019); Munsil et al., (2019) who studied the results after comparing the consuming behaviors and dental caries preventions before and after the program by applying the social cognitive theory. It was found that the experimental group had a higher score for health literacy after the program than before the program at a significance level of .05.

By comparing the average scores for the health literacy of the experimental group that followed the learning management process to the control group that did not follow the learning management process, it was found that the experimental group had a higher score after the

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process was completed than that of the control group at a significance level of .05 if the effects of pre-existing health literacy were controlled. This was consistent with the second hypothesis and the findings of Kaper et al. (2020), who found that the experimental group had a higher score for health literacy than that of the control group at a significance level of .05. In addition, a study by Pratummas et al. (2020) that applied the social cognitive theory to learning about consuming healthy food, found that when comparing the group that applied the theory with the other group that did not apply the social cognitive theory there were different levels of healthy food consumption at a significance level of .05. This was also consistent with a study by Saoweang et al. (2016); Sarobol Na Ayutthaya et al. (2018), who found that the group applying the theory had different vegetable and fruit consumption behaviors, self-efficacy, and perceptions with regards to the benefits from oral health care and food consumption from that of the other group who did not apply the theory at a significance level of .05.

By considering the variables of the average scores with regards to the health literacy of the experimental group and the control group, it was found that the average scores for cognitive health, accessing health information, and self-management of the experimental group after the processes were completed, were higher than that of the control group if the effects of the pre-existing of health literacy were controlled at a significance level of .05. Whereas, the average scores of the health communication, the media literacy, and the decision making skills of the control group after the processes were completed were insignificantly higher than that of the control group, it has to be stated that the scores for cognitive health, accessing health information, and self-management were significantly higher than that of the control group because the learning management process consisted of activities that focused on and covered the above variables with descriptions, such as individual and group studies, field studies in the communities around the Faculty of Nursing, while applying the lessons from the activities to daily lives, and other aspects (Kühn et al., 2022). This experiment was conducted among Bachelor students of the Nursing Program. The experimental group and the control group were the nursing students who had passed the basic nursing or medical science courses. Hence, the control group might have had significantly higher average scores regarding their cognitive health, accessing health information, and self-management, than those of the experimental group (Cal et al., 2022; Kühn et al., 2022). Nonetheless, the average scores for health communication, media literacy, and decision-making skills of the experimental group were insignificantly higher than that of the control group. When considering the process and experimental period, it can be concluded that these three variables were personal skills that required longer time periods to develop than the experimental period in order to enable the students to communicate about their health, receive up-to-date health information and make decisions about their health (Marques, 2020; Leblang, Taylor, Brown, Knapp, & Jindal, 2022; Munangatire, Tomas & Mareka, 2022). Moreover, the activities to complete the communication, media and technologies, and decision-making processes might have been limited or might have been conducted in groups that might not cover all students.

### Conclusions

In conclusion, the learning management processes to enhance the health literacy of nursing students by applying the design-based research approach in the end consisted of the following five steps: (i) learning and understanding of self and others, (ii) inquiry and exchange, (iii) consideration and decision making, (iv) modifying the actions, and (v) reflections and transfers. To implement this learning management process, the goals of the learning management plan, media, materials and learning sources should be comprehensively studied beforehand because each learning management plan has different goals with different

sub-units. Additionally, the media, materials and learning sources for each plan were different. For some plans, the instructors had to prepare, communicate, and coordinate with communities before conducting the learning activities during the Bachelor of Nursing Science Program. It is recommended to implement these learning management plans for the nursing students who passed basic nursing or medical science courses because some activities involve the checking of the patients' records and bodies which require basic medical science knowledge. The periods for the activities should be extended (especially for communicating about health, receiving up-to-date health information, and making decisions about one's health). For further studies, researchers should focus on applying empirical evidence and the design-based research approach when designing educational innovations in order to provide benefits, meet the needs of the students and to be suitable for the contexts of the users since the mixed synthesis method and the design-based approach in this study designed the process by initially using empirical evidence and the learning cognitive theory to actually improve the health literacy of the students according to their needs and contexts.

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