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Appreciation

International Journal of Architecture, Art and Design (IJAD) was firstly launched in January 2023 in line with a current vision of the Faculty of Architecture, Art and Design (Naresuan University) in Thailand. This journal aims to disseminate academic, research, creative works to the public. A wide range of art and design disciplines is welcome to publish which is not limited to creative products (crafts, textiles, ceramic, media art, digital art, creative works); creative spaces (architecture, interior, landscape, built-environment, urban planning & design); creative process (design thinking, design solution, and innovation). Thanks to all contributions from authors for sharing their great creative works. On behalf of the editorial board, I wish this first issue of IJAD will inspire all readers with insightful knowledge and good practices.

Witiya Pittungnapoo
Editor-in-Chief

Assessment of Priority Parental Anxiety Index for School Zone Improvement during Drop-off and Pick-up Time around Primary Schools in Thailand

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Abstract

Road accidents and environmental hazards around school zones cause anxiety to parents when dropping-off and picking-up their children and affect behavioural problems, traffic congestion in cities that lack public facility plans. Improving the school environment as an urgent problem is one of the problem-solving methods. 1,466 questionnaires were distributed to parents by teachers. The probability was evaluated by simple random sampling and selected by teachers on the class numbers of students. The 6 schools were the representatives of 6 regions of Thailand, considered by schools with the highest accident rate among children. The Priority Parental Anxiety Index (PPAI) was developed from the Priority Needs Index (PNI) to prioritize guidelines for improving the school environment based on current anxiety compared to the anxiety improved. The parental anxiety was at a moderate to a high level especially regarding the danger of road accidents at the school zone. The PPAI was at -0.427. This showed that environmental improvement guidelines can be applied to child safety especially an improvement connecting paths between parking lots and student drop-off and pick-up zones, road crossings and roofs as well as facilities, management, and security policy. Finally, the parents are concerned about assisting children more than planning, safety measures, and equipping children's skills.

Keywords: Parental anxiety, Children safety, Drop-off and pick-up behaviour, School zone, Thailand.

Introduction

A major cause of traffic congestion in Thailand as reported in many cities is from the student drop-off and pick-up times at school zones. Since the quality and popularity of primary schools in compulsory education are different, parents are often willing to travel further afield to send their children to better-quality schools in town instead of sending them to schools in their neighbourhood (Sattanon, K, Upala, P, 2017). Previous statistics demonstrate that the risk of losing children can take place at schools. It can be said that the traffic danger and child loss could take place in a school zone that may be considered to be a risk area for child safety (The Mirror Foundation, 2015). Compared to other countries, parent's drop-off and pick-up behaviour in Thailand is different due to the anxiety of child safety. Parental safety anxiety and the school environment are important factors affecting child safety (McLaren, L., Hawe, P., 2005; Ghasrodashti R.E., Ardeshiri M., 2015). Child Safety Solutions in the absence of spatial infrastructure planning, poverty of the School Catchment Area and lack of funds to improve the school zone are key factors. To solve the problem in this case, the priority of improvement should be taken into account. A gap between the current parental anxiety and decreased anxiety after the environment has improved is analysed and created as an indicator called Priority Parental Anxiety Index based

on Need Assessment. The objectives of this study were to 1) explore the risk areas and risk time within school zone. 2) Investigate parental anxiety levels affected by the relevant factors. 3) To propose appropriate guidelines for a safe physical environment improvement for students in kindergartens and primary schools and reduce parental anxiety when picking their children up and dropping them off.

Literature Review

Child Safety

As childhood is an important development stage, primary consideration should be placed on it (Maslow, 1945). Children aged between 4-12 years old, could be considered as part of early childhood. Children in this age range are not able to care for their own safety and protect themselves from danger when encountering a new environment (Ministry of Education, 2546). Caring and assistance for such safety are on parent's and caretakers' responsibility. The sense of safety among children is improved by learning from parents, families and the environment and takes place in the first period of life as it is the perception of danger from a child's environment (Erikson, 1968; Bowlby, 2008; Kerns & Brumariu, 2014). This shows that whether children perceive self-protection positively or negatively depends on the childhood experiences they have through the environment (Liao, Hu, & Zhang, 2014). This is in line with a Californian study about environmental improvements for walking, sidewalks and traffic control. The study states that such measures enable children to feel more confident when walking to school (Boarnet, M. G., Anderson, C. L., Day, K., McMillan, T., & Alfonzo, M., 2005).

Parental Anxiety

Parental anxiety refers to the emotional state reflecting fear of danger, which is caused by individual and environmental factors and can have an effect on behaviour. This present study was conducted to find an approach to develop school safety zones and reduce parental anxiety in picking up and dropping off their children at primary school. The levels of parental anxiety were assessed and prioritized. The factors that could reduce parental anxiety were studied, including 1) the school zone such as traffic accidents, pedestrian quality, pedestrian barriers, and the pick-up and drop-off areas, 2) the school environment such as buildings and learning space, circulation, toilet facilities, and activity spaces, 3) social interactions among students, teachers, and parents, 4) school management including traffic within the school, child kidnap protection, school policy and the system of caretakers, 5) school facilities such as parking, traffic signs, safety facilities, and service points, 6) personal factors such as the understanding of safety, and participation in security activities, 8) weather, can be summarized as follows:

School Zone (SZ.), School Environment (SE), and Risk zone (RZ): Road safety refers to safely walking or cycling on the road or sidewalks, which depends on many factors such as the amount of traffic, route safety condition, age of children, and traffic safety. It is also associated with driving speed, road width, and the parents' road safety perceptions (Merom, D., Tudor-Locke, C., Bauman, A., & Rissel, C., 2006). The research conducted in California indicated that the sidewalk environmental improvement and the traffic controlling significantly affected the parents and children's trust in walk-to-school (Boarnet, M. G., Anderson, C. L., Day, K., McMillan, T., & Alfonzo, M., 2005). In addition, the influence of urban form on children is varied according to the age range of the children. A dense residential area connected with a recreation area such as a public park is conducive to child safety and considered friendly to children. Previous studies show that child safety is affected by school environment designs including buildings, playgrounds, and restrooms (Cummins,

S. K., & Jackson, R. J., 2001; Dudek, 2001). Finally, it was found that school building layout and school boundary limitations created risk spots and blind spots that affected parental anxiety for child safety (Ruangkanchanasetr, S., Plitponkarnpim, A., Hetrakul, P., & Kongsakon, R., 2005; Sattanon, K, Upala, P, 2017)

Social interactions (SI.): Interactions among students, teachers, and parents help promote the children's walking and cycling behaviour and reduce the parental anxiety. Moreover, it is found that males and females in the same neighbourhood seem to have different perceptions of safety (Borelli, J. L., Margolin, G., & Rasmussen, H. F., 2015; Kerns & Brumariu, 2014).

School Facilities (SF.) and School Management (SM): The assistance provided by teacher rotation management, traffic management, and child safety policy is essential to child safety. The facilities and management that can enhance walking and cycling safety. They were found to help enhance walk-to-school behaviour. Structure and interconnection between urban components are indicative of safety (Kerr, J., Rosenberg, D., Sallis, J. F., Saelens, B. E., Frank, L. D., & Conway, T. L., 2006).

Personal factors: The degree of anxiety that parents and children experience reflect different life experiences that have an effect on their behaviours while the environments function as a stimulator. The anxiety of parents and children would decrease when they were in the safety zone or on routes close to their home. The children also had a greater tendency to walk or cycle to school (Timperio, A., Ball, K., Salmon, J., Roberts, R., Giles-Corti, B., Simmons, D., ... & Crawford, D., 2006). Meanwhile, the disconnection and communication between children and parents were factors that made parents worry about strangers (Timperio, A., Crawford, D., Telford, A., & Salmon, J., 2004).

Weather: The previous research revealed that the weather had an effect on the physical activities of adolescents in 2 areas of Europe. According to the field study investigating the environment of schools in Thailand, it was found that different weather conditions had a different effect on parents' behaviour and anxiety in child pick-up and drop-off, especially in the southwest coast with a tropical climate and rain all year round. The parents living in that area were seriously interested in and worried about rain and child pick-up and drop-up (Sattanon, K, Upala, P, 2017). This is similar to the findings of other research indicating that the weather was a key variable affecting the student's choices of travel (Schlossberg, M., Greene, J., Phillips, P. P., Johnson, B., & Parker, B., 2006; Müller, S., Tscharaktschiew, S., & Haase, K., 2008). Research framework presented in Figure 1.

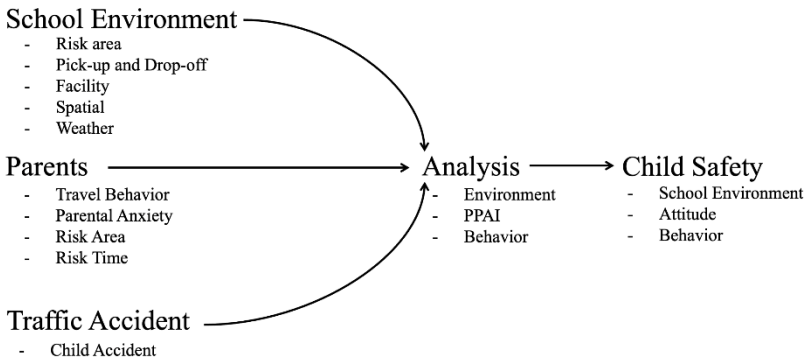

Figure 1 The relationship between variables in the study: adapted from McLaren, L., Hawe, P., 2005; Ghasrodashti R.E., Ardeshiri M., 2015; Nilsen P, Hudson D S, Kullberg A, Timpka T, Ekman R, Lindqvist K., 2004; Sattanon, K., 2017, designed by the authors.

Priority Parental Anxiety Index (PPAI)

Many studies focus on anxiety in children, focusing on the development of anxiety in children assessment to examine anxiety disorder. (Reynolds, C. R., & Richmond, B. O., 1978; Kovacs, 1981; Achenbach, 1991; Witkin, 1984). The studies also compared anxiety of boys and girls (Hosseini, L., & Khazali, H., 2013). In 1999, anxiety in children assessment was developed according to parental anxiety assessment (Spence, 1999). However, it assessed personal factors, rather than environmental factors that affect parental anxiety for child safety during drop-off and pick-up time. Improving the environment to improve safety for children requires current anxiety assessment to assess the severity of problems. A gap of anxiety is examined for the improvement of guidelines of each factor so as to prioritize the importance of problems and optimum design. Therefore, this study applied need assessment. Needs refer to what is needed but is lacking and what is wanted. Basic needs depend on two principles; 1) discrepancies that compares an actual state with a required state; 2) importance refers to needs defined by importance (Guba, 1989). There are many widely-accepted studies investigating needs (Trimby, 1979; Neufeldt, V., & Guralnik, D. B., 1988; Kaufman, R., & Stakenas, R. G., 1981; Scriven, 1991). Need solution is divided into five steps; 1) determination of what should be; 2) determination of what is; 3) discrepancy analysis from the 1st and the 2nd step and priority procedure of the results; 4) causes of discrepancy analysis and; 5) solution determination. Priority Parental Anxiety Index (PPAI) is derived from Need Analysis based on Priority Need Indexmodified (PNImodified) (Vongvanich, 2007).

$$PPAI = \frac{(f - p)}{p} \qquad (1)$$

where:

p = Current anxiety

f = Decreased anxiety when school environment is improved (in the future)

The level of necessity was determined by five levels (Likert, R., 1961).

Methods and Materials

Data Collection

Questionnaires for parents: The researcher conducted this study based upon the study of accident statistics occurring with children around Anuban Schools across Thailand. The selected schools were that of the highest accident statistic in each region. The coordinates of child accidents (latitude and longitude) within the radius of 500 meters around school zones was collected. To select six Anuban Schools (There are 65 Anuban Schools in Thailand) with the highest accident statistics based on the database of the Road Safety Culture (Sattanon, K., 2017), the child accidents coordinates in latest 4 years (2014-2017) were considered. The calculation of the number of questionnaires was based on the population of parents of children attending the selected 6 schools, 16,794 people, 8,369 male students and 8,425 female students, from 406 rooms, using Taro Yamane's population size formula, 95% confidence (Yamane, 1967). As a result, the population of this study included 1,466 parents and primary school students and kindergartens selected by probability proportion according to the systematic sampling by class teachers on the class numbers of students. The questionnaires for parents covered the 3 aspects; 1.1 parental anxiety during drop-off and pick-up time (current); 1.2 opinions toward risk area and risk moment for children and; 1.3

parental anxiety during drop-off and pick-up time (future). The questionnaires were distributed to students in each grade. They were directed to inform their parents that the parents had three weeks to complete and return the questionnaires within the first semester in Academic Year 2018. A Likert's 5-level scale was applied in Section One and Section Three for each assessment (Likert, 1961).

Survey and interview

The researcher surveyed the school environment and interviewed school administrators to uncover actual problems related to physical problems, safety management at the schools and student drop-off and pick-up behaviour. To survey the school environment, the researcher followed 2 steps as follows. 1) The researcher conducted a primary survey of the environment and traffic safety facilities around the schools, using Google Street View to understand the environment before an actual survey (Sattanon, K, Upala, P, 2017). 2) The researcher conducted a survey of the environment of the schools during student drop-off and pick-up times in actual situations.

Study Area

The researcher selected Anuban Schools as the representatives of state primary schools and kindergartens. The researcher collected the accident statistics occurring with children at provincial level, the accident statistics occurring with children within the radius of 500 meters around Anuban Schools and the accident statistics occurring during the student drop-off and pick-up time from 65 Anuban Schools where the highest accident statistics took place in each region. Based upon the collected statistics, the researcher selected six Anuban Schools as the case study schools, consisting of Anuban Lampang, a representative of Northern Region, Anuban Phetchabun, a representative of Central Region, Anuban Nakhon Ratchasima, a representative of the North-Eastern Region, Anuban Phuket, a representative of Southern Region, Anuban Chonburi, a representative of Eastern Region and Anuban Kanchanaburi, a representative of Western Region. The research methodology presented in Figure 2.

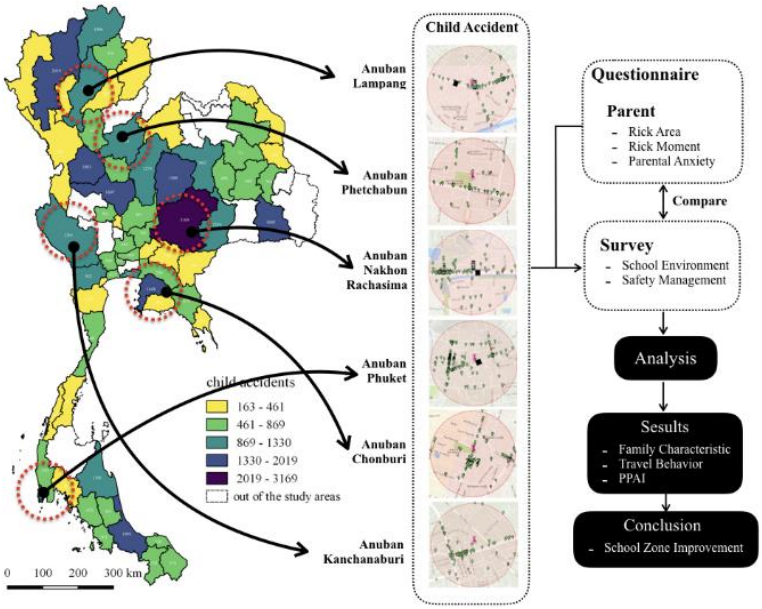

Figure 2 The research methodology.

Data Analysis

All questionnaires were tested for content validity and Construct validity using the index of Item-Objective Congruence (IOC) from 3 experts were 0.93 (Turner, 2003). Moreover, the Cronbach's alpha coefficient was 0.952 (Bland, J. M., & Altman, D. G., 1997). The statistics, which were used to measure the parental anxiety in order to improve safety zones for the children in Anuban schools, consisted of 2 groups; 1) descriptive statistics were the basic statistics used to analyse the data obtained from the questionnaire such as frequency, mean, percentage, standard deviation, and arithmetic mean, 2) inferential statistics were the statistics used to analyse the attitudes of the parents in order to find the differences of the results and prioritize the variables. The inferential statistics were tested as follows: 1.1) variance test was conducted to investigate the differences of the parents' opinions, the levels of parental anxiety. Various contexts were examined and compared at the statistical significance level of 0.05, 1.2) the Priority Parental Anxiety Index: PPAI was adapted according to the Needs Analysis and the Priority Needs Indexmodified: PNImodified (Vongvanich, 2007) and then applied to prioritize the levels of parental anxiety in child drop-off and pick-up, which were affected by school environmental factors. From the table, show the relationship between current parental anxiety and parental concerns levels if any in improving the school environment to the priority parental anxiety index (PPAI.). The analytical findings of anxiety assessment in 2 situations were calculated to identify indices with the value of 4 to -0.8. The findings can be considered as follows. The index with a positive value (+) means that such an improvement guideline is inappropriate. The index with a zero value (0) means that such an improvement guideline does not reduce parental anxiety. The index with a negative value (-) means that there is a gap between current parental anxiety and the anxiety levels when the environment improves in the future is appropriate for adoption in Thailand. The more negative the value, the more powerful and important the guideline. The matrix table demonstrates the current anxiety and the anxiety in the future and formulation is presented in Table 1.

Table 1 The Priority Parental Anxiety Index.

		The current parental anxiety								
		5	4.5	4	3.5	3	2.5	2	1.5	1
The decreased anxiety after the environment	5	0.000	0.111	0.250	0.429	0.667	1.000	1.500	2.333	4.000
	4.5	-0.100	0.000	0.125	0.286	0.500	0.800	1.250	2.000	3.500
	4	-0.200	-0.111	0.000	0.143	0.333	0.600	1.000	1.667	3.000
	3.5	-0.300	-0.222	-0.125	0.000	0.167	0.400	0.750	1.333	2.500
	3	-0.400	-0.333	-0.250	-0.143	0.000	0.200	0.500	1.000	2.000
	2.5	-0.500	-0.444	-0.375	-0.286	-0.167	0.000	0.250	0.667	1.500
	2	-0.600	-0.556	-0.500	-0.429	-0.333	-0.200	0.000	0.333	1.000
	1.5	-0.700	-0.667	-0.625	-0.571	-0.500	-0.400	-0.250	0.000	0.500
	1	-0.800	-0.778	-0.750	-0.714	-0.667	-0.600	-0.500	-0.333	0.000

Results

Demographic Data of the Questionnaire Respondents

Different environmental factors that cause danger, family lifestyles and anxiety about child safety make student drop-off and pick-up behaviour in Thailand different from other countries. Previous studies such as: Assessment of Parents' Anxiety with Regard to the Safety of Children, show that the responsibility of drop-off and pick-up falls mainly on females (Sattanon, K, Upala, P, 2017). Most parents who dropped students off and picked students up were females (mother/grandmother) and most of them were married. In addition, most of the parents had graduated with bachelor's degrees. Their average monthly income shows that most of them were well off financially. Previous studies also show that the income and educational background of parents affect the level of parental anxiety (Sattanon, K, Upala, P, 2017). Most parents dropped students off and picked them up by car or motorcycle. (Figure 3)

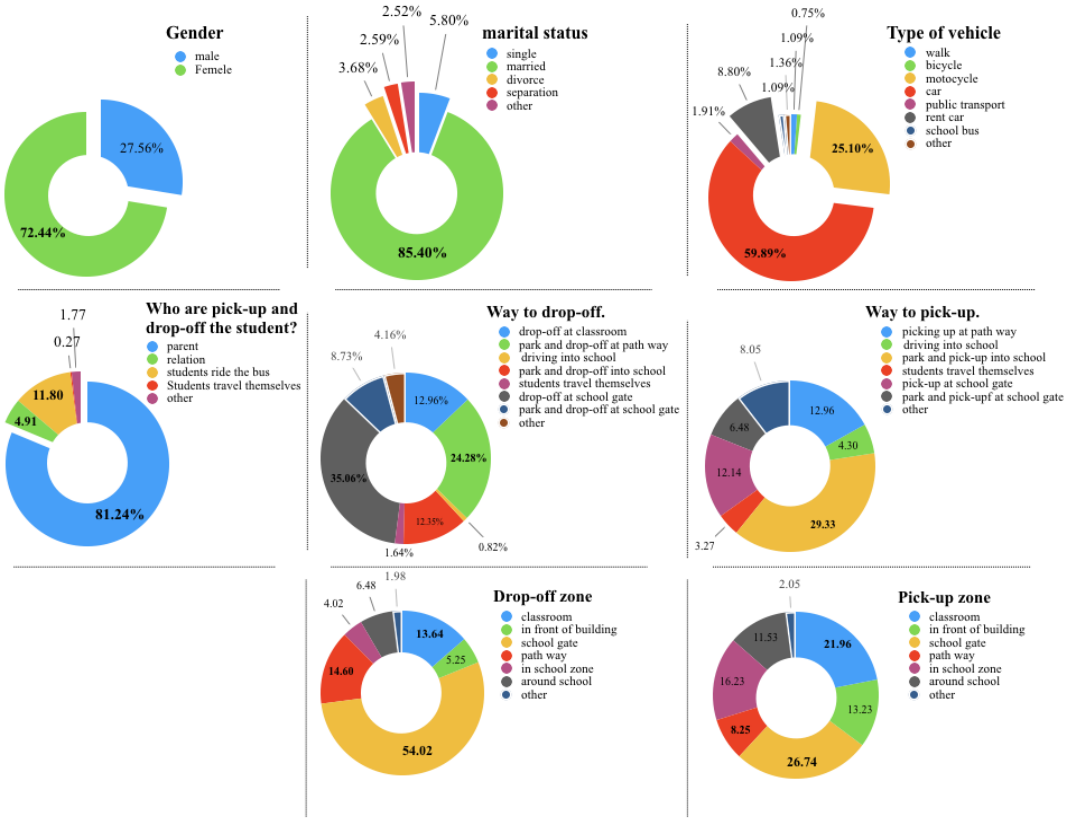

Figure 3 Family characteristics and travel behaviour

Risk area and Risk moment for children

Based on opinions of the parents towards the risk area for children, six aspects of the school environment, that the parents thought the riskiest areas were walkways and the crosswalks and the second most risky areas were the drop-off and pick-up zones, the school gates, and the school fences respectively. In addition, parents thought that the travel routes inside the schools including roads, walkways, and stairs were the riskiest areas. The parents' opinions in individual schools were consistent, except the parents' opinions at Anuban Kanchanaburi. They thought that the walkways and the crosswalks were the riskiest areas. Moreover, some parents had anxiety about blind spots behind school buildings as presented in Figure 4.

The last aspect was the parents' opinions about the riskiest moment for children. The riskiest moments for children, according to parents was the drop-off and pick-up times. The second riskiest moment for children was the after-school time (04.00 p.m.-06.00 p.m.) when it was particularly risky for children. It was found that, in individual schools, the parents' opinions were consistent. Nevertheless, the parents of Anuban Nakhon Ratchasima thought that the after-school time was the riskiest moment for children. This may be because it is the largest school in the sample. There is heavy traffic is on the main road in front of the school and the space for drop-off and pick-up is limited. The other hand, when considering the parents' and the teachers' opinions about the risk moment for children, the opinions were significantly different at < .01. The parents also considered the after-school time as a risk moment for children because it was evening. In addition, the parents dropped the students off and picked students up both inside and outside the school areas. It was the parents' responsibility to ensure child safety when going home while presented in Figure 5.

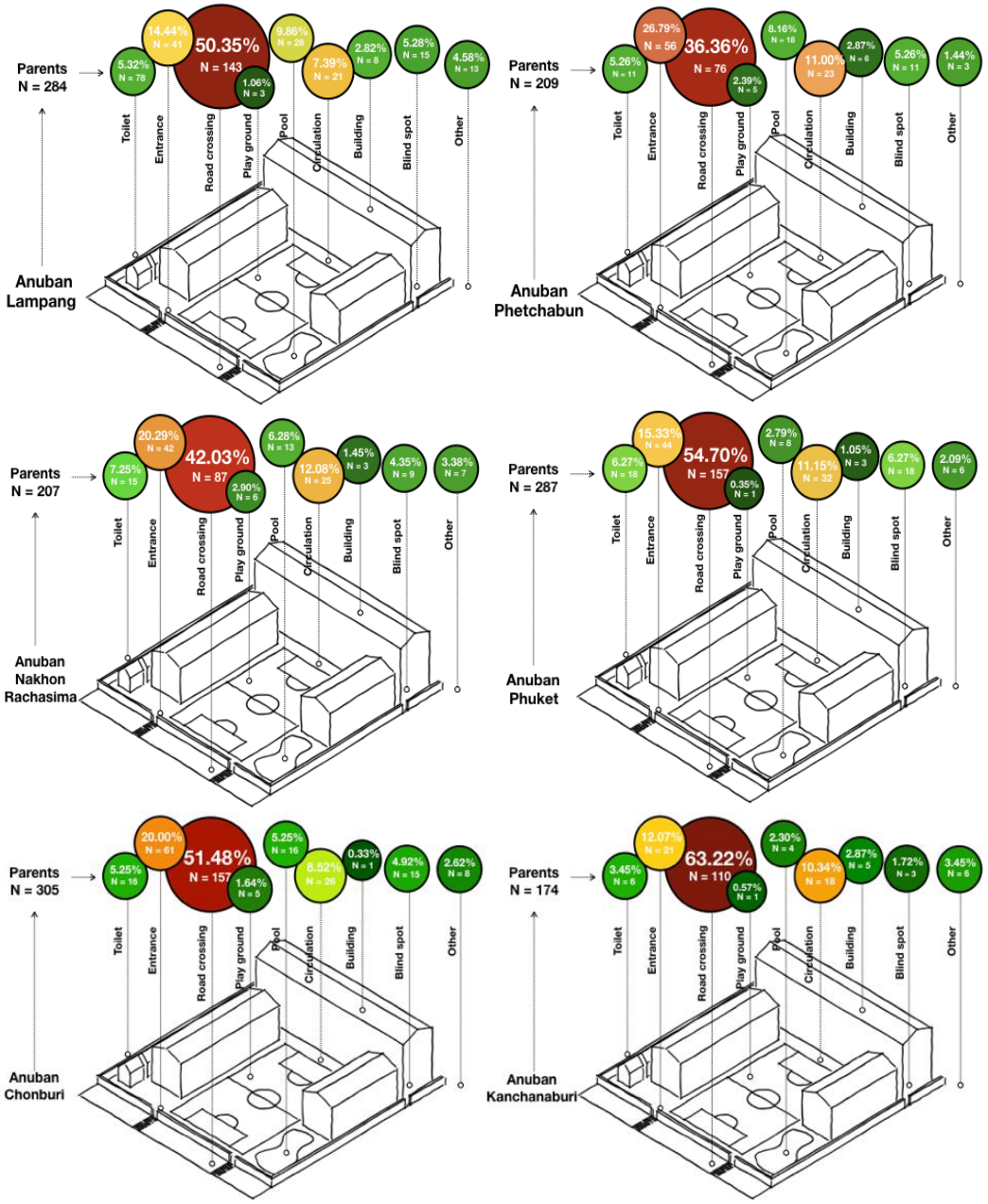

Figure 4 The risk area for children within school zone.

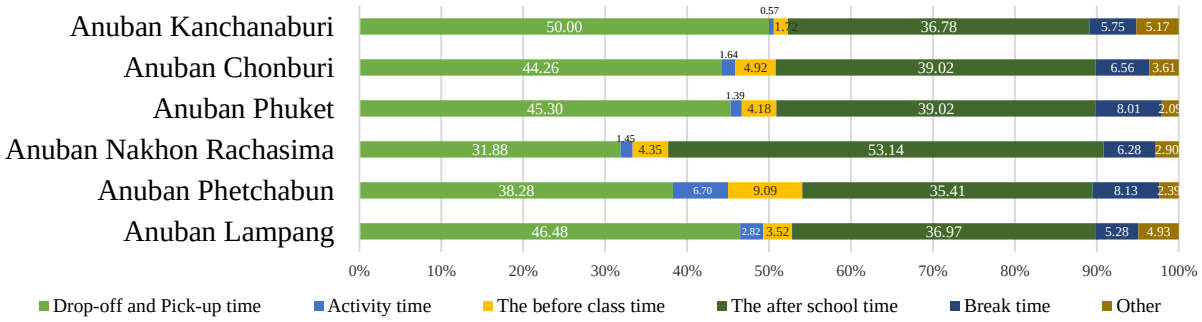

Figure 5 The risk moment for children within school zone.

Parental Anxiety

The findings of the current parental anxiety assessment through five level covering eight factors by questionnaires 1,466 in six representative schools in each region show that parental anxiety was at a moderate level to a high level at 3.57 (from 1: least anxiety to 5: highest anxiety). The highest anxiety for parents was the risk areas for children (RIC: 3.863). The second highest level of anxiety concerned the environment outside the school (SZ: 3.705). On the other hand, the lowest levels of anxiety concern social interactions between parents and teachers (PR: 3.059). This shows that interactions between teachers, parents, and students are closely related. They contacted each other through technology such as social network groups. Regarding the secondary factors, the level of parents' anxiety on traffic accidents most at 4.073 followed by (risk of access from strangers at 3.983, and risk area in the school zone at 3.927, respectively. On the other hand, parents' anxiety level on caretakers' friendship is very low at 2.943. Previous studies conducted in the Southern Region of Thailand where it rains all year round, shows that parents were concerned about the weather conditions (Sattanon, K, Upala, P, 2017). In the same way, when considering such factors such as the different weather conditions, it was found that the weather conditions were the third highest level, as presented in Figure 6.

When sub-variables of each factor are prioritized based on current interests, it was found that the highest parental anxiety was about traffic accidents around schools. On the other hand, when considering sub-variables of the first ten current anxieties it was found that the highest level of parental anxiety concerns risk areas and the second highest level of parental anxiety was about the environment outside the school and school management. In addition, parental anxiety about parking lot facilities and rainy conditions were also on the top-ten list.

Figure 6 Parental Anxiety

When considering each aspect of the parental anxiety, the following findings were found. 1) The parents are concerned about traffic accidents around school zones and about pedestrian barriers such as street vendors, electricity posts, and drainage. 2) The parents are concerned about the school environment. The highest level of parental anxiety about the school environment was about activity space such as playgrounds, swimming pools and toilet facilities respectively. This is consistent with the survey findings which found that toilets were often constructed at blind spots and in isolated areas. 3) The parental anxiety about interactions with teachers. Parental anxiety increased slightly when interacting with other parents and children. 4) When considering school management, it was found that the highest level of parental anxiety about child kidnap protection and about stranger protection respectively. 5) For school facilities, it was found that the parents needed parking lots. For safety, the parents also saw the need for surveillance cameras and lights. 6) This study investigated 2 aspects of personal factors including an understanding of child safety protection and the involvement in child safety in skill enhancement activities. 7) The anxiety about blind spots affected parental anxiety at the highest level. The parents concerned about the risk of access from strangers and risk areas in the school zone. The parental anxiety about blind spots was at 3.82. 8) For weather conditions, it was found that the parents are concerned more about rain than sunlight. When comparing to other factors, it was found that the parents are very concerned about the weather conditions because they concerned about their children's health especially among early-year and kindergarten children as presented in Figure 6.

Priority Parental Anxiety Index for School Zone Improvement

According to the analysis of decreased parental anxiety when the school environment is improved, 62 guidelines (Table 2.) in 26 sub-variables of 8 factors are proposed to create the Priority Parental Anxiety Index (PPAI). It was found that the average parental anxiety after the improvement was at 2.04 (PPAI = -0.427). The guidelines of each aspect are considered. This paper discusses only the most important aspects related to the current parental anxiety.

The guidelines for the environment around school zones such as roads, walkways, entrance and drop-off and pick-up area that may cause danger, the parents thought that crosswalks, crossing bridges, traffic symbols and signs should be improved to meet the standards so as to prevent road accidents around the school zone. Pedestrian barriers should be removed. Holes, ponds and broken drainage covers on walkways should be repaired. Drop-off and pick-up areas should be clearly marked especially walkways in front of the school during rush hours in the morning as presented in Figure 7.

Regarding the guidelines for improving the environment inside the school including buildings, walkways inside schools, service areas and activity space, the parents thought that doors, windows, and electrical outlets should be easy to use and not be dangerous to children. Balcony rails should be upright to prevent children from climbing. Toilet doors and sanitary ware should be easy to use and suit the children's age. There should be fences around the swimming pools. Covers on water buckets and ponds should be closely fitted and tightened to prevent children from accessing them, as presented in Figure 7.

When considering interactions, it was found that communication channels such as public telephones should be increased at schools to decrease parental anxiety. This can slightly decrease parental anxiety when compared to the use of personal equipment as the parents thought that most students have their own personal phones. An increase of public communication will be necessary in case of an emergency. For the interactions between parents and teachers, it was found that organizing interaction activities was better than communicating through Social Media. This is similar to the interaction between parents and children while presented in Figure 7.

For traffic problems inside schools and parking lots, there were limited spaces, resulting in the parental anxiety. The parents thought that prohibiting unnecessary vehicles from access to the school was an appropriate guideline to solve the problem. For child loss prevention, GPS devices such as watches or phones should be used. However, it is difficult to get the parents to accept GPS. Using identification cards, passwords or symbols to group and manage students was as economic way to manage the student population of the school. For safety policies, the parents thought that safety and monitoring policies should be formulated. Drop-off and pick-up areas should be clearly located. Students should be gathered together so that it is easy for teachers to monitor them as presented in Figure 7.

Figure 7 Priority Parental Anxiety Index (PPAI)

For school facilities including parking lots, symbols safety facilities and service areas, the parents thought that connecting walkways between parking lots outside school and drop-off and pick-up areas should be constructed. This would help to reduce road crossing by students more than improving parking lots. In addition, the parents thought that safety

equipment such as a public phone booth and a warning alarm should be provided more than establishing surveillance cameras at drop-off and pick-up areas. This shows that the parents did not consider surveillance cameras as an important factor among other improvements. Similarly, the parents thought that rest areas, meeting areas, and service areas should be provided as presented in Figure 7.

For personal factors affecting a decrease of parental anxiety, providing training for parents and school bus drivers could decrease the parental anxiety about travelling to school. Organizing training for teachers and guardians showed that the parents believed in teachers taking care of their children. When considering students, the parents thought that creating volunteer groups to assist drop-off and pick-up students decreased the parental anxiety more than providing traffic knowledge and self-reliance to students. This shows that the parents did not consider self-reliance among children as an important factor as presented in Figure 7.

For risk areas, the parents thought that establishing a safety monitoring unit for emergency situations was a guideline that could decrease parental anxiety. The index of this aspect was higher than managing proper routes during drop-off and pick-up times. Therefore, it was obviously seen that the parents needed assistance if an accident occurs rather than transport planning. In addition, only one entrance should be used during drop-off and pick-up times to reduce risk areas accessed by strangers. For surveillance and lighting improvements, surveillance cameras should be installed at blind spots and high-risk areas. Slippery surfaces and shock-proof areas should be improved to reduce the risk of injury as presented in Figure 7.

For the weather conditions, parents thought that roofs to protect from rain should be connected to parking lots, walkways and school buildings. For sunlight, the parents thought that the landscape should be improved. They thought that trees should be planted to give more shade on walkways and rest areas rather than building roofs over activity spaces. This shows that the parents want their children to play outdoors and can walk from parking lots to school buildings without getting wet. This is opposite to the current conditions. Schools often build large roofs over playgrounds and activity spaces but there are no roofs connecting from parking lots to school buildings as presented in Figure 7.

Conclusion and Suggestions

The findings showed that parental anxiety is at a medium to a high level. Family characteristics of the population, income, and educational background were high because Anuban Schools are high standard schools at provincial level. The highest level of parental anxiety was about road accidents at high risk areas (Sattanon, K, Upala, P, 2017), the environment around the school zone (Ghasrodashti R.E., Ardeshiri M., 2015) and safety management respectively. On the other hand, the lowest parental anxiety was about the interaction between parents, teachers and students and communication among them. This demonstrates good social characteristics. The PPAI was at -0.427. This means that the guidelines for the school environment improvement are at a good level or at a slightly high level. The connecting walkways to parking lots to reduce road crossing was a guideline that should be improved, a safety monitoring unit for emergency situations in at risk areas should be established. Lighting and surveillance cameras should be installed at blind spots around schools. Roofs to protect from rain should connect parking lots, the school gate and the school buildings. The findings of PPAI in overall reflected parental behaviour that considers child assistance, safety planning (Hosseini, L., & Khazali, H., 2013) and child safety skill enhancement as important factors (Conger, J. J., Kagan, J., & Mussen, P. H., 1969).

Recommendation for Future Research

It is obviously seen that the guidelines for school environment improvement stated in this study are under the parents' opinions who are important to child safety during drop-off and pick-up time. However, there are stakeholders such as teachers and school administrators whose opinions toward solving problems may be different. Therefore, opinions from stakeholders can be further studies in the future. Importantly, impacts from hot weather should be investigated in further studies. A technical manual for school environmental design and development should be implemented for achieving national and international standard which will be one of expected contributions from this research.

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Understanding the Basic Language of Jewellery Design by Shape Grammar

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Abstract

This paper proposes a new method for explaining design through science. In this study, we focus on the conceptual design phase, where the centre of evolving new and creative ideas is located. Shape grammar and shape rules are investigated and applied to study how designers are working to understand the design conditions and identify the final solution during this conceptual design phase. Therefore, ideas of shape grammar, shape rules, and shape transformations are used to capture how designers transform shape from one state to another through sketching until they achieve their goals. Special consideration is given to the field of jewellery design. The results of the experimental study led to the development of understanding of shape transformations during the sketching of jewellery items.

Keywords: Conceptual design, Jewellery design, Product design, Shape grammar, Sketching process

Introduction

In the product design process, conceptual design is the centre in which creative ideas are developed (Jin & Benami, 2010). Conceptual design is an early stage of product design in which designers typically generate broad and various alternatives (French, 1999).

Sketching is a creative design process (Verstijnen, van Leeuwen, Goldschmidt, Hamel, & Hennessey, 1998). In conceptual design, sketching is a constructive tool that is mostly used in different scenarios such as transmitting the designer's ideas, understanding and analysing problems, and exploring design alternatives (Kielarova, Pradujphongphet, & Bohez, 2013). In the conceptual design stage, designers usually use two iterative-interactive processes, seeing and moving, for exploring their sketches (Schon & Wiggins, 1992). Seeing is considered as a reinterpretation process of design elements in a sketch, while moving is counted as a transformation of the reinterpreted design elements. With the work consisting of seeing-moving cycles, a series of related sketches is created by recognizing, associating, connecting, repeating, and elaborating the design elements (M. Prats, Earl, Garner, & Jowers, 2006).

Shape grammar is considered as a production system (Stiny, 2006). Shape grammar generates new designs in accordance with sets of shape rules. The working concept of a shape grammar is the recognition of a given shape and its possible spatial replacements; compiling rules; and exploring the shape grammar (Stiny & Gips, 1972; Tapia, 1999). Shape grammar executes any designs by formalizing the spatial relationships between their design elements (Miquel Prats, Lim, Jowers, Garner, & Chase, 2009).

Shape rules are created to transform initial shapes and sub-shapes within the shape grammar to create a new shape. The functions of shape rules are to recognise the shapes to be replaced and to describe the replacement process. Shape rules, therefore, are used to

explain shape transformations between sketches, in accordance with schemas, in a visual way (Miquel Prats et al., 2009; Stiny, 2006).

In this study, special consideration is given to the field of jewellery design. Consequently, the experimental study of jewellery design was established with the ideas of shape grammar, shape rules, and shape transformations to understand how designers create designs through their sketching process. The proposed methodology is expected to be a starting point for understanding the language of ornaments.

Methodology

As mentioned before, in this study, we focus on the field of jewellery design. The experimental study of sketching in jewellery design was performed with the aims of collecting and analysing information about the ways in which designers explore their design concepts and to observe and study how they transform shapes and design elements in sketches while exploring design ideas.

The experimental study of the sketching process of jewellery designers was organized in the following steps:

1. In the case study, we experimentally investigated the design of jewellery earrings, bracelets, and pendants.
2. We started from analysing the fundamental elements of jewellery items.
3. The elements were classified into shapes and sub-shapes.
4. We attempted to capture the shape rules, which jewellery designers use during developing shapes or sub-shapes from one state to another.
5. We developed shape grammar of jewellery earring design according to the shape rules we captured from the previous stage.

Results

In our experimental observations, we found several issues that are explained as follows. Jewellery design is an industrial design that requires the balance of aesthetics and function. Consequently, jewellery design involves the skills of development, analysis, and creativity.

Jewellery design typically starts with design concepts, which are provided by either the customers or the designers themselves. Later, designers transform design concepts by sketching design ideas in the forms of shapes, lines, curves, and functions of jewellery products. This process is called concept generation in the conceptual design stage and it requires a series of design ideas in the form of sketches.

The results of our experiments show that the interaction between the designers and their sketches are represented by a finite number of shape rules. Those shape rules formalize the shape reinterpretation and shape transformations.

The sketches were mostly manipulated using more than one shape rule at the same time. Some of the sketches from our sketching experiments are shown in Figure 1.

In the experiments, we choose simple geometric shapes like triangle, square, or circle to design earrings, because with simple shapes it can easily be seen how the shapes were transformed.

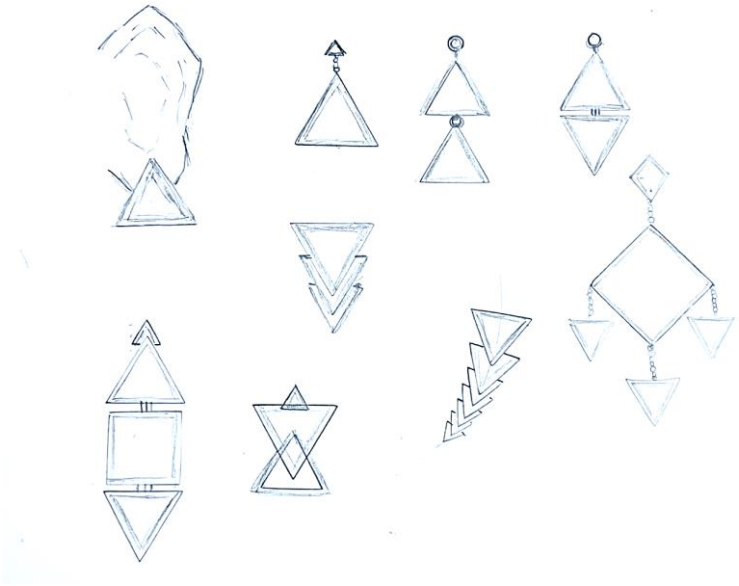

Figure 1 Some sketches obtained in the experimental investigation.

We also studied further the sketches of professional jewellery designers like Maurice P. Galli, Dominique Riviere, and Fabfan Li. We found that in their plate 39 (Galli et al,1994), the structural sketches for a link bracelet show that in each design only a few main shapes were first created, and then they were transformed by repeating the shapes and translating them along the axis of the bracelet, while some of them were rotated to create a pattern as illustrated in Figure 2. The shape grammar of the design of the link bracelet clearly contains shape rules such as repetition, rotation, translation, scaling, and adding new shapes.

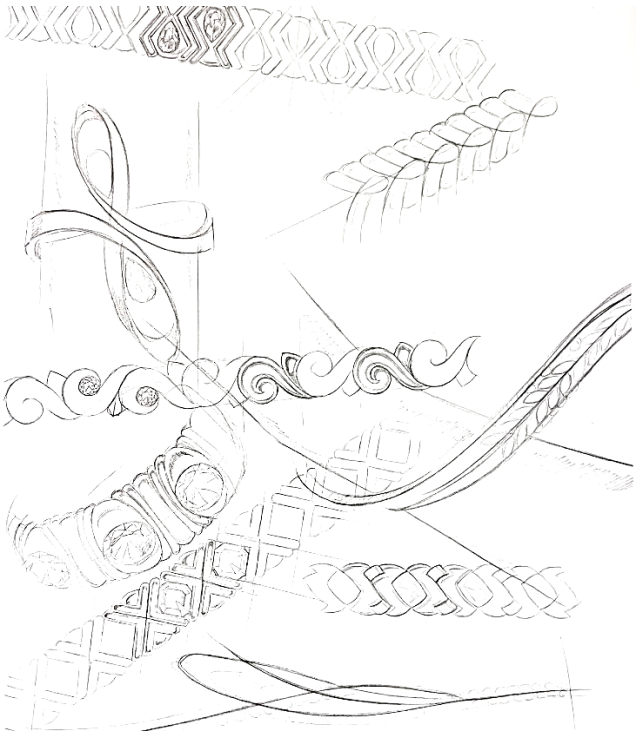

Figure 2 Structural sketches for a link bracelet (Galli, Riviere, & Li, 1994)

In our previous research, we studied Lanna motifs such as the so-called Lai-Sae motifs in Baan Wualai silverware. The Lai-Sae motifs are decomposed from several design elements, illustrated in Figure 3, (Kielarova & Jankam, 2019).

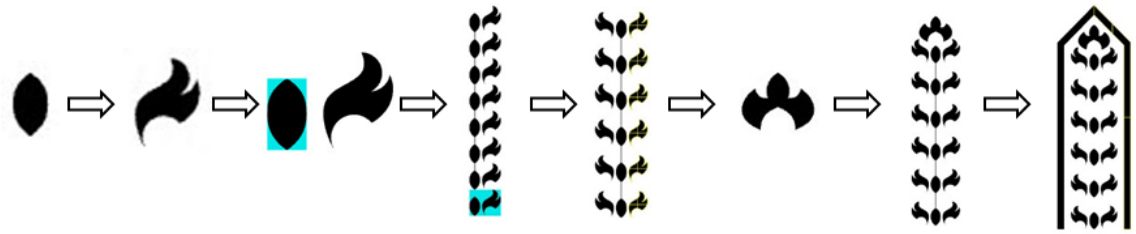

Figure 3 Shape grammar of Lai-Sae motifs in Baan Wualai silverware (Kielarova & Jankam, 2019)

We applied the Lai-Sae motifs to designing jewellery pendants as shown in Figure 4.

Figure 4 A Jewellery pendant designed using shape grammar with Lai-Sae motifs (Kielarova & Jankam, 2019).

From the observations made in several experiments, we found that designers create new designs using transformations of shapes and adaptations of design precedents. The following are the common shape rules often exploited in shape transformations and adaptations:

- Moving a shape to a new position,
- Rotating a shape around a centre or an axis,
- Rotating a shape along a cure or a line,
- Scaling a shape,
- Shearing a shape,
- Mirroring a shape on a vertical or a horizontal axis,
- Repeating a shape and scaling, moving, and rotating the copy to create a new pattern,
- Combining at least two shapes to create a new one,
- Dividing a shape and changing a part of the shape
- Adding a new shape.

Discussion

Based on the experiments, the basic language of jewellery items can be described by a shape grammar through shape interpretation and shape transformation. Shape transformations are employed to describe the connections between sketches according to shape rules. It is extremely difficult to construct shape grammars that cover the whole range of jewellery design styles. As described in the results section, different design styles come from different shape grammars. However, the key common shape rules often exploited, can be captured as summarized in the previous section. Nevertheless, more case studies are needed for further observations to make the study of the basic language of jewellery design more solid and close to its natural language.

Conclusion and Suggestions

By combining art and science, this paper indicates that science can help us to understand the creation of artworks such as jewellery design. In this paper, shape grammar, a scientific method, is used to understand and explain how designers are working on their sketches. The research is mainly based on the experimental investigation of the sketching process of jewellery designers. The investigation was aimed at understanding the transformations and developments of idea sketches. The analysis of the experimental data, therefore, led to the definition of a set of shape transformation rules, which are commonly used in jewellery sketching. This study focuses on design exploration in terms of shape rules used during transforming shapes. Shape transformations performed in the sketching process of jewellery design were observed, which led to the identification of how designers transform shapes from one state to another in a logical manner, which can be explained through shape grammar and shape rules.

Shape grammar, shape rules, and shape transformations can be coded into a computer-aided design program to automatically generate a large set of design alternatives for designers. Shape grammar is also useful for novice designers and design students.

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Jewellery Design with Thai Wisdom and Thai Identity for Modern Consumers

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Abstract

The objective of this research was to support and enable start-up entrepreneurs to design jewellery with Thai wisdom and Thai identity for modern consumers. Five collections of 20 pieces of jewellery prototypes were created for the jewellery groups in Si Satchanalai, Sukhothai province. The beauty of jewellery designed with silver and gems as materials along with story-telling inspired by flowers and Thai identity. Each collection of jewellery presents the emotions, characters, and the traits of owners in combination with Thai uniqueness. Research procedures involved activities of giving in-depth advice to entrepreneurs, developing prototypes, promoting distribution channels, and evaluating the satisfaction levels on the design works among consumers. Seven collections of 21 pieces of jewellery were created under the concept “Flowers of Love”, namely, 1) Marigold, 2) Yellow Star, 3) Queen Sirikit Cattleya, 4) Daffodils, 5) Manee Theva, 6) Crown and Amaranth (Witherless Love), and 7) Roses). The results of the assessment reported a high level of satisfaction.

Keywords: Jewellery design, Thai wisdom, Thai identity, Modern consumers

Rationale

Thailand 4.0 is the development of “New Engines of Growth” by transforming the country’s “comparative advantages” in two areas, namely “biodiversity” and “cultural diversity” into a "competitive advantage", especially among creative, culture & high value services. The government has a policy to increase the management efficiency of various projects so that communities are capable of using local resources and wisdom to develop their products. To this end, the government prepares to support community access to modern knowledge and funding sources, and develop their management and marketing capabilities to connect community products to the markets both domestically and internationally (Department of Community Development, 2012). The implementation of the OTOP Product Champion (OPC) is a project following the policy to implement the One Tambon One Product Project aiming at setting up a database of manufacturers and entrepreneurs and the ranking of the products (1- 5 stars) that will lead to future product development. Most of the agriculturalists in Tha Chai Subdistrict of Si Satchanalai District in Sukhothai Province, when free from farm work, will take a "Silverware" job to supplement their income. However, during the past 2 years, many families have turned to silverware making as their main occupation and gathered to set up an "Antique silverware products group of Mueang Si Satchanalai". The group has made numerous styles of silver jewellery for sale, highlighting ancient patterns as the identity of Si Satchanalai people. Today, group members can earn an average of 3,000 baht per month. Si Satchanalai is famous for their replication and manufacture of ancient jewellery styles, following patterns dating from the distant past. At present, most agriculturalists spend their free time from farming, to work as hired silver jewellery workers. In 2002 they formed the antique silverware products group of Muang Si

Satchanalai with support from agricultural cooperatives of Si Satchanalai which helps to strengthen the group.

The antique silverware products of Si Satchanalai are distinctive for their unique patterns for example, like the Kanok and Kruewan patterns. In addition, the group also applied patterns from ancient objects such as columns, walls, and stucco, and did not use silver casting, but instead, press silver pellets into tiny threads and then weave them into Sukhothai silver patterns using silver with a purity of 98%, higher than in other places. Their best sellers are rings, bracelets, necklaces and earrings. Other than selling at the cooperative products distribution centre in Sukhothai, their products are also available at their booths in many events and are bought by customers to sell overseas especially in Malaysia and Singapore where the products are very popular. Today over 30 group members can earn around 3000 baht per month as the orders keep coming. It is projected that members may be able to earn up to 5,000 baht monthly per person.

The weaving of antique silverware is delicate and exquisite work, marking the art and beauty of such handicrafts that date back hundreds of years when people of the Nakhon Si Satchanalai era had created such classic works. We are thus proud to help carry on the intentions and work of our ancestors of Si Satchanalai. In the light of this significance, the researcher and students aimed to develop community products and increase the strength of the community by integrating and equipping the design knowledge to society on several issues such as production, expansion of production factors, environmental preservation, mass production for distribution, product development including product styles over the past year, packaging development, packaging form, participation with the community to make products that reflect the excellence of Thai wisdom with the styles, colours, patterns, beauty, and distinction that meet market needs.

The researcher intends to give advice and academic service to the community in the area of jewellery design with Thai wisdom and Thai identity for the jewellery group of Si Satchanalai District in Sukhothai Province. This is to offer a concept of building the community economy in line with development, according to the philosophy of the sufficiency economy. It also provides a tool to stimulate the community learning process, promote local development processes, and create a strong and self-reliant community, with the use of electronic commerce (e-commerce) i.e. operating a business using electronic media (Electronic Commerce Development Centre, 1999). The nature of business operations focuses on the production, distribution, marketing, selling or transporting of products and services via electronic media (WTO, 1998). It also involves the analysis of entrepreneurial activity, the availability of all types of transactions related to commercial activities both at the corporate and individual levels on the basis of processing and sending digital data in both texts and images as a medium of trade between entrepreneurs and consumers, entrepreneurs and entrepreneurs, consumers and consumers, including communication and the exchange of information among people with similar consumption styles or the exchange of products among themselves.

Objectives

To support and enable start-up entrepreneurs to design jewellery with Thai wisdom and Thai identity for modern consumers of the jewellery group in Si Satchanalai, Sukhothai province. At least 5 collections with 20 pieces of prototype jewellery were expected to create. The focus is on creating the beauty of jewellery with silver and gems as materials and building stories through the work pieces inspired by flowers and the Thai identity. The jewellery can present the emotions, characters, and traits of owners in combination with Thai uniqueness.

Methodology

Research methodology involved field visits to meet with the entrepreneur of Mai-Ngern shop in Si Satchanalai, Sukhothai province to explore the form, technique and process of silver jewellery production, marketing, and sale promotion, and to provide in-depth advice on jewellery design to meet the needs and demands of consumers. An interview form and questionnaire were used to collect key data used for the developing of jewellery prototypes. Satisfaction assessment was conducted among the target groups.

1. Activity on providing in-depth advice on jewellery design

Figure 1 Providing in-depth advice on jewellery design (Left)
Figure 2 Developing draft jewellery (Right)

2. Activity on developing jewellery prototypes

The researcher, entrepreneurs, and craftsmen worked together to develop draft jewellery and create designs under the concept of "Flowers of Love" which included 7 collections with 20 pieces of jewellery namely: 1. Marigold, 2. Yellow Star, 3. "Queen Sirikit" Cattleya, 4. Daffodil, 5. Manee Theva, 6. Crown and Amaranth (Witherless Love), and 7. Roses. The production process started with melting the silver as the main material, forming by rolling it into strips and sheets, jig sawing to make the desired shapes, rolling it into strips of various sizes in both flat and round shapes, welding together the various parts into shape as designed, retouching the details of the work piece, and polishing and cleaning the piece.

3. Activities to promote the distribution channels should be posted on social media such as Facebook and Line as contact channels.

4. The assessment of consumer satisfaction on the jewellery was carried out using a sample of 100 persons through online media using an assessment form based on the standard criteria of the community products. The assessment list contains general features, patterns, colours, other accompanying materials, and polishing, which are rated on a 4-point scale as follows:

Score	Interpretation
4 = very good	3.50 - 4.00 = very good
3 = good	2.50 - 3.49 = good
2 = fair	1.50 - 2.49 = fair
1 = improvement needed	1.00 - 1.49 = improvement needed

Results

The design work was done under the concept "Flower of Love" comprising 7 collections with a total of 20 pieces of jewellery as shown next.

Figure 3 Marigold Collection with a necklace wt. 128.2 g., a bracelet wt. 45.8 g., and a pair of earrings wt. 14.5 g., a total weight of 101.30 g.

Collection 1 "Marigold" of King Rama IX

Concept: Flower of King Rama IX: H.M. King Bhumibol Adulyadej. Yellow marigold represents "Monday" as the birthday colour of King Rama IX. Yellow colour signifies H.M.'s graceful actions with simplicity and moderation and aiming to benefit the Thai people. H.M.'s kindness and generosity have thus been deeply appreciated and engraved on the hearts of all Thai people for a long time just as the length of time that marigolds bloom. "Marigold" is considered an auspicious plant as it is believed that the flower comes from heaven. Marigolds are native to Mexico and the United States. In the northern part of Thailand, the marigold is known as Kham Pu Ju, and big marigolds are known as Kham Pu Ju Luang. Marigold plants are commonly grown as cut flowers. The African and American marigolds are known as varieties with large flowers. A commercial variety of the marigold in Thailand is the Sovereign. Other new varieties have also been imported such as the Jamaica and a number of other varieties. In Thailand, the main planting areas of Marigolds are Phayao, Lampang, Nonthaburi, Bangkok, Ratchaburi, Samut Sakhon, Suphan Buri and Udon Thani provinces. With its bright yellow petals, marigolds become a symbol of prosperity, progress, and effulgence. Moreover, marigolds are often used as offerings for monks or sacred things according to one's beliefs.

Figure 4 Yellow Stars Collection with a necklace wt. 174.1 g., a bracelet wt. 87.3 g., and a pair of earrings wt. 16.1 g., a total weight of 277.5 g.

Collection 2 "Yellow Stars" of King Rama X

Concept: The significance of Yellow Stars is that it is considered a precious and noble plant that was to be a plant associated with King Rama X: H.M. King Maha Vajiralongkorn Phra Vajiraklaochaoyuhua Bodindradebayavarangkun. Yellow Stars flowers bloom around the time of King Rama X's birthday, and its yellow colour is also the colour of H.M.'s birthday. Importantly moreover, King Rama X often planted Yellow Stars trees at different places where he visited to perform royal duties to be bestowed as representing His Majesty and good fortune to the people.

Figure 5 "Queen Sirikit" Cattleya Collection with a necklace wt. 72.30 g., a bracelet wt. 21.50 g., and a pair of earrings wt. 7.40 g., a total weight of 101.30 g.

Collection 3 "Queen Sirikit Cattleya"

Concept: "Queen Sirikit" Cattleya is a plant in Orchidaceae family. It is a hybrid orchid, a cross between Cattleya Bow Bells and Cattleya 'O' brieniana var. Alba which was created in 1958 by the English company Black & Flory Ltd. and registered as Cattleya Exquisite referring to "flawless excellence" After receiving the first prize from The Royal Horticultural Society in the UK, the company asked permission from Her Majesty Queen Sirikit (The mother of the current King Vajiralongkorn: King Rama X) to name the orchid after her as "Queen Sirikit Cattleya". The royal permission was also received to use Queen Sirikit Cattleya as the symbolic flower for Thai Women's Day on 1 August each year. For general features, the Queen Sirikit Cattleya plant is 20 – 40 cm tall with cylindrical stems and oblong leaves. It possesses single or inflorescences of 1-4 flowers in an off-white colour, with oval triangular lobes, 5 petals, broadly spreading lobes, wavy petal edges, and a golden yellow dot at the petal centre. The flower grows 12 – 14 cm in diameter when fully bloomed with a sweet scent. The plant has triangular shaped pods and its flowers bloom constantly.

Figure 6 Daffodil Collection with a necklace wt. 55.80 g., a bracelet wt. 25.50 g., and a pair of earrings wt. 12.3 g., a total weight of 93.50 g.

Collection 4 "Daffodil" (Dararat)

Concept: Dararat, the flower of great value. "Dararat" is the Thai name for "Daffodil" in English. It is a winter flowering plant. The Thai name "Dararat" has a hidden profound meaning. "Dara" means stars referring to something staying at the highest level, and "Rat" means "crystal" referring to something valuable. There was a time when Queen Sirikit visited Doi Ang Khang and saw these flowers growing there. She decided that she would like to have those flowers arranged in a vase and placed on the dining table. The courtiers then prepared it according to her wishes. This was prior to Her Majesty telling her royal entourage about her attachment to this kind of flower when she had not yet married. At that time, Queen Sirikit resided in Paris since her father was the Thai ambassador to France, while the King was studying and staying in Switzerland. During his free time, the King would always drive by himself across the border to visit the Queen and every time he offered flowers to her. It is these yellow flowers that the King always brought to the Queen.

Figure 7 Menee Theva Collection with 4 pieces of jewellery including a necklace, a bracelet, and a pair of earrings, as the inspiration from Manee Theva flower in developing the designs and composition shown in the figure, above.

Collection 5 "Manee Theva"

Concept: Manee Theva is the name of flower given by Her Majesty Queen Sirikit. Its local names include Ya Phom-ngog (grey-haired grass), Ya Kradum-ngern (silver button grass), Ya Kradum (button grass), Ya Dok (flowering grass), and Ya Toomhoo (earring grass). It is a seasonal, monocotyledonous plant with slender, elongated, flat leaves clumped at the base. The leaf is 3-6 mm wide, 7-30 cm long, and succulent, with frequent parallel longitudinal lines, slender edge and smooth surface. Small flowers are packed into a spherical bouquet like the white gem setting of a ring. The peduncle is round, small, and slender, and stands 10-20 cm tall. The plant is naturally born in the fields after the harvest season around October-February. It is commonly cultivated as an ornamental plant in a fish tank. The plant is distributed in the eastern and north-eastern regions of Thailand. Naturally, they often grow together to form fields on the talus and wetland or the riverside in the northeast and the areas near the Phu Phan Ratchaniwet Palace in Sakon Nakhon Province. Manee Theva is one of the five types of wild flowers that were named by Her Majesty Queen Sirikit. It is a wild ornamental plant that can be dyed and bound together with other types of dried flowers.

Figure 8 Crown and Amaranth Collection (Ruck Mai Ru Rouy or Witherless Love) with a necklace wt. 110.90 g., a bracelet wt. 57.60 g., and a pair of earrings wt. 28.3 g., a total weight of 192.10 g.

Collection 6 “Crown and Amaranth” (Ruck Mai Ru Rouy or Witherless Love)

Concept: Crown plant in scientific name as Calotropis gigantea (Linn.) R.Br.ex Ait belongs to Apocynaceae family and Asclepiadoideae sub family. It is a small shrub with the stem growing to 1.5–3 m. tall. The plant bears white or purple flowers with an appendage like a crown. It is native to Indonesia, Malaysia, the Philippines, Thailand, Sri Lanka, India and China. In Thai tradition, the flowers of this plant, called Dok Ruck (Love), are commonly used to make a garland together with jasmine, marigolds, champa or roses in several propitious events related to love. Since Dok Ruck symbolizes love, in engagement and wedding ceremonies. The flowers are typically included in a tray of gifts as a troth, decorated in a basin for blessed water, twinned as garlands for the bride and gloom, and spread over the mattress in the bedding ceremony. The Hawaiian people regard the garland necklace (lei) made from crown flowers as a symbol of kingship. Amaranth (or Baan Mai Ru Rouy in Thai mean “witherless flower”) bears flowers in a spherical cluster at the branch end with little tiny flowers packed together. Each inflorescence contains about 2-3 small flowers in a spherical shape and the same size as a jujube. The flowers are white, dark red, purple or light pink and firm - white Amaranth are used for medicine as white is a pure colour and when making medicine it will not be mixed with any other colours. The petals are small and stacked in layers all over each flower, with the tip of the petal point like rough hairs and 2 bracts or sepals in green. When in full bloom, the flower is about 1.5-2 cm wide in size and its petals do not easily fall off even when it is old or dry, the origin of the name "Amaranth”.

Figure 9 Roses Collection with a necklace wt. 116.10 g., a bracelet wt. 6.38 g., and a pair of earrings wt. 11.10 g., a total weight of 191.00 g.

Collection 7 “Roses”

Concept: Roses have been commonly grown for pleasure since ancient times. It is estimated that roses originated over 70 million years ago. Fossils of roses have been discovered in Colorado and Oregon, USA, and evidence suggested that wild roses date back 40 million years, but they did not look like modern roses. Humans have brought wild roses to plant and breed, propagate into many different varieties. Roses are considered a symbol of love and romance. Some legends said that roses symbolize the birth of Venus, the Goddess of Beauty and Love. Venus is known as Aphrodite. According to Greek mythology, Venus’s tears dropped and mixed with the blood of her lover Adonis who was killed by a wild boar, and the blood and tears fell to the ground and turned into a deep red rose.

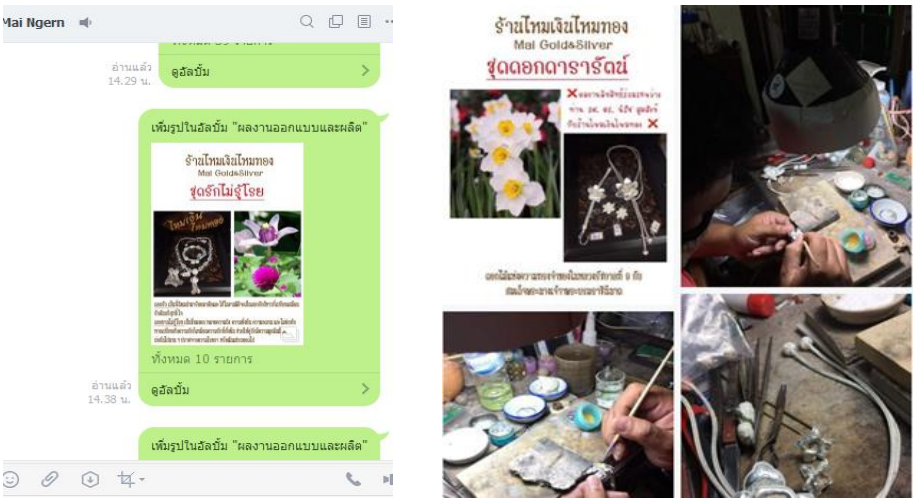

Figure 10 Contact channels: Line ID Mai Ngern

Table 1 Level of satisfaction among the target groups of 100 persons toward the silver jewellery

Lists of features	Set Criteria	Satisfaction Level		
		Mean	S.D.	Interpretation
General features	Form and shape are appropriate, delicate, and beautiful. The piece's cutting or welding must not make obvious seams and reduce strength or it may cause problems in use.	3.88	0.32	Very Good
Pattern	Pattern connections must be harmonious, neat, consistent, and suitable for each function.	3.78	0.41	Very Good
Colour	The colour is uniform with even thickness and without colour breaking and peeling off.	3.76	0.48	Very Good
Other accompanied materials	Exquisite, beautiful, durable, harmonious, and suitable to the piece.	3.36	0.48	Good
Polishing	Uniform shine, no traces of filings or sandpaper known as "swirl marks"	3.58	0.64	Very Good
	Total	3.67	0.18	Very Good

As Table 1 suggests, consumer satisfaction on the silver jewellery was at a very good level.

Discussion

Jewellery design inspired by the 7 kinds of flowers under the concept "Flowers of Love" comprises 7 collections with a total of 20 pieces of jewellery. These include 1) Marigolds, 2) Yellow Stars, 3) Queen Sirikit Cattleya, 4) Daffodil, 5) Manee Theva, 6) Crown and Amaranth (Ruck Mai Ru Rouy or Witherless Love), and 7) Roses. The research process promoted cooperation with business establishments. The design technique and production

are of creative craft industry in contemporary style for modern consumers. It agrees with a study by Podjanapimol P. (2020) suggesting that this concept used the forms and patterns for 4 types of jewellery design, namely jewellery with geometric forms and patterns, jewellery with natural forms and patterns, jewellery with artistic and free forms and patterns, and jewellery with contemporary forms and patterns. The technique used to make silver jewellery here in Si Satchanalai is similar to the antique jewellery made in Phetchaburi province. In a study by Thaveechai W. et al. (2016) to explore the wisdom of making Phetchaburi gold ornaments, the process of pendant invention, and the method of making the styles and patterns, it was found that the making of Phetchaburi gold ornaments has been relayed from generation to generation and usually within the families rather than to people outside. Most of the shapes, form, patterns, materials and production processes are from nature such as pinecones, Spanish cherry, fish roe, and other things from daily life, or are made to order. Materials include gold, silver, copper alloy, and gems. The process is to press gold into stripes, bend them in different patterns, and make each part manually one piece at a time, with the piece presenting local identity.

At present, there are 2 groups of jewellery in Thailand. 1) Precious Jewellery: The jewellery is made of gold, silver, diamonds, platinum, gemstones, and pearls. This type of product is preferable among consumers with enough purchasing power and consumption on a regular basis to buy from the sale stores mostly traditional jewellery and gems stores, department stores, including the stores selling products directly from factories. 2) Costume Jewellery or Fashion Jewellery: This group of products are inexpensive. Product styles depend on consumers' preference especially among groups of teenagers - early working age (aged 18-35 years), and seasonal fashion over short periods of time. The products can be easily purchased at department stores, flea markets, or online trading in the form of E-Commerce. The target groups of precious jewellery are middle to upper class consumer groups with high purchasing power. They consider the purchase of products based on quality, size, design, pre- and post-services. New generation customers aged 20 years and over want to wear diamond jewellery to enhance their personality, the designs that go with their lifestyle, and affordable starting price. In order to attract the customers through E-Commerce, the key is to offer products and promotions that are different and can motivate purchasing decisions compared to mainstream channels, and present/review products that hit into the heart of each customer group. For teenagers, for example, it should present in the form of videos, nice pictures, demonstration of dressing or mix and match of clothing or educating about the products at the same time. For working and middle age people, the presentation style should provide as much details of the product as possible including size, price, quality and design. It should offer conveniences to order such as having a range of ordering channels, fast and safe delivery, and importantly offering more convenient transaction conditions i.e. between business to business or business to customers directly, to ensure consumers with trading, and easy shopping. Additionally, in case of dissatisfaction, return and refund are possible within time limits and conditions of the store, and the problems should be addressed for customers in a timely manner for their impression. The promotion should cover incentive benefits to draw more customers to use the service through this channel. These include, for instances, offering discounts, benefits for the next shopping, or limited-edition products only on this channel.

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The Comparison of Colour Coefficient from Plant-Extracted Colour on Different Types of Paper for Painting

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Abstract

The objective of this study was to compare the values of colours extracted from plants with different solvents and the fastness of colours on five different types of painting papers. The three-colour groups from different kinds of plants are including Yellow: *Gardenia jasminoides* J.Ellis (fruits), *Coscinium fenestratum* (Goetgh) Colebr (climbers), *Nelumbo nucifera Gaertn* (pollen); Red: *Smilax corbularia Kunth* (rootstocks), *Caesalpinia sappan* L. (heartwood), *Bixa orellana* L. (seeds), and Blue: Fresh *Strobilanthes cusia* (Nees) Kuntze (fresh leafs and branches), Clitoria ternatea L. (flowers), Fermented Strobilanthes cusia (Nees) Kuntze. Plants were extracted by ethanol and water as solvents in a ratio of 1:5 (plant: solvent). The materials were dipped into resulting colours and compared for fastness using colourimeters to determine the values of L*a*b* or CIELAB. The results revealed that *Coscinium fenestratum* (Goetgh) Colebr in ethanol and water provides the highest luminance - L* and *Gardenia jasminoides* J.Ellis in ethanol provides the highest b* value in yellow group. In red group, *Smilax corbularia Kunth* in ethanol provides the highest luminance - L* and *Bixa orellana* L. in ethanol provides the highest a* value. In blue group, Fresh *Strobilanthes cusia* (Nees) Kuntze in ethanol and water provides the highest luminance - L* and *Clitoria ternatea* L. in water provides the highest -b* value which is higher than in ethanol. With water, Fresh Strobilanthes cusia (Nees) Kuntze produced highest luminance - L*. After the comparison of colour value, it is found that these 3 following plants provide the different highest colour value on 300 gsm Cotton 100% paper. *Gardenia jasminoides* J.Ellis in ethanol provides the highest b* value at 81.73 in yellow group. Bixa orellana L. in ethanol provides the highest b* value at 47.30 in red group. *Clitoria ternatea* L. in water provides the highest -b* value at -18.65 in blue group.

Keywords: Colour value, Extraction, Natural colour, Painting, Solvent

Introduction

To create works of art like painting, the use of colour impacts on the feelings toward and about the image. The colours are an integral part representing artist's expression. Painting conveys a particular type of work onto a flat surface in 2-dimensions. Tatiya (2004) states that humans can see the colours of objects according to the light that hits the object which reflects the light to the eye which is then seen in colour. Colour has a psychological effect as it influences emotions and feelings. The colour that is seen by the eyes will be transmitted to and perceived by the brain to feel emotions as influenced by colour such as feeling happy, fresh, hot, exited, sad, etc. Today, colours that are used by artists although easily available are synthesized and contain several types of chemicals that might cause health effects to users. In this light, the researcher is interested in finding colours from

different kinds of plants suitable to be used to create paintings. Some artists now use plant colours to create their works of art. For example, Yanawit Kunchaethong, an artist who creates graphic art using natural colours. One colour is extracted from the flowers of the Mexican Calabash plant. His inspiration came when he was removing the seeds and his hands were stained with the colour and he could not easily wash it off. He was then interested in trying to use the colour to create graphic art as he believed that every kind of plant can be used as colour depending on whether they are attractive in producing graphic art. Trial and error in extracting natural colours suggested that thousands of plants have not yet been discovered so they need to be studied to see if they contained usable pigments. However, it is important that these plants are preserved since they provide natural colours that can be used to create art and painted works (Ruenpiromjai, 2015). Ruenpiromjai (2015) also mentioned another artist, Walaikorn Smatthakorn who discovered colours extracted from flowers and has long used colours produced from flowers rather than made from chemicals. She extracted colours by grinding up flower petals with a small amount of hot water to obtain colour. Fruits such as sweet pepper or Ceylon spinach were ground up without using water. Leaves were pounded and filtered with a filter cloth to obtain coloured water. Barks were boiled to extract colour which can be concentrated or treated to make different colours by leaving them overnight or placing them on colour palettes for several days. The resulting colours from plants will finally turn discoloured because they were from nature. Natural colours can also be used in art therapy such as in the works of Anupan Pluckpankhajee, an anthroposophist painter of art therapy who was attracted and fascinated with natural colours. He also used natural colours with art works to heal people. Moreover, artists also regard quality colours, with every colour used in therapy being categorized as appropriate to the clients. Colours from plants do not mean colours only from flowers but also from roots, barks, trunks, leaves, flowers, fruits and skins. Colour extraction from plants also involves how colours from each part of the plant being used to promote balances among human being, and different parts of the same plants being extracted offer different colours. It is the happiness in making colours and it is creativity to use colours with the clients in therapy. The power of life inhibited in plants and nature make people high-spirited. However, each kind of plant involves different process of colour extraction and removal without using any chemicals, so their storage life is only 6 – 7 months. (Sivirach, 2015)

The aforementioned artists are thus focusing on improvement to prolong colour storage life. Colours from nature vary in their tones and change with natural conditions. Colours extracted from the same kind of plant might be different depending on environmental conditions, weather, young or old age of plant. Colours derived from nature are all charming and beautiful in their own way.

In the current research, the researcher used natural colours from plants in painting various works which required an extraction process in order to obtain the intended colours for purposive use. Colours derived from nature are attractive in their quality and beauty, and are even easy to find. Making use of natural plants will also benefit in terms of the preservation of diverse kinds of plants from extinction.

Literature Review

Soonthornchai (1998) explained about natural colours that colours from plants as natural colours though they are not that vivid but they are as well not livid. Because of the liveliness and splendor of natural colours from plants, over the past long period of time up until today human persist to invent new things and new colours from nature, and to improve durability of colours. They employed scientific principles to analyze, test, and try out so that the colours can be well utilized and also harmless to human. It may require somewhat

complicated production process and take time to extract colours. Importantly, to make use of natural colours from plants is to establish a body of knowledge from natural resources locally available, to carry on local wisdom, and to appreciate the value and benefits of plants in nature. This is a way to raise awareness when utilizing natural resources while at the same time better preserving diverse kinds of plants. In here the researcher extracted colours with water and ethanol commonly used to extract pigments from nature. Tuisakda, & Khamnuansin (2011) in his research on traditional wisdom of natural cloth dyeing, using dyes from tree bark, branches, and leaves of indigo. The methods and procedures included selecting bark of astringent taste from trees aged 5 years old or more; cutting or chopping them finely to release colour as much as possible; boiling water, adding mordant and bringing barks or parts of plant to simmer for 1-2 hours to release sap and obtain rich or desired colours, and finally removing bark from water. Dyeing with water can be both hot or cold dyeing. For cold dyeing, colour water was left cold after boiling bark to obtain rich or desirable colour, cotton threads were then dyed in colour water by squashing them with hand in water colour and then bring to hang-dry. Colour extraction with water as solvent has long been widely used especially for dyeing cloth. However, there is another researcher who also examined other solvents to extract colours for using in art works. For example, Mari Selvam et al. (2015: 84) conducted a study on extraction of natural dyes from Curcuma longa, Trigonella foenum graecum and Nerium oleander, plants and their application in antimicrobial fabric. Dyes were prepared using aqueous, acidic, alcoholic, and alkaline extraction techniques. The aqueous and alcoholic extraction of Nerium oleander was able to inhibit the growth of many fungal strains including Tricoderma spp., Tricophyton rubrum, Candida albicans, Aspergillus niger, Cladosporium spp. etc. The antimicrobial property of the dyes was used in developing antimicrobial fabric.

Methods and Materials

In order to achieve the research objectives, research procedures were defined as comparing between colours extracted with ethanol and water solvents, and fastness of plant colours on different types of paper. The research processes are detailed below.

1. The selection and identification 3 groups of plants was carried out. Different parts of the plants were used to extract the 3 colours, i.e. red, yellow and blue as they are primary colours commonly used in works of art. The three kinds of plants from which each colour was extracted are listed below:

Yellow:		*Gardenia jasminoides* J.Ellis (fruit)
		Coscinium fenestratum (Goetgh) Colebr (climbers)
		Nelumbo nucifera Gaertn (pollen)
Red	:	*Smilax corbularia Kunth* (rootstock)
		Caesalpinia sappan L. (heartwood)
		Bixa orellana L. (seed)
Blue	:	Fresh *Strobilanthes cusia* (Nees) Kuntze (fresh leaves and branches)
		Clitoria ternatea L. (flowers)
		Fermented *Strobilanthes cusia* (Nees) Kuntze.

2. Examining solvents commonly used for colour extraction; here the researcher selected 2 types of solvents, i.e. water and ethanol as solvents to extract plant colours, and used the same proportion of each kind of plant. Two experiments were performed.

2.1 Water solvent

2.1.1 Use 100 g. of plant to 500 ml. of water.

2.1.2 Put the plant into 500 ml. of water and bring to boil at 100 ºC, then leave to cool down for 7 days, after that dip each of the 5 types of paper into the coloured water for 5 seconds.

2.2 Ethanol solvent

2.2.1 Use 100 g. of plant to 500 ml. of ethanol.

2.2.2 Immerse the plant into ethanol contained in a plastic jar, close the lid and set aside for 7 days, after that dip each of the 5 types of paper into the coloured liquid for 5 seconds.

Figure 1 Extraction of colour with ethanol solvent

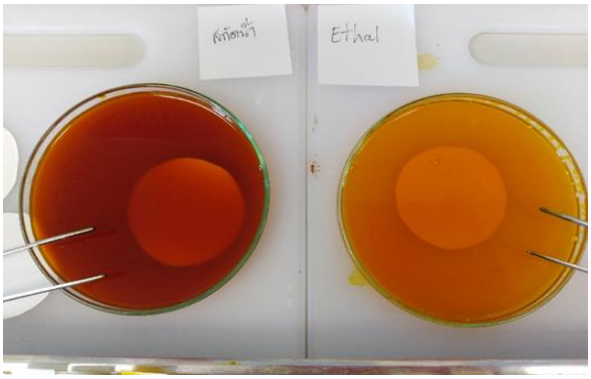


Figure 2 Papers dipped into colours

Figure 3 Coloured papers were air dried and arranged by types of paper for further measuring colour value.

3. All of the 5 types of drawing and painting papers were dipped into each colour; papers were cut into round shape of 4 cm in diameter.

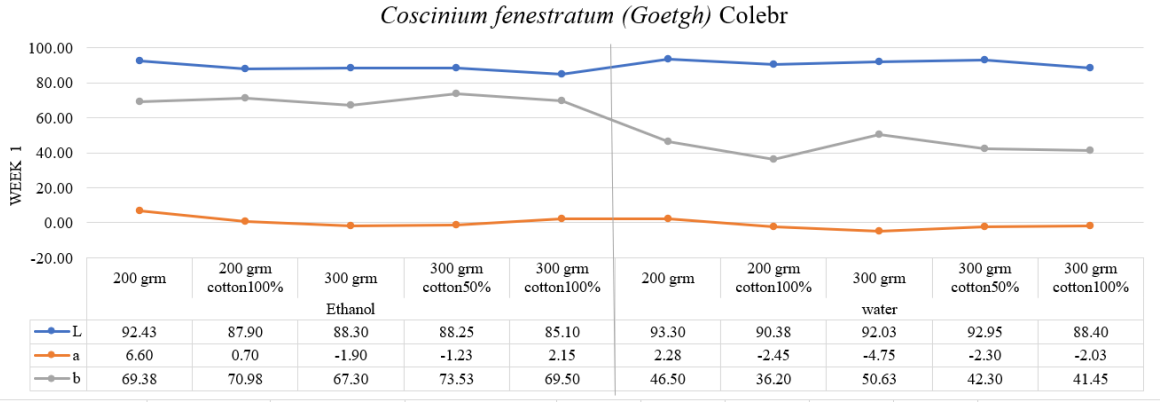
4. This step measured colour values on colour-dipped papers to compare colour intensity; colour fading; L* value or CIELAB in colour system i.e. lightness from low to high as 0-100; and a* and b* values indicating the direction of colour i.e. +a* in red direction, -a* in green direction, +b* in yellow direction, and –b* in blue direction. Colour measurement was defined in 1-month period, and colour fading measurement in 6-month period.

Results and Discussion

Each kind of plant produced differences in colours as shown on Table 1. As observed, extraction with ethanol provided greater saturation and hue than with water, and yellow colour from Gardenia jasminoides J.Ellis with water and ethanol extractions provided greatest saturation.

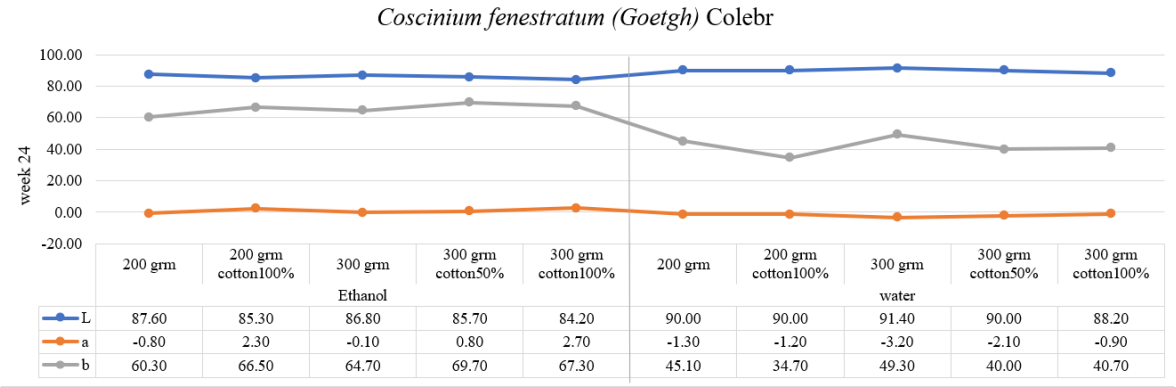
Table 1 Yellow colour group comprising *Coscinium fenestratum* (Goetgh) Colebr extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	*Coscinium fenestratum* (Goetgh) Colebr				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton 50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	92.43	87.90	88.30	88.25	85.10	93.30	90.38	92.03	92.95	88.40
a	6.60	0.70	-1.90	-1.23	2.15	2.28	-2.45	-4.75	-2.30	-2.03
b	69.38	70.98	67.30	73.53	69.50	46.50	36.20	50.63	42.30	41.45

Figure 4 shows the comparison of different colour values from the extraction of *Coscinium fenestratum* (Goetgh) Colebr in the first week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 73.53 on 300 gsm Cotton 50% paper and the extraction by water provides the highest value at 50.63 on 300 gsm paper.

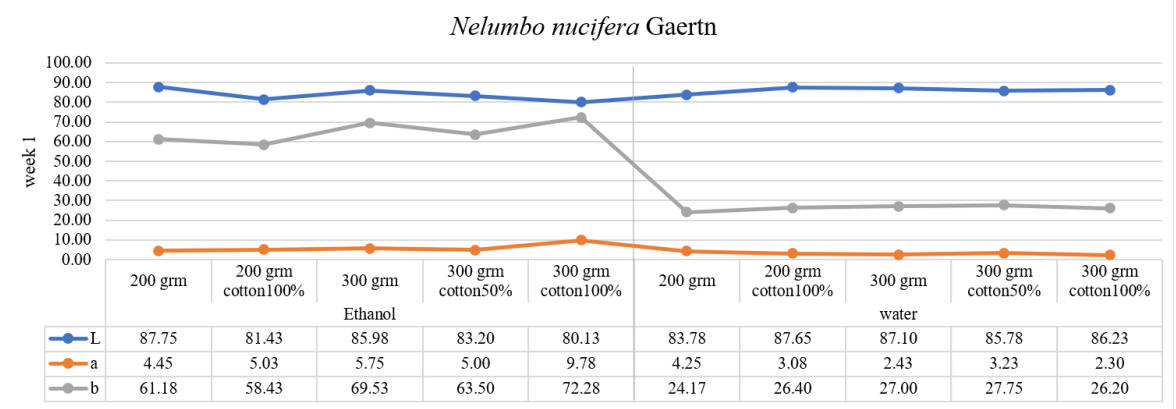


	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	87.60	85.30	86.80	85.70	84.20	90.00	90.00	91.40	90.00	88.20
a	-0.80	2.30	-0.10	0.80	2.70	-1.30	-1.20	-3.20	-2.10	-0.90
b	60.30	66.50	64.70	69.70	67.30	45.10	34.70	49.30	40.00	40.70

Figure 5 shows the comparison of different colour values from the extraction of *Coscinium fenestratum* (Goetgh) Colebr in the twenty-forth week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 69.70 on 300 gsm Cotton 50% paper and the extraction by water provides the highest value at 49.30 on 300 gsm paper.

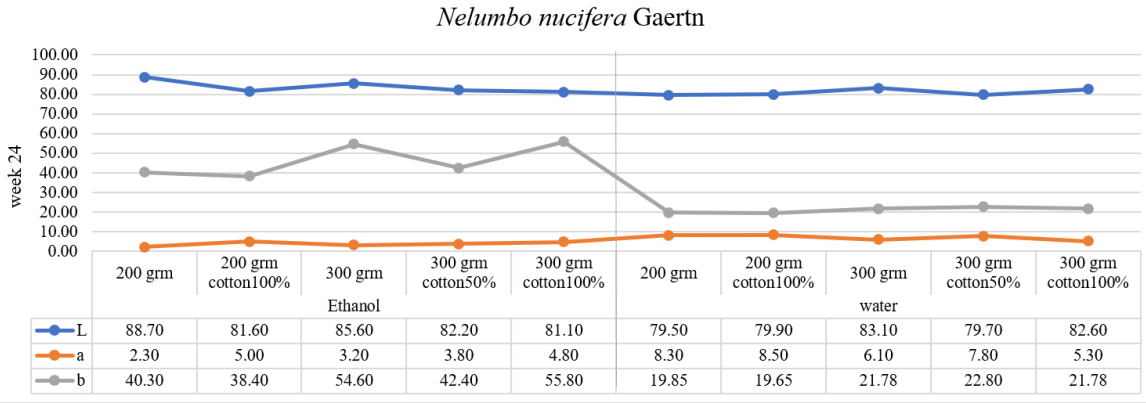
Table 2 Yellow colour group comprising *Nelumbo nucifera Gaertn*, extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	*Nelumbo nucifera* Gaertn				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	87.75	81.43	85.98	83.20	80.13	83.78	87.65	87.10	85.78	86.23
a	4.45	5.03	5.75	5.00	9.78	4.25	3.08	2.43	3.23	2.30
b	61.18	58.43	69.53	63.50	72.28	24.17	26.40	27.00	27.75	26.20

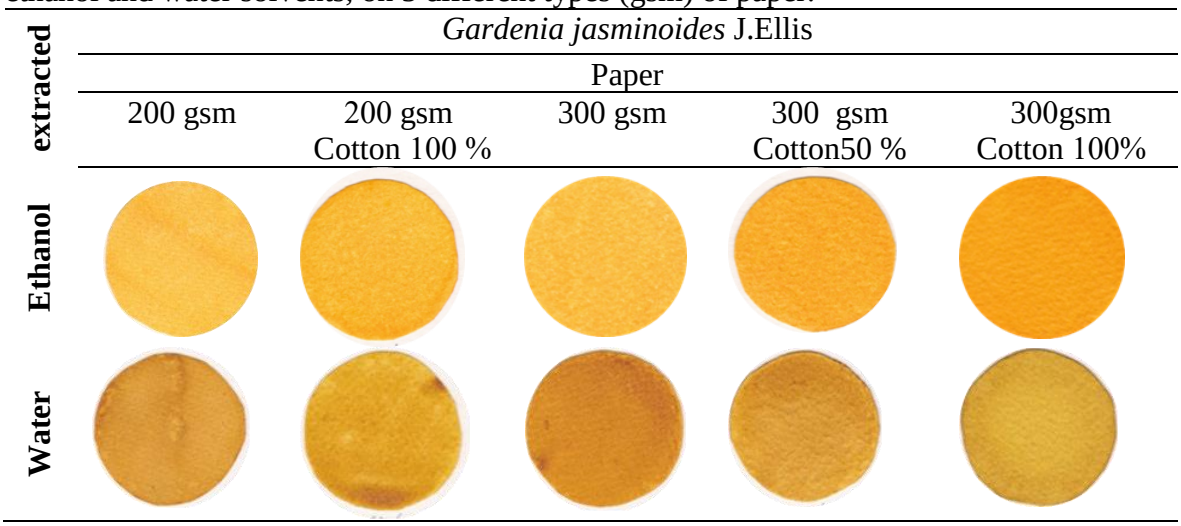
Figure 6 shows the comparison of different colour values from the extraction of *Nelumbo nucifera Gaertn* in the twenty-forth week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 72.28 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 27.75 on 300 gsm Cotton 50% paper.

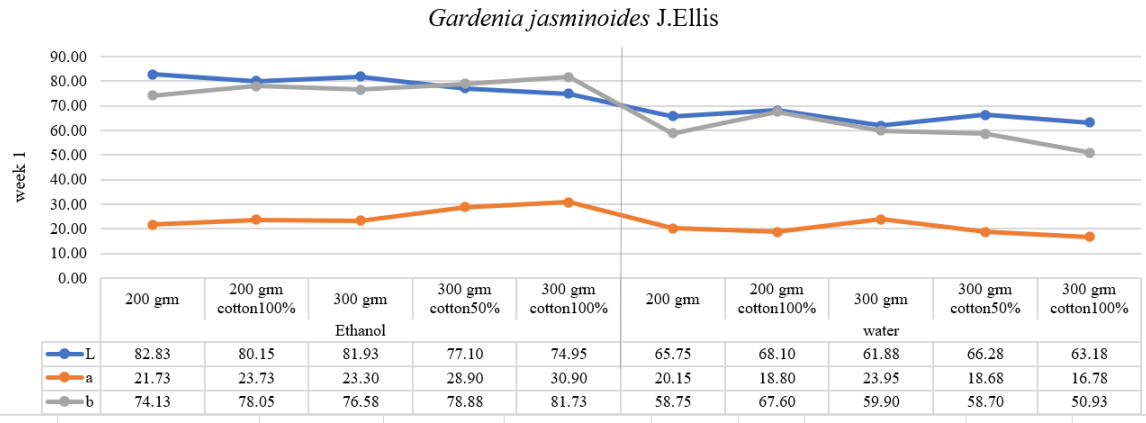


	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	88.70	81.60	85.60	82.20	81.10	79.50	79.90	83.10	79.70	82.60
a	2.30	5.00	3.20	3.80	4.80	8.30	8.50	6.10	7.80	5.30
b	40.30	38.40	54.60	42.40	55.80	19.85	19.65	21.78	22.80	21.78

Figure 7 shows the comparison of different colour values from the extraction of *Nelumbo nucifera Gaertn* in the twenty-forth week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 55.80 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 22.80 on 300 gsm Cotton 50% paper.

Table 3 Yellow colour group comprising *Gardenia jasminoides* J.Ellis extracted with ethanol and water solvents, on 5 different types (gsm) of paper.





	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	82.83	80.15	81.93	77.10	74.95	65.75	68.10	61.88	66.28	63.18
a	21.73	23.73	23.30	28.90	30.90	20.15	18.80	23.95	18.68	16.78
b	74.13	78.05	76.58	78.88	81.73	58.75	67.60	59.90	58.70	50.93

Figure 8 shows the comparison of different colour values from the extraction of *Gardenia jasminoides* J.Ellis in the first week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 81.73 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 67.60 on 200 gsm Cotton 100% paper.

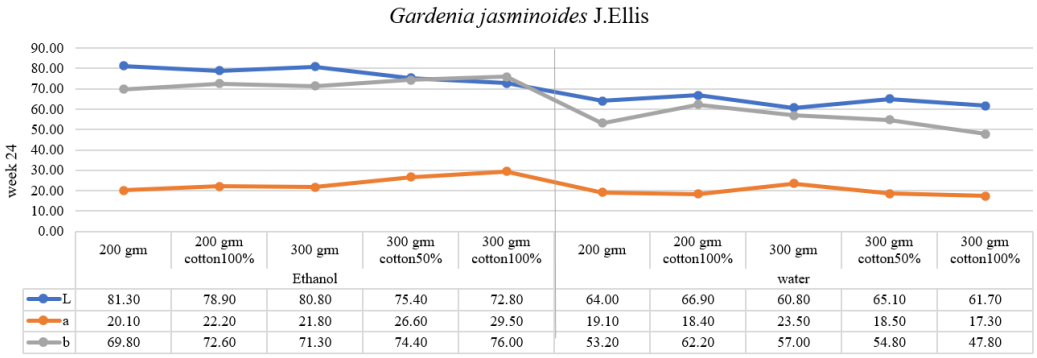


Figure 9 shows the comparison of different colour values from the extraction of *Gardenia jasminoides* J.Ellis in the twenty-forth week. It is found that +b value in yellow shade from the extraction by ethanol provides the highest value at 76.00 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 62.20 on 200 gsm Cotton 100% paper.

Each kind of plant produced differences in colours as shown on Table 4 Table 5 and Table 6. As observed, extraction with ethanol provided greater saturation and hue than with water, and red colour from Bixa orellana L. extracted with ethanol provided high saturation in orange-red colour.

Table 4 Red colour group comprising *Smilax corbularia Kunth*, extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	*Smilax corbularia* Kunth				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					

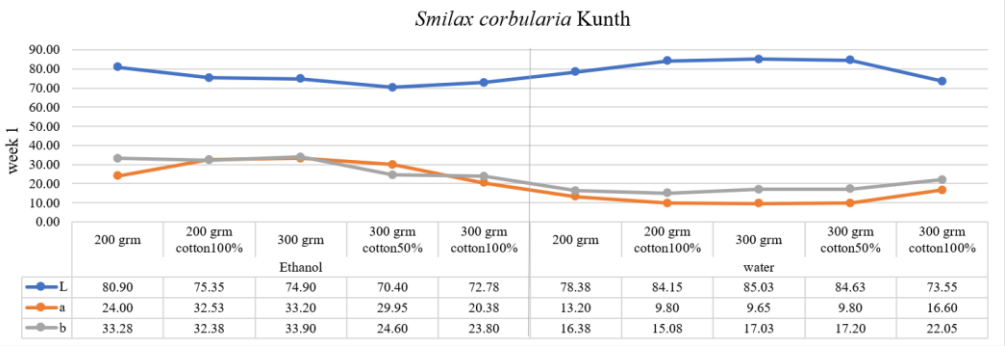
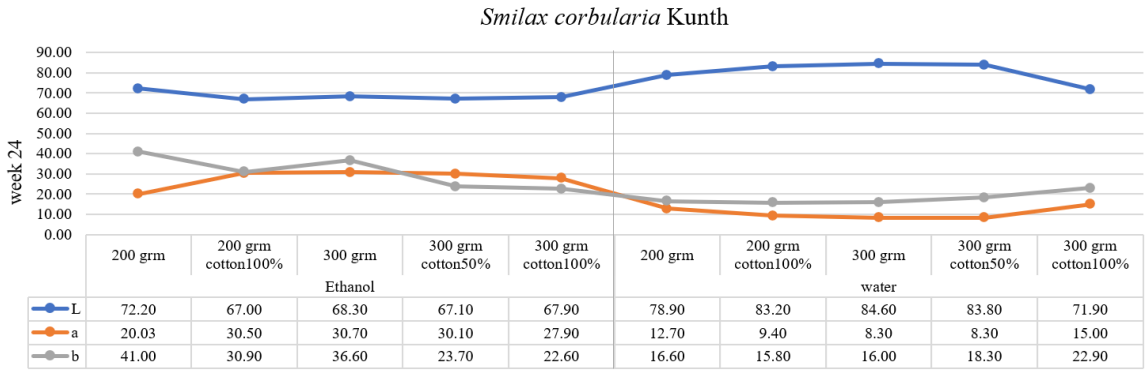


Figure 10 shows the comparison of different colour values from the extraction of *Smilax corbularia Kunth* in the first week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 33.20 on 300 gsm paper and the extraction by water provides the highest value at 16.60 on 300 gsm Cotton 100% paper.

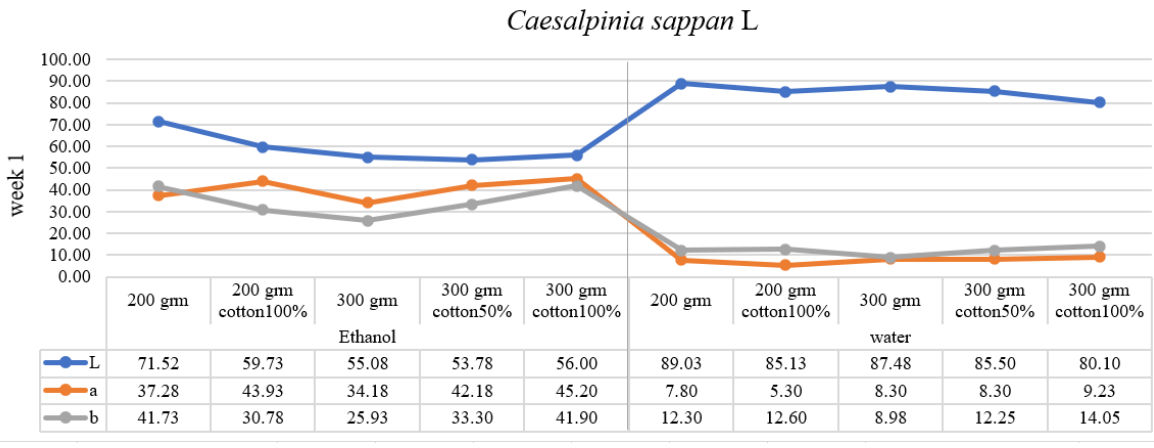


	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	72.20	67.00	68.30	67.10	67.90	78.90	83.20	84.60	83.80	71.90
a	20.03	30.50	30.70	30.10	27.90	12.70	9.40	8.30	8.30	15.00
b	41.00	30.90	36.60	23.70	22.60	16.60	15.80	16.00	18.30	22.90

Figure 11 shows the comparison of different colour values from the extraction of *Smilax corbularia Kunth* in the twenty-forth week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 30.70 on 300 gsm paper and the extraction by water provides the highest value at 15.00 on 300 gsm Cotton 100% paper.

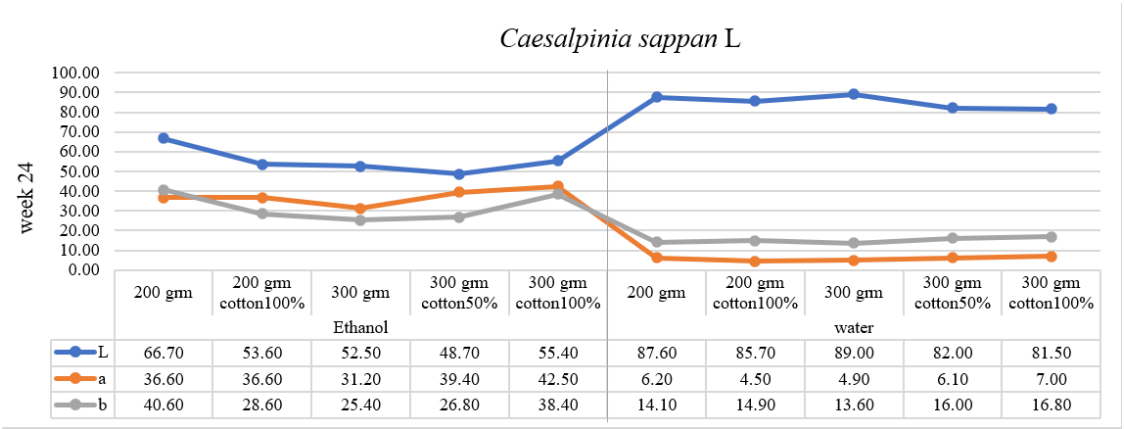
Table 5 Red colour group comprising *Caesalpinia sappan* L. extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	*Caesalpinia sappan* L. Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%	200 grm	200 grm cotton100%	300 grm	300 grm cotton50%	300 grm cotton100%
	Ethanol					water				
L	71.52	59.73	55.08	53.78	56.00	89.03	85.13	87.48	85.50	80.10
a	37.28	43.93	34.18	42.18	45.20	7.80	5.30	8.30	8.30	9.23
b	41.73	30.78	25.93	33.30	41.90	12.30	12.60	8.98	12.25	14.05

Figure 12 shows the comparison of different colour values from the extraction of *Caesalpinia sappan* L. in the first week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 45.20 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 9.23 on 300 gsm Cotton 100% paper.

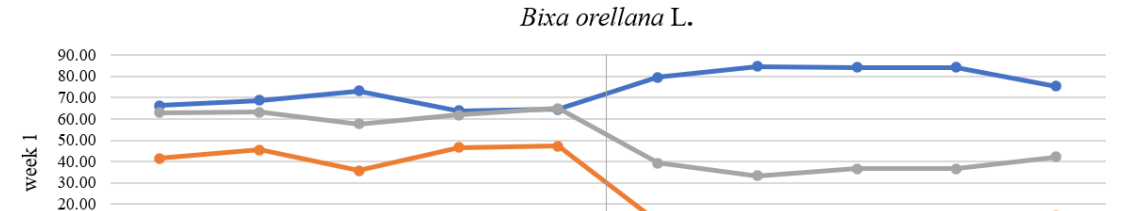


	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	66.70	53.60	52.50	48.70	55.40	87.60	85.70	89.00	82.00	81.50
a	36.60	36.60	31.20	39.40	42.50	6.20	4.50	4.90	6.10	7.00
b	40.60	28.60	25.40	26.80	38.40	14.10	14.90	13.60	16.00	16.80

Figure 13 shows the comparison of different colour values from the extraction of *Caesalpinia sappan* L. in the twenty-forth week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 42.50 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 7.00 on 300 gsm Cotton 100% paper.

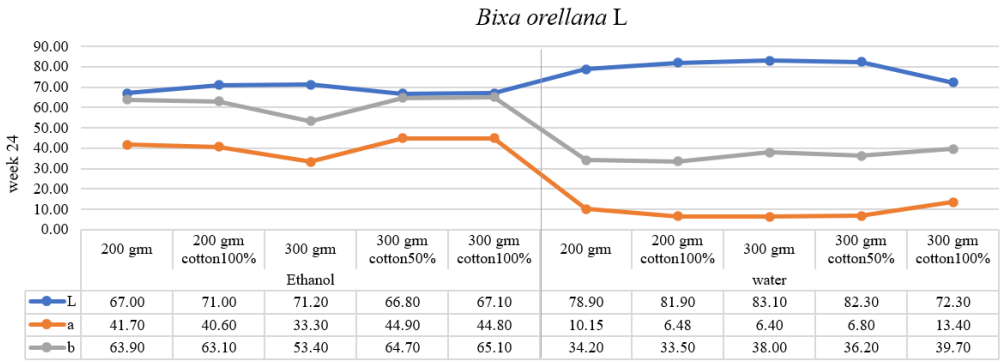
Table 6 Red colour group comprising *Bixa orellana* L. extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	*Bixa orellana* L.				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	66.35	68.70	73.25	63.93	64.55	79.65	84.60	84.23	84.23	75.38
a	41.58	45.55	35.75	46.68	47.30	11.63	7.10	8.80	8.57	14.55
b	62.95	63.28	57.78	61.95	65.10	39.25	33.28	36.63	36.62	42.23

Figure 14 shows the comparison of different colour values from the extraction of *Bixa orellana* L.in the first week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 47.30 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at 14.55 on 300 gsm Cotton 100% paper.



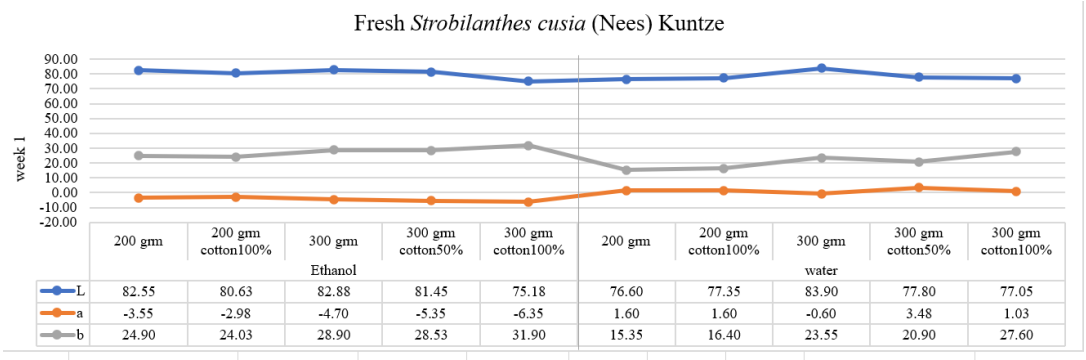
	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	67.00	71.00	71.20	66.80	67.10	78.90	81.90	83.10	82.30	72.30
a	41.70	40.60	33.30	44.90	44.80	10.15	6.48	6.40	6.80	13.40
b	63.90	63.10	53.40	64.70	65.10	34.20	33.50	38.00	36.20	39.70

Figure 15 shows the comparison of different colour values from the extraction of *Bixa orellana* L.
in the twenty-forth week. It is found that +a value in red shade from the extraction by ethanol provides the highest value at 44.90 on 300 gsm Cotton 50% paper and the extraction by water provides the highest value at 13. on 300 gsm Cotton 100% paper.

Each kind of plant produced differences in colours as shown on Table 7 Table 8 and Table 9. As observed, extraction with ethanol and water provided a light blue colour and blue colour from Fresh *Strobilanthes cusia* (Nees) Kuntze ,*Clitoria ternatea* L. and Fermented *Strobilanthes cusia* (Nees)

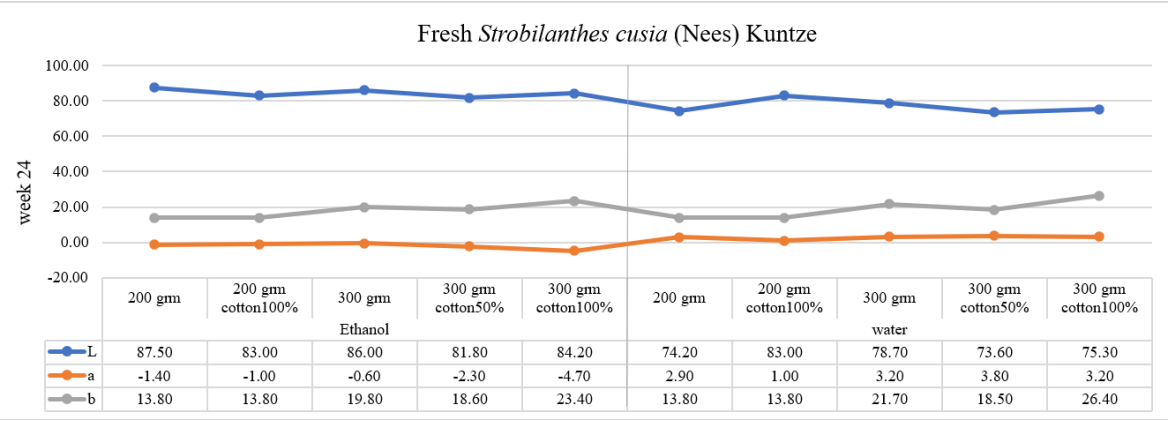
Table 7 The blue colour group comprising Fresh *Strobilanthes cusia* (Nees) Kuntze, extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	Fresh *Strobilanthes cusia* (Nees) Kuntze				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	82.55	80.63	82.88	81.45	75.18	76.60	77.35	83.90	77.80	77.05
a	-3.55	-2.98	-4.70	-5.35	-6.35	1.60	1.60	-0.60	3.48	1.03
b	24.90	24.03	28.90	28.53	31.90	15.35	16.40	23.55	20.90	27.60

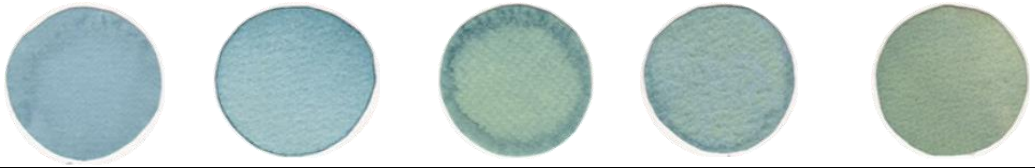
Figure 16 shows the comparison of different colour values from the extraction of Fresh *Strobilanthes cusia* (Nees) Kuntze in the first week The -b value in blue shade is not found in both extraction by ethanol and water.

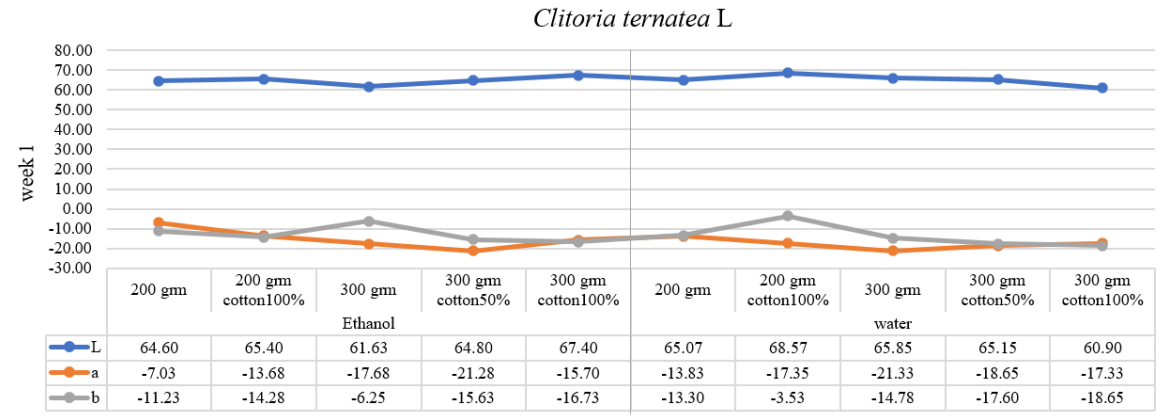


	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	87.50	83.00	86.00	81.80	84.20	74.20	83.00	78.70	73.60	75.30
a	-1.40	-1.00	-0.60	-2.30	-4.70	2.90	1.00	3.20	3.80	3.20
b	13.80	13.80	19.80	18.60	23.40	13.80	13.80	21.70	18.50	26.40

Figure 17 shows the comparison of different colour values from the extraction of Fresh *Strobilanthes cusia* (Nees) Kuntze in the twenty-forth week. The -b value in blue shade is not found in both extraction by ethanol and water.

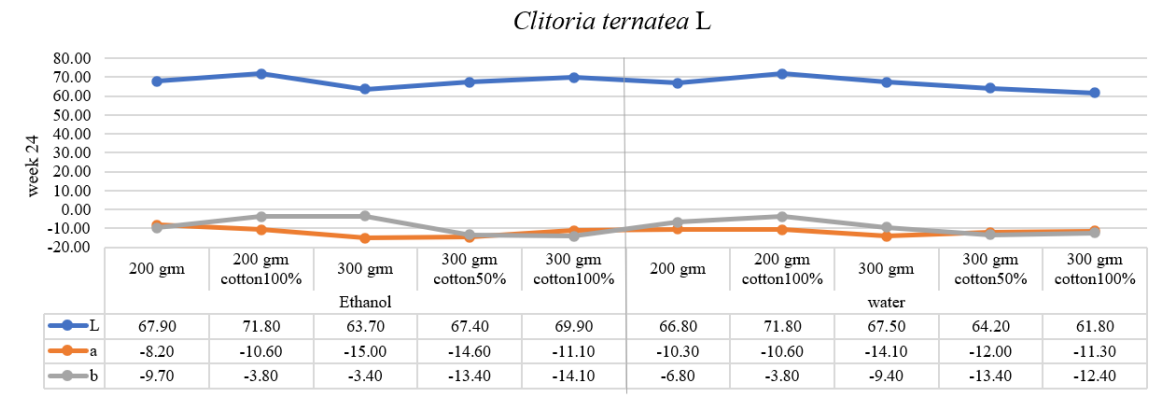
Table 8 Blue colour group comprising, Clitoria ternatea L extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

	Clitoria ternatea L				
extracted	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	64.60	65.40	61.63	64.80	67.40	65.07	68.57	65.85	65.15	60.90
a	-7.03	-13.68	-17.68	-21.28	-15.70	-13.83	-17.35	-21.33	-18.65	-17.33
b	-11.23	-14.28	-6.25	-15.63	-16.73	-13.30	-3.53	-14.78	-17.60	-18.65

Figure 18 shows the comparison of different colour values from the extraction of *Clitoria ternatea* L. in the first week. It is found that -b value in blue shade from the extraction by ethanol provides the highest value at -16.73 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at -18.65 on 300 gsm Cotton 100% paper.

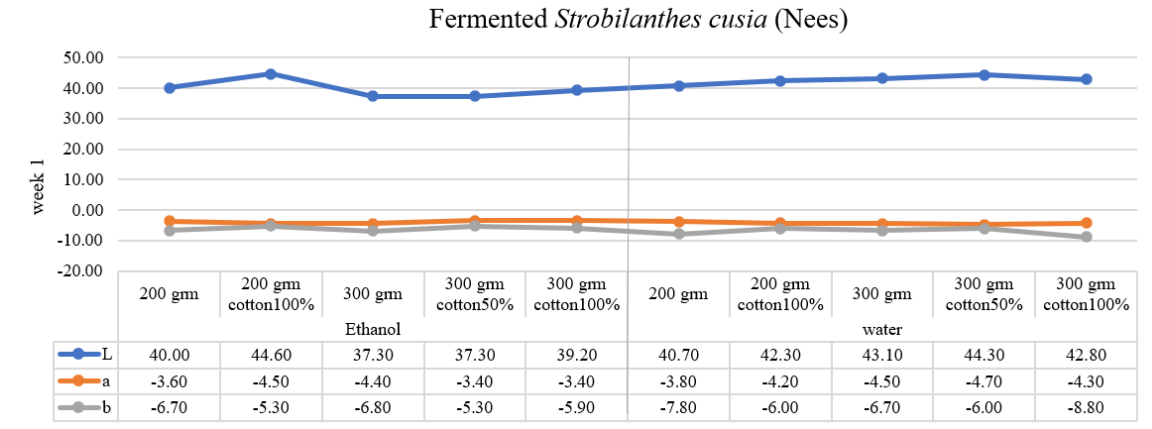


	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	67.90	71.80	63.70	67.40	69.90	66.80	71.80	67.50	64.20	61.80
a	-8.20	-10.60	-15.00	-14.60	-11.10	-10.30	-10.60	-14.10	-12.00	-11.30
b	-9.70	-3.80	-3.40	-13.40	-14.10	-6.80	-3.80	-9.40	-13.40	-12.40

Figure 19 shows the comparison of different colour values from the extraction of *Clitoria ternatea* L. in the twenty-forth week. It is found that -b value in blue shade from the extraction by ethanol provides the highest value at -14.10 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at -13.40 on 300 gsm Cotton 50% paper.

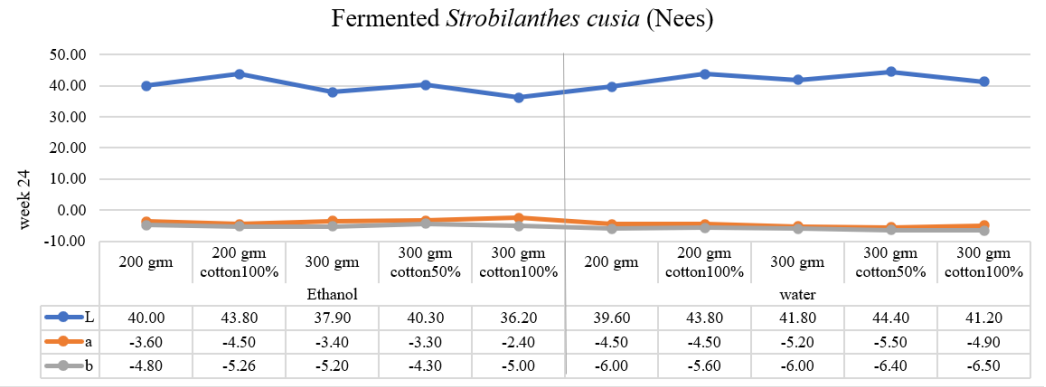
Table 9 Blue colour group Fermented Strobilanthes cusia (Nees) Kuntze extracted with ethanol and water solvents, on 5 different types (gsm) of paper.

extracted	Fermented *Strobilanthes cusia* (Nees)				
	Paper				
	200 gsm	200 gsm Cotton 100 %	300 gsm	300 gsm Cotton50 %	300gsm Cotton 100%
Ethanol					
Water					



	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	40.00	44.60	37.30	37.30	39.20	40.70	42.30	43.10	44.30	42.80
a	-3.60	-4.50	-4.40	-3.40	-3.40	-3.80	-4.20	-4.50	-4.70	-4.30
b	-6.70	-5.30	-6.80	-5.30	-5.90	-7.80	-6.00	-6.70	-6.00	-8.80

Figure 20 shows the comparison of different colour values from the extraction of Fermented *Strobilanthes cusia* (Nees) in the first week. It is found that -b value in blue shade from the extraction by ethanol provides the highest value at -6.80 on 300 gsm paper and the extraction by water provides the highest value at -8.80 on 300 gsm Cotton 100% paper.



	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%	200 gm	200 gm cotton100%	300 gm	300 gm cotton50%	300 gm cotton100%
	Ethanol					water				
L	40.00	43.80	37.90	40.30	36.20	39.60	43.80	41.80	44.40	41.20
a	-3.60	-4.50	-3.40	-3.30	-2.40	-4.50	-4.50	-5.20	-5.50	-4.90
b	-4.80	-5.26	-5.20	-4.30	-5.00	-6.00	-5.60	-6.00	-6.40	-6.50

Figure 21 shows the comparison of different colour values from the extraction of Fermented *Strobilanthes cusia* (Nees) in the twenty-forth week. It is found that -b value in blue shade from the extraction by ethanol provides the highest value at -5.00 on 300 gsm Cotton 100% paper and the extraction by water provides the highest value at -6.50 on 300 gsm Cotton 100% paper.

Conclusion and Suggestions

The present research compared colour extraction from plants to be used in painting works, compared among colours extracted from different kinds of plants using different solvents, and also compared the fastness of colours on different types of paper. The researcher extracted 3 colour groups from different kinds of plants including Yellow: Gardenia jasminoides J.Ellis (fruits), Coscinium fenestratum (Goetgh) Colebr (climbers), Nelumbo nucifera Gaertn (pollen); Red: Smilax corbularia Kunth (rootstocks), Caesalpinia sappan L. (heartwood), Bixa orellana L. (seeds), and Blue: Fresh Strobilanthes cusia (Nees) Kuntze (fresh leaves and branches), Clitoria ternatea L. (flowers), Fermented Strobilanthes cusia (Nees) Kuntze. Ethanol and water were used as solvents. The results indicated the following. In the yellow colour group, Coscinium fenestratum (Goetgh) Colebr in ethanol and water solvents produced the highest luminance - L* and: Gardenia jasminoides J.Ellis in ethanol solvent produced colour coefficients of +b* which was highest in the yellow colour group. In the red colour group, Smilax corbularia Kunth in the ethanol solvent produced the highest luminance - L* and Bixa orellana L. in ethanol solvent produced the colour coefficient of +a* which was highest in the red colour group. In the blue colour group, Fresh Strobilanthes cusia (Nees) Kuntze in ethanol and water solvents produced highest luminance - L* and Clitoria ternatea L. in water solvent produced a colour coefficient of -b* which was higher than in the ethanol solvent and highest in blue colour group. With water solvent, Fresh Strobilanthes cusia (Nees) Kuntze produced highest luminance - L*.

Figure 22 depict the fadedness of artwork using ethanol extracted colours.

After the comparison of colour value, it is found that the following 3 plants provide the highest colour value on 300 gsm Cotton 100% paper. Gardenia jasminoides J.Ellis in ethanol provides the highest b* value at 81.73 in the yellow group. Bixa orellana L. in ethanol provides the highest b* value at 47.30 in red group. Clitoria ternatea L. in water provides the highest -b* value at -18.65 in blue group. However, the aforementioned colours have to be reconsidered for painting because some colours are sticky and hard to dissolve in water. (Narongdecha & Soodsang, 2021) The fruits of Gardenia jasminoides J.Ellis provide the highest yellow colour value. However, when it was used in painting, it has the highest fadedness in terms of colour value after 2 years passed. Besides, it is found that the extracted colour from the fruits of Gardenia jasminoides J.Ellis colouring on 2 types of paper is viscous and takes a long time to dry. Thus, this could make different kinds of stain both in painting and on other kinds of artwork.

For the recommendation, natural colour extraction could be developed for screen inks in the works of Trirat (2017) regarding the development of screen inks from natural mordant by using banana sap, papaya latex, and rubber latex to examine the mordant with the best durability on the material. The usage of natural mordant and colorant is how effective the natural resources are used and how to reduce pollution as well as being eco-friendly. The plant extraction is a spotlight of interest and study. Besides, the aforementioned process initially plays an important role. Even though the usage of plants is also a part of plant and forest destruction, the process also saves the balance of nature. This is because the clear results from the extraction of plants comes out with the benefit of plants, the principal chemical substances, and the portion of plants used appropriately. This is also in accordance with the study of Sathaporn (2012) regarding the creation of printmaking art with natural dyes from plants in Nakhon Si Thammarat Province. This also shows artwork production according to local wisdom. With the process of printmaking art, natural colours are blended with fresh rubber latex and Cassave Starch. Then, these will be tested with natural mordants including the water of Garcinia, red lime, ashes, alum and fresh water. Thus, my study of colours extracted from various plants with unlike extraction provided different colours for the comparison of colour value on the 5 types of water-coloured paper is beneficial especially in the field of artwork as painting because of their fair colouring and safety toward painters. Even though the fastness of plant extracted colours could not be compared and replaced to the entire chemical colours, this is unique attraction of mentioned colour used in painting and could be an alternative for further study, experiment, and development of these in advanced quality. (Narongdecha & Soodsang, 2019) In terms of the eco-friendly approach and the creation of artwork with different patterns, this aforementioned colour is easy and safe to use, as well as convenient to experiment with for research purposes. Additionally, the results also confirm the artist's interest regarding the value of art made with various plants because they stimulate the economy of natural resources in local areas. Moreover, exploring new kinds of hues leads to the discovery of colour making from the best plants for use in future art painting. Besides, this is also an advantage in terms of the natural usage and effects on the development of a human being's life which affiliates with the natural environment as well as raising the awareness of plant conservation.

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Font Design to Promote Thai Identity

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Abstract

This study on font design reflecting the identity of Thai-ness was aimed to: 1) design Thai fonts that reflect Thai identity; and 2) explore the opinion of designers of font types. This font design focused on applying Laai Thai (Thai patterns). The opinions of 30 designers and users were sought and analysed statistically. Statistics used are percentage, mean, and standard deviation.

A summary result of the evaluation on the quality of fonts in the aspects of utility, uniqueness, and Thai identity are reported to be at a high level overall. Individuals reported that Thai identity was found at the highest level. Other opinions included the attractiveness of the design, the design having Thai identity, offering diverse uses, the font sizes being easily readable and the applicability and readability of the designs in various media.

Keywords: Journal format, Printing, References

Introduction

Each particular society differs in culture. Cultural heritage covers ideals, traditions, arts, architecture and social values. Culture partly determines the behavioural patterns of people in a particular community. Arts and culture come from the developments and values that reflect the profound core of that society. Those arts and culture well represent the social situation, background, living and economic conditions at a certain period of time. It has to say that Thailand is fortunate to possess interestingly diverse cultures and different identities.

The cultural heritage and natural history of a nation are precious and unique. The security of cultural heritage relies on a solid foundation which includes cultural sites, old buildings, and temples, landmarks of cultural and historical significance. Culture and history reflect the development of morals, beliefs, and aims that create the national identity of the people. It is imperative to keep our cultural heritage to preserve our identity as a nation. The value of cultural heritage is less on cultural expression and more on the experience and skills accumulated over generations (The Language Doctors, 2012). Identity refers to the collectively of distinctive features of something that makes it known or recognized. Each society has its own cultural identity. Globalization affects identity changes and expression in Thai society (Office of the Royal Society, 2007).

Characters or alphabets were first invented in the Great Era 1205 (B.E. 1826) by King Ramkhamhaeng the Great and were called Laai Seu Thai or Thai letters. At that time the Thai nation had accumulated knowledge in the arts and culture, and academics and had successively passed on the knowledge through the use of Laai Seu Thai. King Ramkhamhaeng the Great invented Laai Seu Thai and stone inscriptions and chronicles remain as evidence of his work (Prasert Na Nakhon, 2003). Letters are used by people as visual symbols to create perception and interpretation in a systemic way. They were used to express feelings, thoughts and human knowledge and help spread those thoughts and

knowledge to others over distances and maintain those thoughts and knowledge for future generations in various media formats containing letters, language characters, messages, and symbols. Letters provide detailed information about things that are meant as shared communication. They bring about the aesthetic value of the arts along with mental aesthetics as well (Ptachis Tinnabutr, 1988).

Today, a wide variety of media are used in communication. Letters are essential to written communication as they are used to build written words which are used in an almost infinite variety of combinations to create messages for communication. The importance of a message sent from a messenger is to act as a stimulus for the recipient to perceive meaning and respond. It is not only print media that contains letters as components, modern media acts more in sending invisible messages. Various shapes and forms of the font itself can trigger responses independently of the spelled words and before reading as they stimulate the imagination, emotions, memories, and connect to all the senses of readers to automatically perceive attributes from the physical world (Simon Garfield, 2011)

Objectives

1. To design a font set to promote Thai cultural identity.
2. To explore the opinions of producers and users of media with fonts as components.

Conceptual Framework

The design of fonts uses Laai Thai as a component.

Procedures

The following procedures formed part of the design of fonts to promote Thai cultural identity.

1. Explore and compile documents, concepts, and research pertaining to font design, Thai culture, and concepts about media design with fonts as components, and designs that reflect Thai cultural identity.

2. Analyse the data to determine font design and concepts applicable in promoting Thai cultural identity.

3. Design fonts and seek comments from design experts of Thai identity, create, revise according to their suggestions, and proceed to design fonts with the aid of a computer program.

Font design steps

1) Sketch fonts on paper, scan and draw using Adobe Illustrator.

2) Enter the font draft into the computer with Fontlab studio.

3) Operational procedures

Phase 1 Planning (Pre- Production)

1. Study font designs and the art of each historical period to guide font design.

2. Sketch out fonts and typeface and draw them using a drawing program, and import them to develop fonts, using the following steps.

Step 1 Download a grid template for font handwriting, print and write the letters

Step 2 in grids.

Step 3 Scan the images written on the computer.

Step 4 Open the scanned file in Photoshop, select the Crop Tool to crop the desired font, and go to Select > Colour Range, select white space, press OK and Ctrl + Shift + I, and then press Ctrl + x to cut the font structure out.

Step 5 Input the fonts onto Font Creator with an opening of the selected file to be edited which is font AAA-Watin-new, then modify, reduce-enlarge the font to the desired size and type. Complete all the fonts according to the Unicode character code chart for Thai characters.

Step 6 Once completing all of the fonts, check the gaps and spaces of letters by pressing F5, and try typing different texts.

3. Design media by using the designed fonts in the title of the design work, and then seek the opinions of others.

4. Explore the opinions of 30 purposively selected media design experts using a 5-point rating scale (Likert scale) questionnaire and conclude the opinions.

5. Try out, among 30 purposively selected students who enrolled in the print design course and use the usability assessment form.

Research Result

1. Font Design

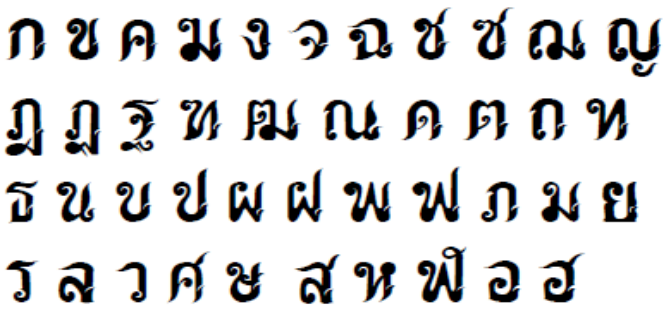

Figure 1 Font set “Tossakan”

2. Opinions of design experts and design students

Table 1 the result of the opinions of design experts and design students

List	Experts		Design Students		Total	Interpretation
	x	sd	x	sd	x	
Utility	4.30	0.56	4.50	0.76	4.40	High
Uniqueness	4.45	0.75	4.45	0.55	4.45	High
Thai identity	4.55	0.45	4.65	0.65	4.60	Highest
Total	4.43		4.53		4.48	High

Table 1 shows that the sample of both experts and design students similarly reported the highest level of opinion on Thai identity, followed by uniqueness, and utility, respectively.

3. Printing Media Design

Figure 2 Fonts from Canva Program

Figure 3 Fonts in the design of Thai tourism sites

Figure 4 Fonts in the design of Thai restaurants

Figure 5 Fonts in the design of Thai dessert shops

Discussion

The results of font design to promote Thai cultural identity was based on the design concept and study of Thai culture from which Laai Thai was adopted for font design. It accords to Putharet Phomdee (2014) suggesting that Laai Thai is a heritage that has been passed down over many generations (*c*725 years) to the present day. It is the craft of the arts that represents the uniqueness of Thai-ness and faith in Buddhism. These inspire artists to invent Laai Thai with ideas acquired from lotus flowers, garlands, and incense smoke and candle flames to create numerous patterns namely Kanok, Pleaw Plurng, Baited, and floral patterns, for example. Laai Thai is regarded as an outstanding part of the arts such as those metal embossed, pearl inlaid, niello, and enamel work, all with different patterns and created from Laai Thai.

The art of Laai Thai images is a legacy that has been passed down from our ancestors and continues to develop to this day. Such development is on the basis of Thai-ness as characterized by delicacy, gentleness and a love of beauty that has long been maintained as part of Thai society, thus making Thai art refined and soft. According to historical evidence, Laai Thai has been part of Thai art since the Chiang Saen period and inherited from the Sukhothai, Ayutthaya and Rattanakosin periods. In former times, artists were found only in temples but they later offered themselves to serve the King and were called "Chang Luang" (court artisans) or "Chang Sib Mu" (10 groups of artisans). At present, other than inheriting knowledge from such artists, various educational institutions have been extensively promoted and encouraged to offer education in this area (Sanay Luangsoonthorn, 1999). Applying Laai Thai in font design for print media suggested that the Thai identity can be conveyed by components of Laai Thai as a design concept, and it is also applicable to the design of other media intended to present Thai-ness.

Recommendations

In this study, the design procedures and fonts development were time consuming, it is therefore recommended that designers should define the concept and design fonts that stand out and are attractive when used in designs. Further studies should be developed for other creative fonts design and applications either preservation or commercial purposes.

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