Examining Child Multitouch Screen Interaction Model: A Causal Effect Analysis

TzeHui Liew[1*], SiongHoe Lau[2], Hishamuddin Ismail[3]

[1,2]Faculty of Information Science & Technology, Multimedia University, Melaka, Malaysia

[3]Faculty of Business, Multimedia University, Melaka, Malaysia: E-mail: thliew@mmu.edu.my

Abstracts: Continual technological innovation, especially in educational technology for pre-school education, has led to a boom in new interaction characteristics in Child-Computer Interaction (CCI) research. The problem of limited screen sizes as a display and input device poses a design challenge that remains unanswered. Research with pre-school children requires careful attention to suitable methods, designs, and child-friendly models. The Child-Oriented TAM model has been adapted, and two new independent variables, namely screen size (SCS) and object size (OBS), were proposed for this study to gather feedback from children on their interaction satisfaction with multitouch screens. This study aims to validate the relationship between the variables of Perceived Usefulness (PU), Perceived Ease of Use (PEOU), screen size (SCS), object size (OBS), and Satisfaction (SATIS) in pre-school children's interaction with multitouch screens, and to test the moderating effects of age on this relationship. The findings of this study confirm that pre-school children's satisfaction with multitouch screen interaction is determined by screen size and moderated by age. Pre-school educators, parents, and researchers can now have a better understanding of how screen size may affect children's ability to interact with multitouch screens.

Keywords: Child-Computer Interaction, Screen Size, Object Size, Child-Oriented TAM model, Multitouch Screen.

1. INTRODUCTION

Multitouch screen is now ubiquitous in a connected world, and their existence cannot be ignored. However, what is most important concerns for pre-school children is that their interactions with multitouch screens may harm their healthy growth and development (Huang et al., 2021; McNeill et al., 2021). Additionally, Kumruangrit et al. (2022) documented that screen usage led to problems such as eye inflammation, excessive tearing, burning eyes, and eye pain among younger children. Therefore, the question now is how pre-school children can harness the positive aspects of multitouch screen technology. Woodward et al. (2017) explored the effect of screen size on young children and found that larger screens did not lead to significant differences in comprehension, but there were individual differences in children's preferences for screen size. Further, Yadav et al. (2021) examined the impact of screen size on children's performance for a search task on touchscreen tablets. The results suggested that screen size has a significant effect on various aspects of children's performance; however, the effects may vary depending on individual differences, task demands, and other factors such as input mechanisms. Several Previous studies have indicated the need for further research to comprehensively comprehend the underlying mechanisms and determine optimal screen sizes for effective child-computer interaction (Raptis et al., 2013; Botella et al., 2014; Woodward et al., 2017; Soni et al., 2019). However, these studies have not yet been conceptualized into an interaction model to evaluate the usability metrics of child multitouch screen interactions. Previous researchers have also acknowledged the critical need to design a comprehensive multitouch screen interaction model and recommendations for young children with different characteristics (e.g., age, experience) (Xie et al., 2018; Soni et al., 2019).

The multitouch screen will continue to be integrated into children's lives. Therefore, the research methodology and evaluation model need to be expanded in order to assess the use of multitouch screens as a part of children's daily activities at home, school, or during playtime. These design trends emphasize on the importance of bridging the gap in practice when it comes to supporting pre-school children's interaction needs with multitouch screens. Failure to address this gap through the development of an appropriate evaluation model may prevent children from engaging positively with multitouch screens and, in the worst case, hinder their development by overlooking opportunities offered by new technology (Soniet al., 2019).

In this study, the 21.5” all-in-one PC and a 10.1” Asus’s tablet had been employed as multitouch screens. A Child-based TAM model with add on of screen size and object size was developed to gain an insight into the interrelationship among the variables that are proposed for this study to explain satisfaction of child-multitouch screen interaction.

2. LITERATURE REVIEW

According to previous studies, multitouch technology has become prevalent in many Malaysian schools, and technological devices such as Tablet PCs, interactive whiteboards, and e-books have been embraced by pre-school children for educational purposes (Rahim & Bakar, 2014). Multiple empirical studies have consistently shown that multitouch screens have a beneficial effect on the learning performance of pre-school children. These studies include works by Huber et al. (2016), Wang et al. (2016), and Furman et al. (2018). However, other studies conducted by Piotrowski & Krcmar (2017) and Zipke (2017) have raised doubts about the educational benefits of multitouch screens for pre-school children. Furthermore, some studies have revealed that touchscreen learning can adversely affect the performance of pre-schoolchildren (Huber et al., 2016). The varied results mentioned above suggest that not all instances of multitouch screen usage led to improved cognitive processing (Wang et al., 2016). One possible explanation for this could be the presence of certain factors that impact the satisfaction of such interactions. To date, numerous studies have been carried out to understand the factors that affect the satisfaction of pre-school children’s interaction with multitouch screens, for pre-school children under 6 years old, with variations in the participants' characteristics, specifically in terms of their age and experience (Xie et al., 2018).

2.1. Screen Size

Pre-school children now have access to interactive content, learning materials, and games at their fingertips, which appear more natural and realistic than ever. However, these advancements also pose new challenges for child-computer interaction. Therefore, it is crucial for us to consider the potential effects of screen size on child-computer interaction from the children's perspective. According to Kim et al. (2011), participants tend to experience greater enjoyment with larger screens, while smaller screens are associated with a higher perception of mobility. It is believed that larger screen sizes provide a greater sensory richness, offering users a more authentic and lifelike experience compared to smaller screens (Kim et al., 2011). Woodward et al. (2017) explored the impact of screen size on children's comprehension of digital storybooks. They found that larger screens did not result in significant differences in comprehension, but individual preferences for screen size varied among children. Additionally, the study examined how the size of the screen influenced children's performance in a search task conducted on touch screen tablets, tabletops, and smartphones. The findings revealed that larger screens were associated with faster task completion times and fewer errors. Previous literature suggests that screen size can significantly affect various aspects of child-computer interaction, including attention, engagement, performance, and learning outcomes (Park et al., 2016). However, the effects may vary depending on individual differences, task demands, and other factors such as input device and disability status. While larger screens may be beneficial for certain tasks and populations, further research is needed to fully understand the underlying mechanisms and optimize screen size for child-computer interaction (Raptis et al., 2013; Botella et al., 2014; Woodward et al., 2017). The existing findings indicates that the size of the screen might have a potential influence on the satisfaction of young children’s interaction with multitouch screens. This study specifically aims to demonstrate that a deeper understanding of pre-school children's satisfaction in interacting with multitouch screens can be achieved by examining the effects of screen size.

2.2. Object Size

Previous studies have confirmed that pre-school children exhibit lower accuracy when tapping on screen objects. These studies consistently reveal that preschool children exhibit less precision across all target sizes, with particularly low accuracy when interacting with the smallest objects (Woodward et al., 2017; Anthony, 2019). It is commonly known that users interact with interactive technology by manipulating the finger. The results of this study challenge the notion of the "fat finger" problem that has been previously suggested in research on mobile touchscreen interfaces. The "fat finger" theory suggests that children's smaller fingers make them more accurate at touching smaller objects on a screen. However, thefindings by Woodward et al. (2017) and Anthony (2019) do not support this idea.

It has also been observed that the size of objects is designed in proportion to the screen size. Generally, objects intended for larger screens are typically larger in size compared to those designed for smaller screens (Windows Development Center, 2016). Previous study had also indicated that the design of big and noticeable objects for interactive technology was relatively an advantage for pre-schoolchildren (Liu et al., 2015). Prior research has demonstrated a significant correlation between target size and user errors, performance, and satisfaction. Parhi et al. (2006) discovered in their study that as the target size increases, user errors decrease. Additionally, Park et al. (2008) reported that users were more satisfied with larger target sizes and their performance improved compared to smaller sizes (Parhi et al., 2006; Park et al., 2008). Both studies have highlighted the close relationship between target size, touch accuracy, and user satisfaction.

2.3. Technology Acceptance Model (TAM)

The Technology Acceptance Model, also known as TAM (Davis, 1989), is widely recognized in technology acceptance research for its simplicity and accurate prediction of outcomes. Previous research has demonstrated that perceived ease of use and perceived usefulness are the primary factors influencing individuals' attitudes and intentions to use technology (Davis, 1989; Mou et al., 2017). The use of the Technology Acceptance Model (TAM) in child-computer interaction research is relatively limited compared to its application in studies on adult technology acceptance. However, the TAM model has been utilized to investigate the factors influencing children's acceptance of educational software. It was found that perceived usefulness and perceived ease of use were significant predictors of children's behavioral intention and acceptance of e-books (Elyazgi et al., 2016). The study also revealed that perceived usefulness, perceived ease of use, and attitude towards using e-books were all significant predictors of children's intention to use. Furthermore, TAM was employed in research examining the acceptance of mobile educational applications among young children. The findings indicated that both perceived usefulness and perceived ease of use significantly predicted children's intention to use the applications, and that age played a moderating role in the relationship between perceived usefulness and intention to use (Papadakis et al., 2017).

In this study, the researcher had employed TAM model with 3 variables, and add on with two (2) new variables namely screen size and object size. The used of this model had been verified by the pre-school teachers and children during the cognitive interview session. Both the teachers and children clearly stated their preference for something simple and easy to understand, in line with the guidelines suggested by Read (2008). Regarding the questionnaire, pre-school children and teachers preferred short, simple, and child-friendly questions that were easy to understand. They expressed a preference for a smaller number of questions, unlike the UTAUT model.

2.4. Satisfaction

Satisfaction is described as the perceptions and responses of users or pre-school children derived from their interaction with an information technology, specifically the multitouch screen in this study. Satisfaction also arises from the children's internal and physical conditions, which are influenced by their past experiences, attitudes, capabilities, age, and the circumstances in which the multitouch screen isbeing tested (ISO 9241-210:2019, 2019). In this study, satisfaction refers to the extent to which the children's physical, cognitive, and emotional responses resulting from their interaction with the multitouch screen meet their needs and expectations (ISO 9241-11:2018, 2018). Therefore, in this study, satisfaction is defined as the consequences and responses that arise from the self-reporting of the use of an interactive system, specifically the multitouch screen.

2.5. Child-Computer Interaction

Child-computer interaction (CCI) is a rapidly evolving field that focuses on the design, development, and evaluation of interactive technologies for children. This interdisciplinary field brings together researchers from various disciplines, including computer science, education, and psychology, to investigate the effective utilization of technology in enhancing children's learning, play, and social interaction (Lehnert et al., 2022). In the past many years, certain significant findings have been questioned due to advancement in technology and the changes in children's technology proficiency (Lehnert et al., 2022; Woodward et al.,2017).

Children possess unique cognitive and social abilities that may require different approaches to interaction design compared to those used for adults (Tsvyatkova & Storni, 2019). To address this challenge, researchers have developed a range of evaluation methods specifically tailored to children's needs and abilities, including observation, interviews, and focus groups. Soni et al. (2019) highlight the potential of technology as a valuable tool in supporting children's learning, but it must be carefully designed to ensure effectiveness and engagement. To these circumstances, another major research gap in CCI is the need for more comprehensive understanding of the influencing factors on children's technologyadoption and use. As children continue to engage with technology at younger ages, it is essential to design technologies that are suitable for their cognitive and developmental abilities. Additionally, there is a need for further research aimed at designing and assessing child-computer interaction (CCI) tailored to children from various cultural backgrounds, as cultural factors can significantly influence children's attitudes and behaviors towards technology (Tsvyatkova & Storni, 2019).

Overall, these research gaps emphasize the ongoing need for exploration and innovation to design and evaluate technology in a manner that addresses the unique needs, perspectives, and well-being of children, as proposed in this study.

3. RESEARCH METHODOLOGY

This study proposed a Child-Oriented TAM Model to explain the factors that influence children's satisfaction when interacting with two different sizes of multitouch screens, namely a 21.5-inch all-in-onePC and a 10.1-inch Asus tablet.

3.1. Population and Sampling

In this study, sampling is necessary due to the large population size. Hair et al. (2019) defines a sample as a group of more than two individuals who share common characteristics with the overall population. Sekaran & Bougie (2016) defines a sample as a portion of the population, which is relatively uniform and can be representative of the population. According to (Taherdoost, 2016), convenience sampling is a non-probability sampling technique that involves selecting participants who are easily and readily available. This approach is favored by the researchers because it is less expensive and complex compared to other sampling methods and can overcome various limitations associated with research.

3.2. Sample Size

In statistical analysis, the sample size is a crucial factor that has a significant impact on the reliability and validity of parameter estimates, statistical power, and R-square (Hair et al., 2019). The choice of sample size often depends on the type of analysis being conducted. In this study, the researcher selected 103 preschool children who participated in the study on a voluntary basis with verbal consent from their parents. G-power analysis was used to confirm the sample size for this study, which recommended a total of 98 sets of responses, considering the six predictors, including four independent variables and two moderating variables.

3.3. Child-Oriented TAM Model

The Child-Oriented TAM model is proposed to provide insights into the interrelationship among the variables proposed for this research in explaining satisfaction in child multitouch screen interaction. The proposed Child-Oriented TAM Model is categorized as below.

Children The TAM model with add on of 2 new variables, namely Screen size (SCS) and Object size (OBS) has been adapted to understand the factors that actually influence the satisfaction of children's multitouch screen interaction. Satisfaction is described as an actual or self-reported usage, gathered through cognitive interview survey questionnaires. This study employed two types of multitouch screen, namely 21.5' all-in-one PC and 10.1' Asus tablet.

Based on the proposed model exhibited in Figure 1, the following hypothesis have been developed:

H1: Perceived Usefulness (PU) has positive relationship with satisfaction (SATIS).

H2: Perceived Ease of Use (PEOU) has positive relationship with satisfaction (SATIS).

H3: Screen Size (SCS) has a positive relationship with satisfaction (SATIS).

H4: Object Size (OBS) has a positive relationship with satisfaction (SATIS).

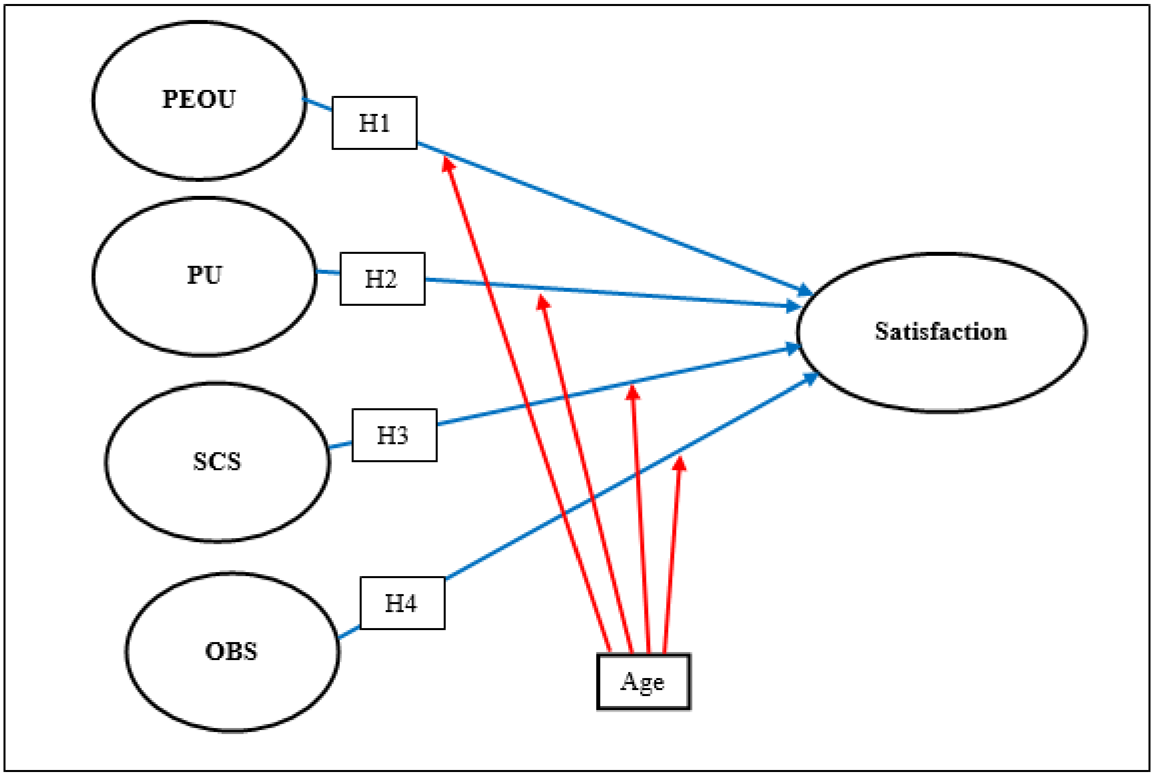

Fig 1: The Proposed Child-Oriented TAM Model

3.4. Data Collection

Data collection for this study occurred once all the children had finished their interactions with the multitouch screens. Cognitive interview methods were utilized in conjunction with the Smiley meter to facilitate the questionnaire survey. To enhance ease of completion, the questionnaire was divided into distinct sections. Furthermore, a Likert scale was utilized, comprising five response levels ranging from"1 - Strongly Disagree" to "5 - Strongly Agree."

To ensure the easy comprehension of the questions by the pre-school children, the researcher provided additional explanations and simplified the language in "children slang". Next, the researcher placed the smiley rating on the white board and let the children chose based on their emotional feeling. Based on the children's response, the researcher than recorded down all the data, and transferred these data into the excel form. The children were requested to express their interaction satisfaction using the Smiley meter, as depicted in Figure 2, to indicate their actual feelings. Smiley Face Likert's (SFL) have a long history of use as a measure of children's experiences in the use of multitouch screen (Read, 2008).

Fig. 2: Smiley Meter

3.5. Analysis Techniques

Descriptive analysis is a statistical technique employed to categorize and summarize primary data in a manner that is readily comprehensible. Frequency distribution is useful in generating statistics and meaningful graphic displays that help researchers interpret the data obtained from respondents.

Reliability testing is a statistical technique utilized to ensure that measurements are consistent and not influenced by errors that may affect study results. Cronbach's coefficient alpha (α), which ranges from 0 to 1, will be used in this study to evaluate the consistency of measurements through the internal consistency test. Alpha value above 0.6 is deemed reliable, while alpha value below 0.6 is considered unsatisfactory and will not be used for further analysis (Lian & Yen, 2014).

Factor analysis is often used as an exploratory tool to gain insights into the underlying structure of a data set. It is primarily employed in data exploration, aiming to understand the newly introduced variables, namely screen size and object size, and uncover the underlying structure. Therefore, this study utilizes factor analysis to establish construct validity. Discriminant validity refers to the degree to which the factors in a model are genuinely separate and distinct from other factors. The Bartlett's Test of Sphericity and the Kaiser-Meyer-Oklin (KMO) with the minimum threshold of 0.6 is utilized for this study (Kaiser, 1974). Further, the cross-loading criterion (Hair et al., 2019) and Heterotrait-Monotrait ratio of correlations (HTMT) were tested for factor analysis.

Multiple Linear Regression is a statistical technique used to explore the impact of one or more predictor variables on a dependent variable, which is the outcome variable. It enables us to make predictions about how well one or more independent variables will predict the value of the dependent variable. The multiple linear regression technique assists in assessing the correlation between the independent and dependent variables, along with assessing the strength and direction of that relationship (Samuel & Addo, 2014). Besides, in this study, the multiple linear regression technique is also used to analyze the moderating effects and understand if the moderator significantly changes the interaction result between the independent variables and the satisfaction of child interaction with the multitouch screen.

4. RESULTS AND DISCUSSIONS

A total of 127 pre-school children had participated in the study, however, only 103 had completed the study successfully. A total of 24 children unable to complete the study, and all of them were from nursery group. In total, 103 set of data were collected from pre-school children located in Malacca, Malaysia. All 103 set of data were completed. The response rate for this study is 81.1%. According to Godolja and Spaho (2014), a study should have a response rate of more than 30% to be considered acceptable. Therefore, this study meets the acceptable criteria as the response rate exceeds 30%. The collected data were then analyzed using the SPSS statistical tool to draw conclusions about the phenomena of interest.

Table 1: Respondent Profile (n = 103)

		Frequency	Percentage
Age (years old)	3	22	21.4
	4	31	20.1
	5	26	25.2
	6	24	23.3
Experience	Yes	75	72.8
	No	28	27.2

Table 1 above depicts the age and experience of the pre-school children in this study. The pre-school children were divided into two groups namely nursery or “0” for Age s3 to 4 years old and Kindergarten or “1” for ages 5 to 6 years old. Besides, Table 1 above also depicts the experience group of the pre- school children in this study. The pre-school children were divided into two groups. The group of pre- school children with no interaction experience was labeled as “0”, while for those who have prior interaction experience was indicated by “1”.

4.1. Reliability Analysis

Table 2: Reliability Test Result

Variables	No. of Items	Cronbach’s Alpha
Perceived Usefulness (PU)	3	0.904
Perceived Ease of Use (PEOU)	3	0.875
Screen Size (ScS)	3	0.910
Object Size (OBS)	3	0.934
Satisfaction (SATIS)	3	0.782

The SPSS output of the reliability test is presented in Table 2. According to Lian & Yen (2014), the minimum requirement for Cronbach's Alpha to be considered reliable is 0.60. Since the Cronbach's Alpha values for all the variables employed in this study are greater than 0.60, it can be concluded that all the variables included in the proposed research model are reliable. Among the independent variables, Object Size (OBS) exhibits the highest level of reliability, with an alpha value of 0.934. On the other hand, Satisfaction (SATIS) demonstrates the lowest level of reliability among all the independent variables, with an alpha value of 0.782.

4.2. Factor Analysis

Once the reliability tests have been confirmed, factor analysis was utilized to establish construct validity. Table 3 displays the Bartlett's Test of Sphericity and the Kaiser-Meyer-Oklin (KMO) value of 0.727, which exceeds the minimum threshold of 0.6 (Kaiser, 1974). The Bartlett's Test of Sphericity and the KMO suggest that there is a correlation among the variables, as indicated by the significant value below 0.05. The significance value or p-value in Table 3 is 0.00 ($p \leq 0.05$), implying that the correlation matrix of this study is suitable for factorization, as supported by Bartlett (1954) and cited in Sentosa et al. (2016).

Table 3: KMO and Bartlett’s Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.727**
Bartlett's Test of Sphericity	Approx.Chi-Square	1038.013
	df	4105
	Sig.	**0.000**

Table 4 reveals that there are five factors with initial eigenvalues greater than 1, and their cumulative percentage is 83.291. Therefore, the final extraction consists of five factors with a cumulative percentage of 83.291. This indicates that the extracted factors continue to validate the five factors with a percentage above 70 in the extraction sums of squared loading of cumulative percentage, as stated by Hair (2019).

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.791	25.272	25.272	3.791	25.272	25.272	2.759	18.391	18.391
2	3.301	22.003	47.275	3.301	22.003	47.275	2.564	17.096	35.487
3	2.181	14.537	61.813	2.181	14.537	61.813	2.558	17.051	52.538
4	1.864	12.425	74.238	1.864	12.425	74.238	2.501	16.671	69.209
5	1.358	9.053	83.291	1.358	9.053	83.291	2.112	14.082	**83.291**
6	.455	3.032	86.323						
7	.427	2.849	89.171						
8	.356	2.371	91.543						
9	.293	1.954	93.496						
10	.225	1.499	94.995						
11	.216	1.442	96.437						
12	.169	1.124	97.561						
13	.137	.912	98.473						
14	.120	.801	99.274						
15	.109	.726	100.000						

Extraction Method: Principal Component Analysis.

Table 5: Factors Structure

Rotated Component Matrix[a]

	Factor 1	2	3	4	5
PU1		**0.914**			
PU2		**0.933**			
PU3		**0.865**			
PEOU01				**0.925**	
PEOU02				**0.864**	
PEOU03				**0.860**	
SCS1			**0.912**		
SCS2			**0.897**		
SCS3			**0.889**		
OBS1	**0.925**				
OBS2	**0.938**				
OBS3	**0.909**				
SATIS1					**0.861**
SATIS2					**0.780**
SATIS3					**0.783**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

This study employs Principal Axis Factoring as the extracted method of factor analysis. Table 5 indicates that there are 15 items, and all of the extraction values are above 0.5, as stated by Hair (2019). Furthermore, no variables have communalities that fall below 0.5 for both the initial and extracted components. Table 5 presents a distinct breakdown of the extracted items from each variable and confirms that the construct validity test of satisfaction and the four independent variables are valid for further analysis. Thus, all 15 items are deemed suitable for inclusion in the analysis, and no items need to be dropped or deleted. Furthermore, Table 5 illustrates the summary of the rotated component matrix for the factor loading. The factor loading is clean where each factor is loaded into its own group.

4.3. Multiple Regression Analysis

In order to conduct Multiple Regression Analysis, the F-Test of the model must be significant, which occurs when two or more independent variables are highly correlated with each other.

Table 6: Aggregate Effect of Satisfaction

		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.773	4	1.693	5.508	**.000**[b]
	Residual	30.127	98	0.307		
	Total	36.900	102			

a. Dependent Variable: SATISmean

b. Predictors: (Constant), OBSmean, PEOUmean, SCSmean, PUmean

Table 7: Model Summary on Aggregate Effect on R-square

R	R-sq	F	df1	df2	*p*
.428	**.184**	5.508	4	98	**0.0000**

a. Predictors: (Constant), OBSmean, PEOUmean, SCSmean, PUmean

Table 7 above indicates that the multiple regression analysis in this study revealed a significant correlation between Perceived usefulness, Perceived ease of use, screen size, and object size with satisfaction. Collectively, these four variables accounted for 18.4% of the variance in satisfaction. The R-square value of 18.4% (0.184) in Table 7 represents the proportion of variance in satisfaction that can be explained by all the independent variables. R-square serves as a measure of the accuracy of the regression analysis, and it must be greater than zero (0). It is important to note that a high R-square does not necessarily imply a good analysis, and a low R-square does not negate the significance of a predictor or alter the coefficient. According to Cohen (1988), R-square values for endogenous latent variables can be evaluated as follows: 0.26 (substantial), 0.13 (moderate), and 0.02 (weak). Therefore, the R-square value obtained in this study, at 18.4 percent, can be considered moderately acceptable. In conclusion, the obtained R-square value in this study of 18.4 percent is moderately acceptable.

Table 8: Coefficients[a] of Satisfaction with the Independent variables

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
:	(Constant)	3.116	0.547		5.701	0.000		
	PUmean	0.112	0.071	0.149	1.577	0.118	0.932	1.073
	PEOUmean	-0.146	0.079	-0.173	-1.853	0.067	0.952	1.051
	SCSmean	0.297	0.083	0.335	3.559	**0.001**	0.943	1.061
	OBSmean	-0.002	0.089	-0.003	-0.028	0.978	0.897	1.114

a. Dependent Variable: SATISmean

To demonstrate the significant relationship between each independent and dependent variable for hypotheses H1 to H4, multiple regression analysis was employed.

As depicted in Table 8, the results showed the specific relationships between each independent variable and the satisfaction of pre-school children's interaction with multitouch screens. The significant p value $p = 0.001$ ($p \leq 0.05$), shows that there is a significant relationship between screen size and the satisfaction of child multitouch screen interaction. However, Perceived usefulness, Perceived ease of use, and object size did not show a significant relationship with satisfaction. These findings suggest that preschool children, due to their limited vocabulary and understanding of words, may struggle to express their satisfaction levels, particularly regarding Perceived usefulness and Perceived ease of use (Khanum & Trivedi, 2012). While for the object size, besides the reasons mentioned, the in-significant result was affected by the change of object size due to the change of screen size. This finding was proven by Im et al. (2015) in their research that the ratio of object size is related to a screen size; the smaller the screen, the higher the figure-background ratio (Im et al., 2015).

The only significant relationship in this model is explained by screen size. Previous researches (Khanum & Trivedi, 2012) have proven that young children are not capable to conceptualize something that out of their understanding. While screen size in our study is something tangible and able to be directly touched and felt by the pre-school children. Besides, when the researcher changes the screen size for usability testing, the size of object changes accordingly. Therefore, in the mind of pre-school children,they are able to understand clearly what is screen size, which finally contribute to the significant of the relationship between screen size and satisfaction (Khanum & Trivedi, 2012; Im et al., 2015).

Table 9: Coefficients[a] of The Moderating effect of Age on Satisfaction

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
3	(Constant)	-.069	2.617		-.026	.979
	PUxAge	-.173	.059	-1.522	-2.912	**.005**
	PEOUxAge	-.046	.094	-.464	-.487	.627

SCSxAge	.158	.068	1.300	2.308	**.023**
OBSxAge	-.133	.081	-1.199	-1.638	.105
Age	.786	.603	1.405	1.305	.195
a. Dependent Variable: SATISmean					

The results presented in Table 9 above demonstrate the detailed moderation effects of age on each independent variable with the dependent variable. The significant p value p = 0.001 (p≤0.05) indicates a significant relationship between PUxAge and SCSxAge with the satisfaction of child multitouch screen interaction. However, the interactive effect on the relationship Perceived ease of use and object size with satisfaction is not moderated by age. As depicted in Table 9, the results reveal that the interactive effect of age on the relationship between Perceived usefulness and satisfaction is significant at p = 0.005 (p≤ 0.05). Additionally, there is a significant interactive effect by age between screen size and satisfaction with interactions result of p = 0.023 (p≤0.05). The significant p value indicates a significant interactive effect of age between screen size and the satisfaction of child multitouch screen interaction. This result is consistent with prior research, which indicates that age has a notable moderating effect on the intention to use information and communication technology (ICT).

4.4. Summary of Results

Table 10 provides a summary of the findings for the hypotheses in this study, as derived from the results of the Multiple Linear Regression analysis.

Table 10: Summary of Hypothesis on Child Multitouch Screen Interaction Satisfaction

Hypothesis	*p*-value	Accepted or Rejected	Reason
H1: Perceived Usefulness (PU) has positive relationship with satisfaction.	0.118	Rejected	*p*-value > 0.05
H1a: The effects of Perceived Usefulness (PU) onsatisfaction are significantly moderated by age.	**0.005**	**Accepted**	*p*-value ≤ 0.05
H2: Perceived Ease of Use (PEOU) has positive relationship with satisfaction.	0.067	Rejected	*p*-value > 0.05
H2a: The effects of Perceived Ease of Use (PEOU) on satisfaction are significantly moderated by age.	0.627	Rejected	*p*-value > 0.05
H3: Screen Size (SCS) has positive relationship with satisfaction.	**0.001**	**Accepted**	*p*-value < 0.05
H3a: The effects of Screen Size (SCS) on satisfaction are significantly moderated by age.	**0.023**	**Accepted**	*p*-value < 0.05
H4: Object Size (OBS) has positive relationship with satisfaction.	0.978	Rejected	*p*-value > 0.05
H4a: The effects of Object Size (OBS) on satisfaction are significantly moderated by age.	0.105	Rejected	*p*-value > 0.05

This study has revealed that the only significant relationship in this model is explained by screen size. Additionally, the interactive effects between the independent variables and the satisfaction of interaction with multitouch screens are significantly moderated by age. While the relationship between screen size and the satisfaction of interaction with multitouch screens is not moderated by experience. These findings suggest that screen size is an important consideration for designers in the context of child-computer interaction.

CONCLUSION

The only significant relationship observed in this model is explained by screen size. Previous research (Khanum & Trivedi, 2012) has demonstrated that young children struggle to conceptualize things beyond their understanding. While screen size in our study is something tangible and able to be directly touched and felt by the pre-school children. Besides, when the researcher changes the screen size for usability testing, the size of object changes accordingly. Therefore, in the mind of pre-school children, they areable to understand clearly what is screen size, which finally contribute to the significant of the relationship between screen size and satisfaction (Khanum & Trivedi, 2012; Im et al., 2015). The findings from the multiple regression analysis indicate a significant interactive effect between the relationship of PUxAge and SCSxAge with the satisfaction derived from child multitouch screen interaction. Additionally, the moderating effects of experience demonstrate a significant interactive effect on the relationship between PUxExp and the satisfaction derived from child multitouch screen interaction.This study has exhibited that the interactive effects between screen size and the satisfaction of interaction with multitouch screen is significantly moderated by age. These findings emphasize the importance of considering screen size as a crucial factor in contemporary child-computer interaction design. As multitouch screens continue to gain importance as a medium for direct manipulation and as a learning toolin Malaysian preschool settings, it becomes essential to further understand how age variables mayinfluence the interaction experience of preschool children, particularly in the context of multitouch screens.

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