

The Study and Development for the Set of Activity Table to Support the Activity Learning of Grade 4 Students by Department of Arts

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Abstract. The research objectives are 1) to study the students' behavior in using desk and chair set for art learning activities, 2) to develop a desk and chair set for art learning activities, 3) to test the efficiency of developed desk and chair set according to the loading standard with the universal testing machine -UH4, and 4) to evaluate the satisfaction of 4th grade students and teachers in using the desk and chair set. The result of the behavior study identified that some students sit leaning forward to the desk causing an inappropriate posture for using pencils and brushes in art learning activities, and also the existing desk design does not allow for group learning which is the major need for them. The developed desk is evaluated as being very appropriate ($\bar{x} = 4.18.$, S.D. = 0.82). We built a prototype and put it through the load test with the universal testing machine – UH4 and found that the new design passed the standard. Finally, we gathered feedback from the 4th grade students and teachers stating that they are very satisfied (for students $\bar{x} = 4.69.$, S.D. = 0.48 ; and for teachers $\bar{x} = 4.72.$, S.D. = 0.54).

Statement of the Problem

Elementary school students that are aged with intellectual development at Jean Piaget is called “Concrete Operation”, which is the ability to think logically. The learners are able to recognize the environment according to reality. They can compare the products into groups by using many criteria. The young learners begin to understand the rules and understand the stability of the matter. The change of external shape does not affect the original condition on quantity, weight and volume. There is a sense of creativity. The students like to solve problems according to their own methods. They like to seek various methods from practicing, asking, comparing and remembering things from people correctly. The language development and symbolic use at this age are very advanced. They are able to understand the language, the new meaning of each word, being capable of reading and writing more, and having the ability to explain the similarities as well as the differences. There is a concept about the environment by bringing together existing things. This includes the understanding of the lesson meaning which are in the areas of mathematics, language and reading, promoting proper intellectual development from parenting, and teaching management on part of the teachers. This idea will help children have a way of thinking, appropriate learning methods, as well as making the right choice and solution which will further promote the development of the next age [1].

To arrange the environment in the classroom, the room should be well-ventilated, with ample light and evenly across the table, with a chair that is suitable for all ages. The objects should be in light weight for allowing the children to move easily, taking into account the value and durability [2].

The student desks and chairs are also organized as part of the learning management process so that learners will be able to learn with convenience. In this standard, the table refers to the table

used in various educational institutions at the grade level from kindergarten to early elementary school, junior high school, and secondary school high school, which will use the body height of male students, female students aged 3-5 years, 6-8 years, 9-11 years, 12-14 years and according to the standard height of the table and the floor height of the chair during the age of 15-17 years. Data was obtained from the survey from the period of 1793 - 1994 to be used as a reference standard in the size of the table and chair for each level [3].

The area of surveying the schools in the Muang District, in Chiang Mai Province was done by observing the teaching, interviewing, and inquiring with the teachers and primary school students. The study was organized according to the core curriculum of basic education, 2008, consisting of 8 groups. The researchers considered that the art learning group is a material group that helps develop the students to be creative with an artistic imagination, an appreciation of beauty, aesthetics, value, which affects the quality of human life. Art activities help develop students physically, mentally, intellectually, emotionally, socially, as well as leading them towards environmental development. Learners become encouraged to have confidence in themselves, which is the basis for further education or occupation. It was found that the students were curious, and wanted to do something on their own. They prefer to stay motionless and will pay attention to the teaching and learning activities that are performed by themselves or in groups rather than from the textbooks. The art classes are organized in a variety of teaching and learning activities, such as drawing, printing, sculpting, carving, etc. Therefore, some activities are not appropriate to do on the existing tables, because the students' desk is too small. Therefore, most teachers often have activities on the classroom floor. But when students do that activity for a long time it often causes students to become fatigue, and developing some pain in the leg and back, which will affect the physiology of students according to the principles of physical science. Also, the researchers found that the tables and chairs of the students used in teaching and learning were in a size that was not suitable for students. This resulted in some students suffering from body fatigue after doing some long-term teaching activities. In addition, the materials used in the manufacturing of tables and chairs are very heavy, so it is not easy to move into group activities or outside the classroom. This causes problems in teaching and learning sometimes. Moreover, the material of the table and chair set becomes damaged due to the material being used for a long time, thus putting students at risk of getting injured.

Chiang Mai is unique in terms of tradition and culture. Based on the interview with the teachers in the subject, the art group saw the importance of the student's desk and chair in the art course. There should be a design or picture of a traditional lifestyle story on the student's desk page for students to see and learn about the local traditions and culture, which is one of the cognitive integration for students.

From the reason above, we are interested in studying and developing a desk and chair set for the 4th grade art learning activities to meet both individual and group art teaching and learning behavior. The desk and chair set's size and proportion must be appropriate according to the student's ergonomic standard. Moreover, we want to deliver the concept of lifestyle, wisdom, and tradition of Chiang Mai province through the visual design on the desk and chair set to communicate the value of the local culture to students.

Purpose of the Study

To study the behavior of the students and the form of the table and chair set for the activities of the 4th grade art learning group.

To develop a table and chair set for activities of the 4th grade art learning group.

To test the performance of the table and chair set for activities according to the standard Load Testing by the Universal Testing Machine UH.

To evaluate the satisfaction of students and teachers towards the table and chair set for activities Learning of the 4th grade art learning group.

Research Methodology

The research methodology is conducted to achieve the objectives of the research through these processes.

Research Sample

We used purposive sampling and divided the samples into 4 groups.

1) *The samples for studying in this case were 26 students who were studying in the 4th grade and 3 teachers in Suan-Dok school.*

2) *The samples for evaluating the development and design of the desk and chair set for art learning activity were 3 furniture design experts, and 3 material experts.*

3) *The samples for load testing were the prototypes of the desk and chair set*

4) *The samples for usability and satisfaction testing were 26 students who were studying in the 4th grade and 3 teachers in Suan-Dok school.*

Research Application

1) *We used observation, open-ended questionnaire, memo, and photograph to investigate the behaviour in using the existing desk and chair set during the art class session, and structured-interview and close-ended questionnaire with teachers to understand the teaching and learning style.*

The 5 points Likert Scale was conducted with the experts to evaluate the new design of the desk and chair set, and select the best solution.

We tested the efficiency of the desk and chair set through the load testing according to the industrial standard in the laboratory with the Universal Testing Machine UH.

We evaluated the satisfaction in using new desk and chair set design through the 5 points Likert Scale.

2) *Data Analysis.* We grouped the data and used descriptive statistics to analyse and summarize the data from the interviews and close-ended questionnaires.

For the data from the 5 points Likert Scale questionnaires, we used average (\bar{x}) and standard deviation (S.D.) to translate the data from the questionnaires in design, efficiency, and satisfaction. This resulted in correcting the error for a better design output.

Results and Discussions

The Result of Studying the Teaching and Learning Behavior in Using Desk and Chair Set for the 4th Grade art Learning Group

Teachers reported that they were not satisfied with the existing desk and chair set because the desks are heavy and below standard (e.g. having sharp corners, and gaps between joints), and none of the chairs were provided which allowed inevitable accidents and unhealthy habits in using them. From the observation, students were sitting in an inappropriate posture, according to the principle of ergonomics, and against the group learning behavior; the existing desk was static, heavy, and very difficult to move due to the assembling of the structure being weak. Moreover, the existing desk was lacking in aesthetic value, and cannot foster the imagination and creativity of the students. This is an interesting feedback that, in developing a new desk and chair set, we should enhance the aesthetic and cultural value to facilitate the students' left brain practice.

Selecting the Design Solution from Developing Desk and Chair Set for the 4th Grade Art Learning Group

From the data collection, we defined the factors and problems in designing a new desk and chair set which are established in table 1. The existing desk and chair set failed in every aspect since it was made without a valid design. This is the gap that this research seeks to close in providing a better design solution for desk and chair set to the students and teachers.

Table 1. Factors and problems in designing new desk and chair set.

	Desk	Chair
Figure		
		None of chair was provided
Function	<ul style="list-style-type: none"> -Did not support learning activity -No variety in usage -Only capable for using by small children because the height of the table cannot be adjusted 	
Safety	<ul style="list-style-type: none"> -Having sharp corners -They are imbalance and can fall on the students 	
Durability	<ul style="list-style-type: none"> -Not very strong and below industrial standard 	
Convenience	<ul style="list-style-type: none"> -The size of the table does not match with the size of the users -Very heavy, and inconvenience in moving 	
Aesthetic	<ul style="list-style-type: none"> -Non aesthetic value 	
Cultural Identification	<ul style="list-style-type: none"> -Performs very weak in cultural identification. - The only component that communicate the cultural identity is the local wood material 	
Maintenance	<ul style="list-style-type: none"> -Used to be easy for maintenance by teachers or support staff, but, after years of use, maintenance is not capable to perform 	

Quality Function Development (QFD).

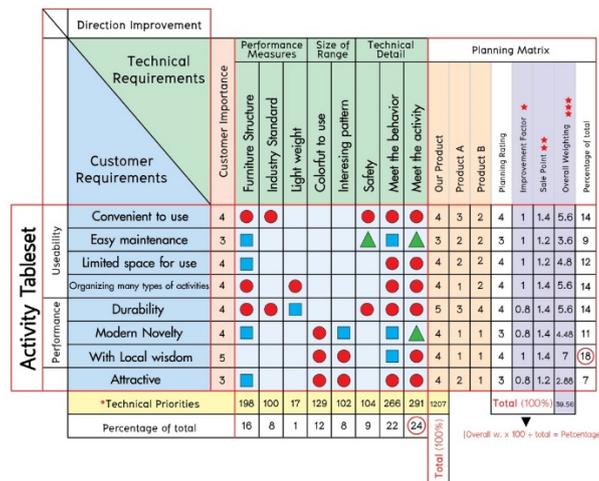


Figure 1. Quality function development (QFD).

In this benchmarking, we found that product A has strengths in convenience for use and durability, and product B has strengths in durability and limited space for use. There are some weaknesses to development. However, it can be corrected by adding function for organizing many types of activities, portraying modern novelty, establishing easiness in maintenance, and reflecting local wisdom.

Organizing many types of activities is the unique selling point that matches with the users' needs. Moreover, we analyzed with the house of quality principle, and selected on reflecting local wisdom,

having convenience in use, and being concerned with the limited space for use to enhance the value of our design.

The limitation that we extracted from the quality function development (QFD) (figure 1.) allowed us to develop a new design for the desk and chair set. From the result of the SWOT analysis on product A and product B, we can brainstorm on the new industrial product design concept by aligning it with the TRIZ principle to identify the problem and solution of the design.

The Theory of Inventive Problem Solving. From this insight and the TRIZ matrix principle (figure 2.), we selected the rubber wood, which has a lighter weight, good durability, and easy for manufacturing to enhance safety and convenience in moving the desk and chair. Also, the desktop can insert different pictures of the Chiang Mai culture and tradition which can inspire students' imagination and creativity. The desk needs to be added with a new essential fitting such as wheels and level adjustment, so that it can be moved easier and adjusted to a level that fits with the height of students. Moreover, students and teachers can adjust the desktop in different angles to match with the several nature of art learning activities, and we also add a chair in the set to enhance the students' usability according to the ergonomics principle.

● The TRIZ Matrix

Meet the Activity		Shape	Any Principle from TRIZ's tool used in the solutions			
Strength (14)	Cause the conict (Technical Conict) →	→	10	30	35	
Durable in movement (15)		→	14	26	28	
Energy Consumption by movement (19)		→	12	2	29	
Ease of use (33)		→	15	34	29	28

Figure 2. The Theory of Inventive Problem Solving (TRIZ Matrix).

We generated 3 different design concepts for a new appearance of the desk and chair set (table 2.).

Table 2. Opinions of the experts in furniture design and materials.

	Style1	Style2	Style3
Items			
Furniture Design Specialists			
Expert 1			✓
Expert 2			✓
Expert 3			✓
Material Specialists			
Expert 4	✓		
Expert 5			✓
Expert 6	✓		

3 of 3 furniture design specialists chose style 3, 2 of 3 material specialists chose style 2, and 1 of 3 material specialists chose style 3. The majority in selecting style 3 gave an interesting feedback stating that style 3 has a unique appearance, so we picked style 3 for developing the prototype design, and evaluated it through the criteria in table 3.

From table 3., the evaluation from 3 furniture design experts and 3 material experts indicated that personality has the most strength of this design with the average of 4.44 and standard deviation of .20. From the ranking within these criteria, students can use the space on the table to learn the local culture of Chiang Mai from the drawings which has the highest point. The second rank is on applying the local material to achieve local characteristic. On the table there is a drawing of important traditions for each month in Chiang Mai which has established the same score.

Experts also see that function is another strength of the design with an average score of 4.42 and standard deviation of .22. The ranking score reveals that it can be adjusted with the usage according to the needs and activities by themselves. It has the highest average score, following with facilitating the movement of tables and chairs, storing, adding, and organizing a variety of activities, and there are usable forms that are suitable for the art subjects ordered.

Table 3. Results of the evaluation of the development of the table and chair set for organizing learning activities in model 3.

Item	List of Evaluation	Comment level (N = 6)		Level of Suitability
		(\bar{x})	S.D.	
1. FUNCTION				
1.1	Responding to the learning activities of teachers.	4.17	0.98	High
1.2	Can adjust with the usage according to the needs and activities by themselves.	4.67	0.52	Very High
1.3	Facilitating the movement of tables and chairs, storing, adding, and organizing a variety of activities.	4.50	0.55	Very High
1.4	There are usable forms that are suitable for the art subjects.	4.33	0.52	High
2. SAFETY				
2.1	Student desks and chairs have a negative angle.	3.83	0.75	High
2.2	There is rust prevention on the iron part of the table and chair.	3.83	1.47	High
2.3	The tables and chairs are connected with wood or screwed nails.	4.00	0.89	High
2.4	Tables and chairs are made with environmentally friendly materials.	4.50	0.55	Very High
3. DURABILITY				
3.1	Meets with TIS standards.	4.33	1.03	High
3.2	Tables and chairs are in stable condition	4.17	0.98	High
3.3	The strength and durability of tables and chairs.	4.00	1.26	High
3.4	Shelves have the strength and durability of cabinets and shelves.	4.17	0.75	High
4. ERGONOMIC				
4.1	The table width is suitable for the proportions of the students.	4.00	0.89	High
4.2	Tables and chairs are at the level, size, relationship, and body height for school children.	4.00	0.89	High
4.3	Height can be adjusted when in use.	4.33	0.52	High
4.4	Convenient for group teaching by the teachers.	3.83	0.75	High
5. AESTHETICS				
5.1	The form of tables and chairs helps create motivation in the learning process of the learners.	4.33	1.03	High
5.2	Helps create an atmosphere in teaching and learning activities for learners and instructors.	4.17	0.98	High
5.3	The drawing on the table can show beautiful local identities for promoting the thinking process of concrete learners.	4.00	0.89	High
6. PERSONALITY				
6.1	Applying local materials to achieve local characteristics.	4.33	0.52	High
6.2	On the table there is a drawing of important traditions for each month in Chiang Mai.	4.33	0.52	High
6.3	Students can use the space on the table to learn the local culture of Chiang Mai from the drawings.	4.67	0.52	Very High
7. EASY OF MAINTENANCE				
7.1	Can be easily maintained.	4.00	0.89	High
7.2	Cleans very easily with a wipe from a cloth.	4.17	0.75	High
7.3	Materials can be easily purchased on the market.	4.00	0.89	High
7.4	Users can repair it by themselves.	4.00	0.89	High

The Results of the Performance Test of the Table and Chair Set for Activities according to the Standard Criteria

The researchers tested the performance of the table and chair for the learning activities of the

knowledge group of the 4th grade art, using the universal testing machine UH-100 KNIR weights with a test speed of 5 millimeters per minute. The temperature, while testing, is 23.0 degrees Celsius, with a relative humidity of 54%. The performance tested the results in a table set and chairs for five activities using different weights. Based on the results no damage was found in the test; as shown in table 4.

Table 4. The cost of testing tables and chairs for activities.

Testing of Items		Unit	Testing Results
Loading Capacity	Tables	20	No damages
		50	No damages
		70	No damages
		100	No damages
		120	No damages
	Chairs	100	No damages
		200	No damages
		500	No damages
		700	No damages
		1000	No damages

The results of the Satisfaction Assessment of Teachers and Students towards the Chair and Table Set for Learning Activities of the 4th Grade Art Learning Group

The researchers have provided the teachers and students from the Wat Suan Dok school to try out a series of tables that have been tested for performance by making interviews and completing the satisfaction assessment from the teachers. A total of three people and 26 students found that the students were in satisfaction on the table of chairs for the learning activities of the art learning group. The 4th grade in the 3rd model has an average from the query that is at the most level ($\bar{x} = 4.69.$, S.D. = 0.48) and the teacher's satisfaction on the table of chairs in the 3 average format is at the highest level ($\bar{x} = 4.72.$, S.D. = 0.54).

Recommendations and Suggestions

In the study and development for the table and chair set for organizing learning activities of the grade 4 art learning group, the suggestions for applying the research results are as followed:

Recommendations for the Use of Research Results

Suggestions for testing the table and chairs set in the performance test can be applied in the design of tables and chairs for learning activities in other learning materials. Development should have the ability to receive pressure with ease. Also, it should be able to be repaired easily in case of any damages, including the use of local production materials.

Suggestions for Further Research

In the next research, local materials should be in use, especially rubber wood, in order to promote farmers to grow rubber trees. In addition, there should be a research on the size of the rubber wood that is suitable for the production of student desks and chairs. Most of the design will be on cost-effective activities, because at present the rubber wood size is 1.20 x 2.40, which is sold in the market, and can produce a set of student desks and chairs in large numbers that can be produced within the industrial scale. Furthermore, the surface of the table should have a whiteboard for teachers and children to learn. The idea is on being able to integrate a variety of table sets such as mathematics for students to calculate on the table and language subjects, such as English and Thai language, that allows learners to practice writing words and adding words.

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