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Development of the Learning Environment Model of Makerspace for Promoting Students' Creativity in a Vocational College under the Vocational Education Commission

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The objectives of this research were, 1) to study current conditions and needs for learning environment based on Maker Space concept, 2) to develop the model, 3) to study the findings in applying the learning environmental model based on Maker Space concept for promoting students' creativity in Vocational College under the Vocational Education Commission. There were 3 Phases of this research including, Phase 1, The study of current conditions and needs for learning environment based on the Maker Space concept, Phase 2, the model was developed, Phase 3, study the findings in applying the learning environment model based on Maker Space concept. The research tools were, 1) the current conditions questionnaire and needs, 2) the In-depth Interview, 3) the learning environmental model, 4) the Handbook for applying the model, 5) the advance thinking skill test, 6) the satisfaction questionnaire, 7) the evaluation and assurance of model. For quantitative data, statistic including mean and standard deviation was administered. For qualitative data, the content analysis was administered. For hypothesis testing, the Wilcoxon matched-pairs signed-rank test through matching. The research results found that current conditions of agreement in learning environment, was in "Low" level. For the needs, the agreement in learning environment were in "the Highest" level. The developed model was comprised of, 1) the principle and approach of model, 2) the objective of model, 3) the learning environmental management, 4) the Maker Space, 5) the activity management process, 6) the Creativity. For comparison of thinking, the posttest scores were significantly higher than those of the pretest at .05 statistical significant level. The satisfaction on learning environmental management was in "the Highest" level. Finally, the findings in evaluation and assurance for the model, in overall, propriety of every aspect was in "Good" level.

Keywords: Model development, Learning environment, Maker Space, Creativity.

1. Introduction

Learning inside the Vocational College would be valuable experience as well as foundation of learning development for students not only gaining knowledge in the classroom but also learning from society and classmates. It the same as learning in parallel outside the classroom which would support, facilitate, obstruct, and develop students' impressive experience. According to a large number of research studies, it was indicated that the appropriate environmental condition or environment was useful for both of learning regarding to the body of knowledge as well as social learning specially for learning and teaching in Vocational Education level which was different from general schools in higher secondary schools due to more flexible learning schedule. The environmental conditions or supportive environment for students to search for and practice by themselves, was not less important than learning from instructors in class. For the period of rapid growth and progress in the world owing to technological application for connecting various information from every region of the world. The trend of social changes being occurred during the 21st century, could have an impact on livelihood of people in society thoroughly. Therefore, it was necessary for the educational management for the 21st century to make change in perspectives from tradition paradigm into new paradigm so that the students would be persons who could search for knowledge by themselves more and more especially their competency in using the technology to search for knowledge completely. They also would be able to analyze, critique, and construct knowledge by themselves very well. In addition, they would be able to present their own idea appropriately which would be an important technique being able to develop the students' desirable characteristics in the present. (Chaicharoen, Sumalee. 2004) In Vocational College, there were many changes in this age. The most important thing was the information, communication, and technology was radical changing. The amount and technique to access the information was not necessary to be limited by studying in classroom anymore. Besides, the students' learning behavior was absolutely changed. Although learning activities were the same as traditional learning, a variety of experiences being new occurred due to the changes based on changing behavior. Consequently, behavior was a major factor for determining the pattern of architectural work as well as interior architect. Since the good design was caused by one's attempt response the usage to me most appropriate.

Developing characteristic for Thai population during the 21st century, was based on the educational management rational in focusing on student-centered. In learning process, the material content should be organized to be congruent with students' interest, aptitude, and differences. The thinking process skill, management, situation facing, and application were necessary for prevention and problem solving. The students should learn from their real experience, practice for be able to do, think, and act. The Vocational College Students were important for production and service sectors of Thailand since they were during the age being ready to work. So, they should be developed their basic skill as well as association with creativity, problem solving skill, flexible idea of thinking, applying, and being brave for experimenting in different aspects very well. Creative thinking was a person's ability in expressing one's different directions as well as facets by using one's own former experience as a basis in leading to new idea for inventing various new things. Creativity was one's competency as an aspect of higher cognition. It was various ways of thinking which could be developed into higher level based on learning as well as provision of facilitating climate. It

was also one's brain process in divergent thinking which would lead to searching for new things by thinking, adapting, and modifying from former thinking to be mixed into new things and inventing the new things as well as theoretical approach being different from prior one being existed. It could be occurred not only to think from the impossible thing which was reasonable. However, the importance of creativity was the imagination leading to the new one. So, creativity was one's applied imagination which would lead to new invention being able to solve the problem, and utilize both of oneself and society. It was one's unique characteristic being innate from birth. For creativity which could be learned, was caused by one's experience or reaction to conditions around people. In learning process management for promoting and developing one's creativity, there were various approaches. Maker Space was an approach or concept being well known since it was suitable for content in learning courses for future. Because, people could have real practice from textbook learning. The students could access modern tools on knowledge-based, and provide the area for enhancing learning. Consequently, Maker Space was another factor being able to support people in developing one's innovative skill since it was an environmental management to be ready as well as sufficient for developing the new innovation. It was an area for being used by people to create one's performance openly. Moreover, this area was a learning society for developing one's communication skill as well as participation in working as sub-skill in innovative skill as well.

Besides, the development of learning conditions for learning, was not limited in classroom only. But, once the information, communication, and technology or educational innovation could play their role in extending the boundary of learning conditions more widely without time or place limitation. Learning conditions on Website was a combination of computer technology with process in designing both of learning and teaching for improving learning efficiency as well as solving the problem in limitation of time and place. Teaching on Website would apply the characteristic and resource of World Wide Web (WWW.) in organizing the learning conditions promoting and supporting both of learning and teaching. In addition, it was the design and provision of facilitators in internet system facilitating the learning through website. Both of the Online learning environment and virtual learning, were different from the Physical environmental management being provided in classroom. Recently, learning source in internet organized the learning environmental conditions to serve for students' needs very well. The educational environmental conditions could have an impact on students' learning achievement. Because the teachers' teaching behavior in classroom was the most important in learning and teaching. The teachers have to know how to select various teaching techniques being suitable for learning objective and conditions.

According to the above reasons, the researcher was interested in designing the learning environmental model based on Maker Space concept for promoting students' creativity in Vocational College in order to improve and develop the process of original learning management for High Vocational Certificate so that it would have characteristic in serving Vocational field through the usage of Science in Vocational field for developing the citizen's learning of citizens in every group, age, and occupation so that they would have strong basic knowledge, life skill, excellent competency being ready for entering into competitive world with quality. It was dispensable for promoting the high Vocational College students to be able to think as well as select the problem solving technique in working quickly and actively with situation and need efficiently as an important goal of this research.

2. Objectives

2.1 To study current conditions and needs for learning environmental management based on Maker Space concept for promoting the students' creativity in Vocational College under the Vocational Education Commission.

2.2 To develop the learning environmental model based on Maker Space concept for promoting the students' creativity in Vocational College under the Vocational Education Commission.

2.3 To study the results in applying the learning environmental model based on Maker Space concept for promoting the students' creativity in Vocational College under the Vocational Education Commission.

3. Research Methodology

The design of this study was research and development aimed to develop the learning environmental model based on Maker Space concept for promoting the students' creativity in Vocational College under the Vocational Education Commission, there were 3 Phases of this study.

Phase 1, The study of current conditions and needs for learning environment based on the Maker Space concept.

The study of current conditions and needs for learning environment promoting creativity based on Maker Space.

1. Steps for implementation:

1.1 To study the principle, theoretical approach of learning environmental model

based on Maker Space concept from related research literatures and documents.

1.2 To ask opinion of Vocational College Students in Vocational College under the Vocational Education Commission regarding to current conditions and needs for learning environment promoting creativity based on Maker Space.

1.3 To interview people with experience in designing the learning environmental model promoting students' creativity based on Maker Space.

2. Population and Samples

2.1 Population

1) The number of 684,055 High Vocational Certificate Students in Vocational

College under the Vocational Education Commission during 2018 academic year.

2) The persons with experience in designing the learning environment for

promoting students' creativity.

2.2 Samples

1) The number of 400 Vocational College Students in Vocational College under

the Vocational Education Commission during 2018 academic year. The number of samples obtained by calculation based on Yamane's Formula (1973) through the Multistage Sampling.

2) The number of 5 people with experience in designing the learning

environment for promoting students' creativity for In-depth Interview. They were selected by Purposive Sampling.

3. Data Analysis

3.1 For Quantitative Data, the mean and standard deviation were administered. The

needs were ranked in order from high to low through improvement based on approach of Wongwanich, Suwimol (2015).

3.2 For Qualitative Data, the Content Analysis was administered.

Phase 2, The development of model in learning environment for promoting the students' creativity based on Maker Space in a Vocational College under the Vocational Education Commission.

The model development in learning environment for promoting the students' creativity based on Maker Space in a Vocational College under the Vocational Education Commission, was implemented as followings:

1. Steps of implementation

1.1 The components and details of learning environmental model for promoting the

creativity of students in a Vocational College under the Vocational Education Commission, were synthesized by using data from analysis of related documents as well as opinion questionnaire from phase 1.

1.2 The tentative model of learning environment for promoting the creativity if students under the Vocational Education Commission, was established.

1.3 The environment as well as activity management pattern based on learning environmental model through Marker Space for promoting creativity of students under the Vocational Education Commission. There were steps in construction as follows: 1) the learning area based on Marker Space concept, 2) the support station for promoting creativity, 3) the evaluation form of propriety in environment regarding to the learning and teaching activity management as well as the content material, was constructed, 4) the environmental conditions were developed based on developed model.

1.4 The environmental conditions, activity management plan, and quality evaluation were presented to the experts for being investigated in both of quality and propriety for being used.

1.5 The learning environmental based on Marker Space concept for promoting the students' creativity, and the activity management pattern were revised from the experts' recommendations.

2.Key Informants

2.1 The number of 8 experts for evaluating the learning environmental model, were

selected by purposive sampling.

2.2 The number of 10 experts for evaluating the learning environment for promoting

the creativity of students under the Vocational Education Commission, were selected.

2.3 The number of 30 Vocational College Students were tried out in searching for quality of research tools

3. Research Tools

3.1 The learning environmental model based on Marker Space concept for promoting creativity of students under the Vocational Education Commission, was outlined. There were steps in construction as follows:

3.2 The Evaluation Model Test

4. Data Analysis

4.1 For Quantitative Data, the Mean and Standard Deviation were administered.

4.2 For Qualitative Data, the Content Analysis was administered.

Phase 3, the study in the findings of learning environmental model for promoting creativity based on Marker Space concept of students under the Vocational Education Commission.

The study in the findings of learning environmental model for promoting creativity based on Marker Space concept of students under the Vocational Education Commission, was implemented by following techniques

1. Steps of Implementation

1.1 The learning environmental model based on Marker Space concept for promoting creativity of students under the Vocational Education Commission, was tried out with 30 students majoring in Electrical work, Rang-si-yo-pas Technology College, during 2022 academic year. They were selected by purposive sampling.

1.2 The students' satisfaction questionnaire on the usage of learning environmental model for promoting creativity of students under the Vocational Education Commission, was constructed.

1.3 The connoisseurship was provided for serving the learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, was held.

2. Research Tools

2.1 The learning environmental Model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission.

2.2 The learning environmental conditions based on Maker Space concept for promoting creativity of students under the Vocational Education Commission.

2.3 The Achievement Test of Creative Thinking Development.

2.4 The students' satisfaction questionnaire on the usage of learning environmental Model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission.

2.5 The evaluation and assurance of model, and supplementary document.

3. Data Analysis

3.1 For Quantitative data, the mean and standard deviation were administered.

3.2 For Qualitative data, the content analysis was administered.

3.3 For difference testing of mean scores, the Wilcoxon Matched Pairs Sign Rank Test by matching, was administered.

4. Research Results

4.1 The results of study in current conditions and needs for learning environment based on Maker Space concept for promoting creativity of students under the Vocational Education Commission.

Table 1: The findings of study in current conditions, needs, and priority of needs regarding to creativity based on Maker Space concept of students under the Vocational Education Commission, in every aspect.

Components	Current Con. Condition			Needs			PNI	Rank PNI
	$\overline{X}$	S.D.	Interpret	$\overline{X}$	S.D.	Interpret		
Physical Environment	2.36	0.54	Low	4.31	0.46	High	0.830	4
Psychological Environment	2.32	0.49	Low	4.29	0.45	High	0.850	3
Sociological Environment	2.28	0.46	Low	4.35	0.48	High	0.907	2
Information Environment	2.26	0.46	Low	4.36	0.48	High	0.926	1
Students	3.77	0.45	High	4.35	0.48	High	0.154	5
Instructors	4.28	0.46	Low	4.62	0.47	Highest	0.079	7
Process	4.27	0.45	High	4.72	0.48	Highest	0.105	6
Total	3.29	0.48	Moderate	4.34	0.47	High	0.319	

According to Table 1: the current conditions, needs, and Priority Needs Index of needs for learning environment based on Maker Space concept in promoting creativity of students under the Vocational Education Commission in overall, found that the current conditions were in "Moderate" level, and the needs for learning environment in overall in "High" level. The priority needs Index regarding to learning environment based on Maker Space concept in promoting creativity of students under the Vocational Education Commission, in order including: 1) the Information environment, 2) the sociological environment, 3) the students' psychological environment, 4) the physical environment, 5) the students, 6) the process, and 7) the instructors.

Table 2: The current conditions, needs, and priority of needs index regarding to components of Maker Space concept for promoting creativity of students under the Vocational Education Commission.

Components	Current Conditions			Needs			PNI	Rank PNI
	$\bar{X}$	S.D.	Interpret	$\bar{X}$	S.D.	Interpret		
Electronic Device	2.25	0.44	Low	4.37	0.48	High	0.94	5
Woodworking and handwork	2.27	0.45	Low	4.43	0.50	High	0.95	3
Embroidery Device	2.25	0.43	Low	4.40	0.49	High	0.95	3
Digital Production	2.27	0.44	Low	4.45	0.50	High	0.97	1
Cutting Device	2.26	0.44	Low	4.44	0.50	High	0.96	2
Digital Inventive Device and Software	2.27	0.44	Low	4.35	0.48	High	0.92	6
Area for Work piece construct	2.29	0.46	Low	4.33	0.47	High	0.89	7
Area for knowledge sharing or group working	2.27	0.44	Low	4.34	0.47	High	0.92	6
Total	2.27	0.43	Low	4.39	0.49	High	0.93	

According to Table 2, the current conditions, needs, and Priority of Needs Index regarding to the needs for components of Maker Space concept for promoting creativity of students under the Vocational Education Commission, in overall, found that the current conditions were in "Low" level. But, the needs were in "High" level. For priority of needs for learning environment promoting creativity of students under the Vocational Education Commission, ranking in order including: 1) the digital production device, 2) the cutting device, 3) the wood and invention work, 4) the area for constructing the work piece, 5) the electronic device, 6) the digital system of invention device and software, and 7) the area for constructing work performance.

4.2 The results in developing the learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, in overall, being revised according to experts' recommendations. Consisted of 6 components including: 1) the principle and approach of model, 2) the objective of model, 3) the management of learning environmental conditions, 4) the Maker Space, 5) the process of activity management, and 6) the creativity shown in Figure 1.

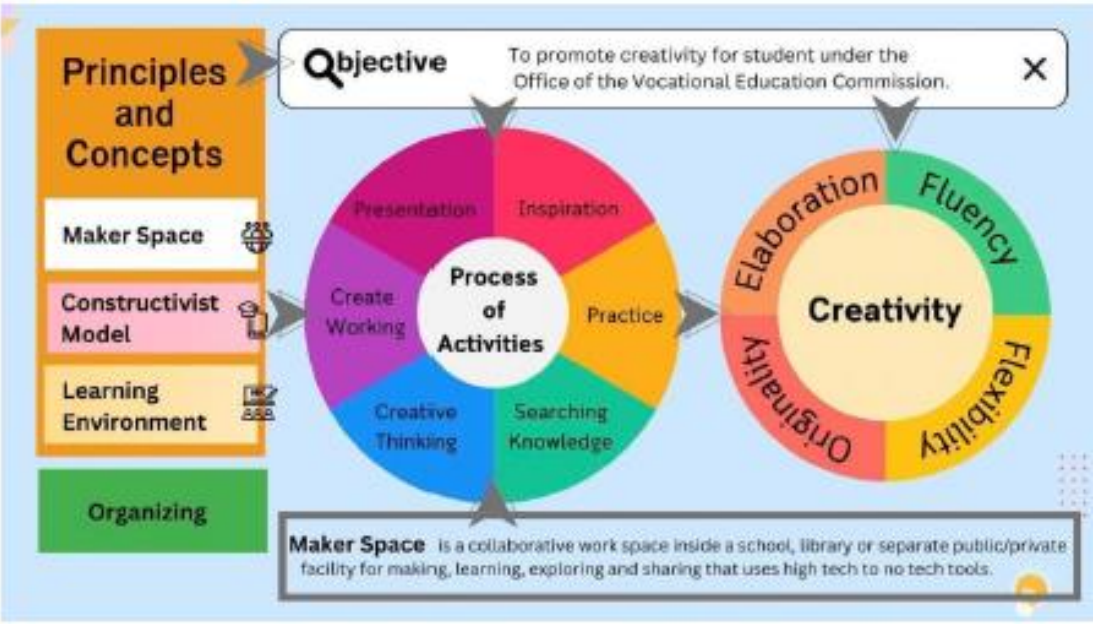

Figure 1: The learning environment model based on Maker Space for promoting creativity students under the Vocational Education Commission.

4.3 The results of trying out the learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission:

4.3.1 The comparative findings of Mean Scores in evaluating the creativity of students under the Vocational Education Commission, between pretest and posttest.

Table 3: The comparative findings of mean scores in evaluating the creativity of students under the Vocational Education Commission, between pretests and posttest, in overall.

Creativity	N	Mean	S.D.	Mean Range	Sum of Ranks	Z	P
Pretest	30	4.13	0.51	11.00	187.00	2.837	.005**
Posttest	30	4.57	0.50				

** Statistical significant at .05 level.

According to Table 3, comparative findings of mean scores in evaluating the creativity of Vocational College Students under the Vocational Education Commission, between pretests and posttest, in overall, found that the results of testing by statistic of Wilcoxon Matched Pairs Signed Rank Test through matching at .05 statistical significant level, found that the students participating in experiment for model application, the students' posttest Mean scores were significant higher than those of the pretest at .05 significant level.

4.3.2 The evaluative results in evaluating the students' satisfaction on learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, were shown in Table 4.

Table 4: The evaluative results of students' satisfaction on learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission.

Evaluation List	Satisfaction		
	$\bar{X}$	S.D.	Interpret
Maker Space			
Device and equipment were ready for using, served one's need and sufficient.	4.51	0.98	Highest
Speedy and stable Internet Network System.	4.40	1.04	High
Creative construction areas were sufficient with student number.	4.30	1.02	High
Tidy area.	4.20	1.05	High
Adequate area for learning.	4.25	1.05	High
Adequate area management for work presentation.	4.14	1.05	High
Adequate temperature, light, and climate facilitating work practice and learning.	4.15	1.04	High
Total	4.20	1.05	High
Learning and teaching management Process			
Step 1: Motivating	3.82	0.59	High
Step 2: Imaginative Training	4.41	0.70	High
Step 3: Knowledge Searching.	4.22	0.58	High
Step 4: Towards Creativity	3.81	0.66	High
Step 5: Creating the work performance	3.81	0.64	High
Summation	4.01	0.65	High
Total	4.12	0.89	High

According to Table 4, evaluative findings of satisfaction on learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, found that the overall satisfaction of students the Vocational Education Commission, was in "High" level. ($\bar{X}$ = 4.12, S.D. = 0.89) for Maker Space aspect, their satisfaction was in "the Highest" level. ($\bar{X}$ = 4.20, S.D. = 1.05) The second order was the process of learning and teaching management. ($\bar{X}$ = 4.01, S.D. = 0.65)

4.3.3 The results of assurance for learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission found that the experts certified the Propriety of component inside the learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission in every component. In addition, the evaluative findings of model were in "Good" level.

5. Research Results

5.1 According to the study of current conditions and needs for learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, found that the current conditions of learning environment for promoting creativity of students under the Vocational Education Commission, in overall, every aspect was in "Moderate" level In addition, the overall needs was in "Moderate" level. It was supported by the study of Pa-pad-ta, Chantana (2014) titled "A Study of Sufficiency, Deficiency, and Needs for Using the Instructional Media of Faculty of Technology and Mass Communication, Bangkok Rajamangkala University of Technology Phra Nakhon," found that the sufficiency was in "Moderate" level including the priority of needs Index in learning

environment based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, ranking in order from high to low : 1) the Information Environment, 2) the Sociological Environment, 3) the students' Psychological environment, 4) the Physical environment 5) the student 6) the process 7) the instructors. For current situation in component of Maker Space for promoting creativity students under the Vocational Education Commission, ranking in order from high to low: 1) the digital production device, 2) the cutting device 3) the wood working 4) the area for creating the work piece 5) the electronic device 6) the digital system and software of invention device 7) the area for constructing the work piece. It was supported by the study of Sintupan, Chut-ya-wed (2015) titled "Make Space: The area of creative people, Doing to be True," by studying the components of Maker Space as physical area or virtual area in the form of learning environment providing opportunity for general people, children, students, and teachers to learn and work together through direct experience caused by inventing, playing, and surveying openly for everybody. They could share their idea, device, and knowledge. It could be used as the place for developing one's original work piece including necessary devices for being borrowed by the inventors. Everyone would have one's own area or table for constructing one's performance. In the area, it was surrounded with the devices, machines, and equipment such as drilling machine, lathe, steel cutting machine, and 3D Printer etc.

5.2 According to research findings found that the developed learning environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, consisted of 6 components including: 1) the principle and approach of model, 2) the objective of model, 3) the environmental learning management, 4) the Maker Space 5) the process of activity management included 5 steps. Step 1, the inspiration development, Step 2, the imaginative practice, Step 3, the knowledge searching, Step 4, the creativity entering, Step 5, the create working, and Step 6, the performance presenting. Since the researcher studied rational and approach of Maker Space concept of Wongtongsiri, Kannika (2017), Youth Maker Space Playbook (2015), Maker Space Playbook (2013) as well as approach of the learning environmental management, description and components, and activity management for improving students' creativity. It was found that the learning environmental management, the learning environment for promoting one's creativity based on Maker Space concept, was a form of Learning Environment being designed by collecting various kinds of media such as message, voice, videotape, graphic, and animation etc. for conveying both of content and activity training for enhancing one's creativity by presenting the content being served for the students' need through the devices and equipment being ready for supporting students' work piece construction appropriately with their needs.

5.3 According to research results found that the findings in applying the learning

environmental model based on Maker Space concept for promoting creativity of students under the Vocational Education Commission, found that the mean scores from posttest creativity evaluation of Vocational Students, were higher than those of the pretest Mean Scores at .05 significant level. It might be because the researcher provides learning environment for students to cope with problem which was a challenge in practicing one's task including the design and construct one's work piece both of in group and individual. In learning management, the inspiration was stimulated by asking the question for thinking. So, the students were challenged and wanted to develop the innovation successfully whereas they

were not challenged from traditional teaching. It was supported by viewpoint of Bender (2012) through conclusions: learning by project, the students would face with problem or real situation. Both of motivating and engaging question by instructor would cause the students to be interested in and want to learn. In addition, when the instructor provided students to participate in Teamwork, the developed task would be accomplished. Besides, it was also supported by findings of Matthews and Johnson (2017) by conducting their research through project learning management for promoting Bachelor Degree Students' innovative thinking, the research findings found that the Project learning management could enhance the students' innovative thinking very well. In addition, the learning supportive system by using internet system in searching and learning by themselves, was provided. Furthermore, See-ya, Chutarat (2015) studied both of creativity and learning achievement of students learned by open learning environment on network enhancing the secondary school students' creativity, found that the students' posttest scores were higher than the pretest scores at .05 significant level.

Moreover, the results in evaluation of Vocational College Students' satisfaction on learning environmental model based on Maker Space for promoting their creativity, were in "the Highest" level. It might be because the researcher designed and developed area for providing the students' learning management in a pattern of Maker Space which was suitable for future subject content. The students had their opportunity in learning as well as practicing from what being studied in their textbook. They had an area for work piece construction with devices and equipment. In the area, they had an opportunity to learn and do independently. It was supported by statement of Sang, Na-tee (2015) that modern age students did not have much opportunity to learn from experience or practice both inside or outside classroom. As a result, they showed their satisfaction on learning environmental model for promoting creativity based on Maker Space concept in "High" level. In addition, the research findings also found that the experts certified an confirmed learning environmental model based on Maker Space concept for promoting creativity of the students under the Vocational Education Commission through connoisseurship. The results in certifying the propriety was in "Good" level. It might due to the assurance of model in this study, was performed by connoisseurship. Laktong, Sontaya (2018) concluded this technique that the connoisseurship was an evaluation method based on naturalistic value-oriented evaluation: NV Model. The evaluators judge the value of thing to be evaluated by one's potentiality in valuing. Besides, it was supported by statement of Buason, Rattana (2013) that the research and development process was a research process being recognized that when any innovation was gone to process, the innovation would have quality and be accepted. It should be started from the study if problem and need first. Then, the findings in using the innovation should be studied later.

6. Recommendations

6.1 Generation Recommendations:

1) According to research results found that the learning environmental model for promoting creativity of Vocational College Students, consisted of propriety and feasibility regarding to both of component and process aspects. The instructors were able to apply this model with learning and teaching for other courses. Before learning management, content analysis should be performed. Furthermore, work load should be determined appropriately

with learning model. Then, learning for Vocational College Students could be provided.

2) According to research results found that the promotion for Vocational College Students' creativity, both of propriety and feasibility were practical for both of component and process aspects. The instructors were able to apply this model in teaching the other courses. Before the learning management would be performed, the content analysis should be conducted. Besides, work load should be determined to be adequate with learning model. Later on, the learning should be provided for Vocational Students.

3) According to research results found that in order to promote the creativity for Vocational Students, the process in providing both of learning management and cooperation between students and instructors, was very important. Before applying this model, the instructors should inform the agreement to students clearly before learning, including: the learning type, assumption in using Maker Space, technique, devices, and criterion for evaluating students' creativity as well as steps in learning management should be informed clearly.

6.2 Recommendations for future research:

1) Research studies in innovation development for promoting a variety of creativity based on Maker Space concept, should be conducted for a variety and instructors' guidelines in using or applying in learning and teaching management further.

2) Extensive research should be conducted by collaboration from network alliance in both of government and private sectors so that it would be learning environmental model for promoting creativity based on approach of Maker Space which would be suitable for students in early childhood level, Basic Education Level, Higher Education level, and Informal Education etc.

References

1. Bender, W.N. (2012). Project-based learning: Differentiating instruction for the 21st century. California : CORWIN A SAGE Company.
2. Bua-son, Rattana. (2013). Qualitative Research in Education. Bangkok: Chulalongkorn University Printing.
3. Chai-cha-roen, Sumalee. (2004). Model Development of Knowledge Development by using the Information Technology. Khon Kaen: Faculty of Education, Khon Kaen University.
4. Laktong, Sontaya. (2018). Model Development of Mixed Training Model for Enhancing the Digital Competency of Teachers under Office of the Basic Education Commission. Ph.D. Dissertation in Educational Technology and Communication, Faculty of Education, Mahasarakham University.
5. Maker Space Playbook (2013). Makerspace Space Playbook. [online]. Available from : http://makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf. [accessed 16 June 2021].
6. Matthews, W. and Johnson, D.C. (2017). Promoting Technology-Based Collaboration Among Pre-Service Music Educators : An Inter-University Project. International Journal of Teaching and Learning in Higher Education, 29(3), 436-446.

7. Pa-patta, Chantana. (2014). A Study of Sufficiency, Deficiency, and Needs for Using the Instructional Media of Faculty of Technology and Mass Communication, Bangkok Rajamangkala University of Technology Phra Nakhon. Bangkok: Multi-Media Technology, Faculty of Technology and Mass Communication, Rajamangkala University of Technology Phra Nakhon.
8. Posuwan, Paattarapon. (2015). Maker Space: New Approach of Learning Area, Thinking, Practicing, Sharing, and Learning from Mistake. [Online]. From: http://tkpark.or.th/eng/articles_detail /227/Maker-Space: New Learning Approach. [Searching on the 16th May 2022].
9. Sang, Na-tee. (2015). Maker Space: New Approach of Learning Area, Thinking, Practicing, Sharing, and Learning from Mistake. http://tkpark.or.th/eng/articles_detail/227/Maker-Space-New Approach of Learning Area. [Searching on the 16th May 2022].
10. See-ya, Chu-ta-rat. (2015). A Study of Creativity and Learning Achievement of Students studying from Open Learning Environment on Network enhancing Creativity in Secondary School Students. Master of Education Thesis
11. Sintupan, Chutayawech. (2015). Makerspace : The Area of Creative Persons, Doing to be True. [Online] From: http://www.progressth.org/2015/03/makerspace.html. [Searching on the 21st May 2022].
12. Sri-sa-ad, Boonchom. (2002). Foundation of Research. The 7th Education. Bangkok: Su-wi-ri-ya-san.
13. Tech Lab (2017). Maker space 101: Building a Maker space for Library and Education Professionals. [online]. Available from : https://forma space.com /articles /tech-lab /building – maker space-education. [accessed 16 June 2021].
14. Torrance, E.P. (1962). Goals for guiding creative talent. In E. P. Torrance, Guiding creative talent (pp. 142–161). New York : Prentice-Hall, Inc.
15. Wilepana, Cataliya. (2022). Guidelines for Developing the Area in Enhancing the Maker Space for Developing the Students' Innovation Skills. Bangkok: Computer Science, Demonstration School of Srinakarin Wirot University, Prasanmit. (Secondary School)
16. Wongtongsiri, Kannika. (2017). Enjoy Maker Space in Freeing the New Age Innovationists' Creativity. [Online] from https://mgronline.com/science/ detail/9600000018295. [Searching on the 21st May 2021].
17. Wongwanich, Suwimol. (2015). Research for Evaluating the Needs. Bangkok: Chulalongkorn University Printing.
18. Yamane, T. (1973). Statistics An Introductory Analysis. 3rd ed. New York : Harper and Row. Youth Maker Space Playbook. (2015). Youth Maker Space Playbook. [online]. Available from: http://makered.org/wp-content/uploads/2015/09/Youth-Makerspace-Playbook_FINAL.pdf. [accessed 16 June 2021].