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# Digital Game-Based Learning of Domestic Safety (eSafety) for Pre-School

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**Abstract.** Home accidents in children less than 6 years of age mostly occurred due to the negligence of parents or the victims themselves. This study is aimed at educating pre-schoolers on dangerous tools that could be found at home to enable them to identify such items. It is imperative as it could lead to injuries or even worse death if no preventive actions are taken. These interactive learning tools are developed based on constructivism theory, *Constructive Alignment Model* dan *ASSURE Model*. Learning Domestic Safety topic in *digital Game-Based Learning* format for pre-schoolers is constructed using Microsoft PowerPoint Office 2019 software. A combination of Wordwall, quizzes, and digital games are developed and arranged as learning activities. This device emphasizes exciting game-based learning including interactive games such as hidden objects and word wall (maze game and select dangerous items). Such activities could indirectly allow children to learn, identify and avoid dangerous objects which could be found around them in their daily life and at the same time increase their knowledge on domestic safety protection. The children's cognitive domain and skills are evaluated using word wall (Game Show Quiz and rearrange letters). Mixed-method (combination of qualitative and quantitative) is applied in this study. The study samples comprise 10 academicians who are also expert evaluators from the Institute of Teacher Education Darulaman Campus (IPDA), Sultan Idris Education University, Tanjung Malim, and primary schools in Jitra. Feedbacks from the experts on design and *the Digital Game-Based Learning* application curriculum are gathered and analyzed to determine the suitability of the developed device. Findings showed that the experts evaluated the application at a moderate range while the reliability score is 0.725.

## INTRODUCTION

Accidents could happen anywhere to anyone regardless of their age. Home accidents such as falls, burns, and poisoning are recorded to be the leading cause of children's death which resulted from children's carelessness across the world [1]. Most of the unintentional injuries involved children aged five below. They are constantly exposed to the risky environment at home such as kitchen and toilet without close supervision from adults. Domestic accidents could be intentional or unintentional be it at home or in the surrounding area. It occurred mostly to children less than six-year of age because they spend most of their time at home. They play, run, grab, climb and touch dangerous objects freely without realizing it. Without adults' supervision, these acts could pose higher chances of being hurt.

Children's safety should be monitored from all aspects to prevent accidents or injuries. It is alarming when home becomes the highest-ranked location of accidents involving children. Thus, parents, close relatives, or babysitters need to be more responsible in preventing accidents. There is also a high number of accidents caused by conflicted or

problematic families. The act of shifting responsibilities of children's safety onto babysitters also contributed to accident cases [2, 3]. In short, safety is a crucial aspect of children's daily life which has to be given priority to ensure the quality of their growth. They need to be provided with utmost protection from dangerous elements around them and equipped with safety knowledge as children are very curious, eager to explore new things, and tend to touch something without knowing the consequences which is part of the learning and growing process.

## **PROBLEM STATEMENT**

Statistics on accidents and injuries involving children across the globe including Malaysia issued by World Health Organization [1] showed that 95% of the accidents occurred in low-income countries and 40% of them are fatal. Accidents such as falls, burns, and poisoning which mostly occurred at home made up about 40% of total injuries reported worldwide. Studies in Oman revealed that home accidents are the highest recorded involving children aged six below. A total of 8.8% of children suffered head injuries, 2.6% sustained burns injuries, 5.6% ended up with broken bones, and 5.6% were poisoned. In Argentina, 51.9% of injuries occurred at home while in United State 40% involved fatal accidents and 50% were unintentional injuries taking place in the surrounding area [4].

In Malaysia, 51% of burn accidents at home are identified as the leading cause of injuries among children. It was reported that most of the burn injuries were due to hot objects such as iron and kettle. Other injuries were caused by electrocution (20%), fell from high places or furniture (4%), and drown (2%) [2]. In this regard, the research is focused on pre-schoolers as they need to be educated on safety priorities at a young age following their development and growth. They need to be guided and trained by teachers via various approaches to protect themselves at home and avoid dangerous objects around them. A better understanding of safety protection aspects at homes could help minimize accident and injury risks.

## **CHILDREN'S SAFETY AT HOME: GLOBAL ISSUES**

World Health Organization [1] reported 25% of injuries around the world such as falls, burns, and poisoning were caused by children's carelessness. United State's Disease Control Statistic Centre disclosed that a child succumbed to injuries every hour a day. Apart from that, more than 50,000 children were admitted to hospitals due to accident-related injuries yearly. The Safety Report Card Summary for 18 European Union countries also reported over 10,000 children died due to unintentional injuries every year. Studies in Oman, United Arab Emirates, Saudi Arabia, Greece, and United Kingdom showed that home accident injuries among children less than five years of age were ranked the highest. A total of 716 children sustained injuries due to falls, which is the most common home accident involving children in Oman. Meanwhile, 1333 children were admitted to Emergency Department within six months due to unintentional injuries at home and 331 pre-schoolers aged between three and six years old suffered from home accident injuries [5].

Unintentional injuries are identified to be the second-highest cause of death among children aged four years old and below in England and Wales. In 2012, the Emergency Department reported 416 children aged five below being warded for unintentional injuries. A study in India showed that in the past year, home accidents occurred to 39% of children aged 14 below, 54.3% to age group 1-3 years old, followed by 45.1% to children aged between 5 and 10. The most common home accident injury is fall (59.5%), followed by accidents caused by sharp objects and burns. It is discovered that the environmental risk due to the unsafe electrical core is 95.3%, dangerous ladder use (100%), hazardous kitchen due to sharp objects (29.3%), access to active fire (19.3%), and the risk of unsafe furniture and objects is evaluated at 22.8%. It proves that although home injuries did not occur to 60% of children during the research period, the risk of injuries in the future is relatively high. Increasing safety awareness among parents and children and improving the safety of surrounding areas are imperative strategies to prevent home accidents [6]. Unintentional injuries happened to 29.3% of 650 children aged below five years old. From the age of 2 to 5 years, the injuries continue to increase from 29% to 50% [7]. Statistics by Safe Kids Malaysia, UPM [2] showed that children died due to fire or burn injuries every two weeks. 6.4% of parents or guardians have lodged reports related to fire at their houses, while 54% reported that their children sustained injuries such as burns within two years. Haliza Abdul Rahman and Siti Nabila Ahmad [8] stated that children are among the high-risk group suffering from injuries and death due to fire and burns at home. The average injury locations are the living room, bedroom, kitchen, and stairs.

## RESEARCH QUESTIONS

- i. How do the experts view the innovation of the eSafety interactive learning tool?
- ii. What is the reliability value of the eSafety interactive learning tool based on its design and curriculum?

## Methods

The mixed-method comprising data analysis and gathering via quantitative and qualitative approaches was used in this study [9]. The data gathered from both methods could complement one another, allowing the researcher to obtain more accurate information. Qualitative data analysis is applied to measure the experts' view on the eSafety interactive application while the quantitative data was used to explain the research problem analysis statistically.

## Instrument

A set of questionnaires used to evaluate the design and eSafety application. The questionnaires have been modified and adapted from Sharon et al. [10], distributed to 10 evaluator experts online by Google form. The interactive application was presented to the experts during online meeting. During the presentation, the experts were required to score each item and they could give feedbacks directly at the chat section or on the questionnaires' feedback section.

## Research Procedures and Sampling

All 29 items have been reviewed dan improvised to fulfill the research objective. Instruments need to be scored by experts to test the validity of questionnaires' contents. The 10 chosen academicians are the expert evaluators from the Institute of Teacher Education Darulaman Campus (IPDA), Sultan Idris Education University, Tanjung Malim, and primary schools in Jitra. Two of them have the expertise in curriculum field, one in assessing teaching and learning contents, one in education management, two in languages, one in Information Technology, one is an innovation expert in evaluation and measurement, and one is a preschool teacher. The eSafety application and evaluation instrument were given to all the experts to be reviewed. This is to smoothen the evaluation online via the Google Meet application that was carried out simultaneously for 30 minutes. All the experts have more than 10 years of experience in teaching and conducting researches. They were required to give constructive reviews, comments, and suggestions at the Google Meet chat section and F section on the questionnaires (see Fig. 1).

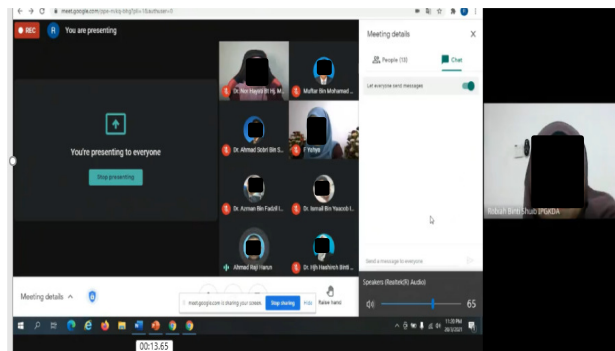


FIGURE 1. Experts' Evaluation Session

The eSafety application design requires the respondent's evaluation of the performance layout while the curriculum needs to be reviewed in terms of the learning outcomes, contents, learning activities, and assessment. The sampling is selected based on the background and objective of the research to ensure the data gathered would be meaningful to the research findings [9]. Qualitative data were obtained from interview protocol with evaluator experts. The purpose of the interview is to gather feedbacks pertaining contents and development of the eSafety application. All the 10 evaluators experts shared their expertise and experiences during the interview to gain information regarding the suitability aspect in terms of application contents, performance design, learning activities, and assessment

of eSafety application as teaching interactive tools to be used at preschools for the safety of children at the home topic. The interview sessions were carried out online due to Conditional Movement Control Order implementation. Respondents were instructed to sign the consent letters for the interview and were informed that the session would be used for research purposes only.

## Reliability

Intraclass Correlation Coefficient is applied to estimate the approval value among the experts towards the interactive tools. This research is also aimed at obtaining the reliability value of digital game-based learning from the design features particularly its contents, performance, and curriculum. Creswell [9] suggested that the reliability index in the test to be categorized as satisfactory if the value ranged at 0.7 while [11], stated that the alpha index value 0.7 and above are good for instrument scales that have more than 10 items.

## Data Analysis Technique

Quantitative data is analysed using Statistical Package for the Sosial Sciences (SPSS) V21.0. The Cronbach Alpha and Intraclass Correlation Coefficient (ICC) reliability analysis are applied to view the agreement between all experts regarding the evaluation criteria of eSafety application. ICC is the reliability between rate used to reach agreed value among evaluators [12] while the qualitative data analysed through content analysis. According to Creswell [9] the data analysis process were carried out in three phases namely transcription, data reduction and coding.

## Interview Protocol

Interview protocol is a guideline to ensure the interview being conducted accordingly without deviating from topic to be discussed [13]. The protocol inclined towards the learning contents, performance design and the suitability of learning activities in the eSafety.

## The Development Process of eSafety Application

The *eSafety* construction was based on four main phases adapted from *the Constructive Alignment Model*. This model is selected for the application's development because the design focused on the learning outcomes in the first place and closed with assessment. The layout of the model design is in focused order and interrelated between each teaching step, learning outcomes, contents, activities, and evaluation at the end of the teaching process [14]. Learning outcomes are determined following the preschool Standard Document for Curriculum and Assessment, where the learning content covered teaching topics related to the children's safety at home, learning activities equipped with interactive games such as choosing and identifying dangerous objects at home and distinguishing situations as well as the source of injuries through *word wall* application. The children's level of understanding and knowledge on safety aspects is evaluated from the *Game Show Quiz*.

The development of interactive multimedia applications requires organized strategy and execution according to particular teaching models to guarantee the application's quality besides from fulfilling the desired learning outcomes. [15] stated that *ASSURE* Model is used as a guideline to plan and manage teachings via electronic media. There are six phases involved:

**A = Analyze.** An important phase to identify students and their needs as per their experiences. In this study, preschoolers were selected the safety topic suit their needs.

**S = State objectives.** The multimedia materials are developed based on desired learning outcomes such as identifying dangerous sources, injury situation and choosing sources that lead to injuries.

**S = Select media & materials.** Teaching materials selection match the teaching topics and students' existing knowledge. The chosen media is suitable with students' ability level such as *power point* and *word wall* applications.

**U = Utilize media & materials.** Digital media and material application covered the students' ability level in understanding the desired learning outcomes. Validity and reliability of materials and media are proven with the evaluator experts' scores.

**R = Require learner participation.** Students are exposed to digital game activities which requires overall participation. The activities outlined for students to explore the game is similar to the learning activities which are

listing, identifying and selecting source of accidents and injuries. Students could also fully take part in assessment activities like quiz.

**E = Evaluate & revise.** The *eSafety* application need to be evaluated by experts to detect the strength and weakness of its contents. The evaluation is aimed at improvising the application before being fully implemented.

## The eSafety Application Content

### 1. Learning outcomes:

- i. Listing dangerous items at home
- ii. Identifying injury situation correctly
- iii. Selecting objects that could lead to injuries

### 2. Learning Activities:

Learning approach via online

- a. Students watch video on home environment.
- b. Students list out dangerous objects found in the video
- c. Interactive game activities:
  - i. Listing harmful objects (Learning Outcome 1) Search hidden object activities. List the harmful objects found (see Fig. 2).



**FIGURE 2.** Listing harmful objects (Learning Outcome 1) 1.

- ii. Students able to identify injury situation (Learning Outcome 2). Rearrange letters to form the right word (see Fig. 3)



<https://wordwall.net/resource/11990007>

**FIGURE 3.** Identify injury situation (Learning Outcome 2).

- iii. Students can identify injury from stimulus situation (Learning Outcome 2). In this game, students are required to identify type of injury based on the dangerous object given (see Fig. 4).



<https://www.wordwall.net/resource/12897237>

**FIGURE 4.** Identify injury from stimulus situation (Learning Outcome 2).

iv. Students able to choose hazardous objects (Learning Outcome 3). In this game, eight dangerous and non-dangerous objects are given. They have to pick the dangerous objects that could cause injury (see Fig. 5).



**FIGURE 5.** Choose hazardous objects (Learning Outcome 3).

d. Assessment (see Fig 6).



<https://www.wordwall.net/resource/12894887>

**FIGURE 6.** Assessment.

## **The Integration of eSafety Interactive Tools for Teaching Safety of Children At Home Lessons**

Teachers need to be more creative in planning their lessons, especially during the Covid 19 pandemic. To ensure the smooth sailing of the teaching and learning process in this situation, eSafety, game-based learning was developed to teach the topic of home safety from various sources, venues, and situations. The concept of learning while playing attracted children who are playful by nature and at the same time they could gain more knowledge on the topic.

Game-Based Learning approaches which include video, audio, interactive games, and images are regarded as the 21st-century teaching method that could attract childrens' interest and attention when learning [16]. Teaching and learning with the aid of animation such as cartoon character synonym to children could make the session more interesting and creative, hence increase their participation in class [17]. The class session would no longer be boring with the fun learning method. Another advantage of this approach is that it encourages the students to be more creative and focused. The learning process also requires the students to remember every information learned.

Children nowadays are more exposed to advanced digital devices which allow them to access information at their fingertips as young as below six years old. Digital Game-Based Learning is able to make students more active in a fun learning environment. This could make them engrossed in their learning while creating meaningful, interesting, effective, and motivational sessions. Li [18] pointed out that the use of multimedia teaching aid could pique the students' interest and attention. Prensky [19] defined that digital game-based learning as integration of educational content and computer game which is aimed at achieving better results compared to the traditional learning method. Such an approach is flexible and advantageous in applying learning principles such as instilling behavioral, cognitive, and constructive theories [10]. Chalkiadaki [20] elaborated that the digital game is efficient in boosting learning skills, fitting with the 21st-century development and it is more favorable as such learning method could increase the students' focus as well as their knowledge. Chun-hui and Fu [21] discovered that students who were taught using animation teaching aid showed outstanding performance while the majority of them stated that creative and innovative teaching methods have further enhanced the learning process.

### **Theory Related to Game-Based Learning**

The eSafety is developed based on Constructivism Theory and Constructive Alignment Model. The theory was adopted as it stressed the cognitive development of the students through their experiences. According to Qian and Clark [22], this theory is among the frequently used by researchers in studies pertaining to game-based learning. Nam

and Osman [23], explained that students would interpret and relate the new knowledge gain with the existing ones during the learning process. Next, they would express the newly-gained knowledge according to their understanding.

In the learning process, students play the role of active participants [24]. In the constructive environment, students are facing new learning styles and data processing strategies [25] compared to the traditional methods. The former methods create more opportunities for students to freely conduct self-learning [26]. Through digital learning, teachers will facilitate the process of acquiring knowledge related to their lessons. This could increase their interest in study [27].

Constructive Alignment Model [14] highlighted the curriculum alignment namely learning outcomes, contents, and learning activities which are interrelated. The alignment in learning started with identifying desired learning outcomes, followed by drafting the assessment to measure the achievement of learning outcomes, and lastly planning learning activities to enable the students to enhance their skills, knowledge, and understanding measured in the assessment. This model showed the importance of evaluation in ascertaining the understanding level of the concept learned, consistency between assessment, teaching strategies, and intended learning outcomes.

## The eSafety Concept

The eSafety was developed through PowerPoint Microsoft 2019 application with multimedia elements such as animation, video, audio, and images related to the personal safety topic. This method focused on teaching the children about the danger posed at home in a situation that could lead to accidents. Images of dangerous objects found at homes such as the kitchen, living room, dining room, and toilet are displayed visually and verbally. The learning activities are conducted through interactive games like searching hidden objects, word wall, and the assessment is made via word wall (game show quiz). The tool construction concept fits [28] view that text, images, graphics, animation, audio, and video are among the graphic components constantly used to develop an application.

## RESULTS AND DISCUSSION

### Quantitative Findings

The reliability value for the eSafety application is 0.725, indicating it was developed at moderate level. The value of an average measure was .725, which was analysed through Intraclass Correlation Coefficient (ICC), based on 95% confidence interval between .550 to .851 ( $F(29, 174) = 3.632, p < .005$ ). This data (Table 1) shows high degree of consensus among panels of expert for this interactive tool.

**TABLE 1.** Intraclass Correlation Coefficient

	Intraclass Correlation <sup>b</sup>	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.208 <sup>a</sup>	.109	.363	3.632	29	261	.000
Average Measures	.725 <sup>c</sup>	.550	.851	3.632	29	261	.000

### Qualitative Data

Qualitative data showed that all experts strongly agree with the eSafety application's learning contents. Experts 1 and 2 who are specialised in content related field explained that the application's contents are very suitable for the children's level and meet the Preschool Standard Curriculum and Assessment

t Document's prerequisite.

*Content: Grading According to Ability Level*

"The eSafety application contents are in accordance with DSKP". (Expert 1)

"Its contents are suitable for pre-schoolers". (Expert 2)

Meanwhile, other experts who are not specialised in content related field also shared their views:



- “Suitable contents and the safety aspects delivered match the pre-schoolers level”. (Expert 3)
- “Contents are clear and suits the focused activities”. (Expert 4)
- “Contents of the interactive application developed fits the exciting game activities”. (Expert 5)
- “The software is suitable for children who knows how to spell or read”. (Expert 6)
- “The application contents are in accordance with the students’ experiences”. (Expert 7)
- “Contents are appropriate for pre-schoolers and assessment made is aligned with safety topics”. (Expert 8)
- “Safety topics match with the students’ existing knowledge”. (Expert 9)
- “The activities lined up are in accordance with safety topics”. (Expert 10)

#### *The eSafety Performance Design*

6 experts strongly agree with eSafety’s performance design. One of them (Expert 6) is specialised in IT field.

- “Audio instructions for search the hidden object activities are provided”. (Expert 6)
- “Relevant audio such as applause sound and teacher’s voice are inserted in the game activities”. (Expert 3)
- “Images are suitable with safety topics”. (Expert 8)
- “Slide buttons are suitable and consistent”. (Expert 7)
- “Audio instructions from teachers are clear”. (Expert 10)

#### *Suitability of Learning Activities*

9 experts strongly agree with the suitability of the interactive game learning activities while one disagree

- “Interesting interactive game activities”. (Expert 1)
- “Activities are suitable with the pre-schoolers’ level”. (Expert 2, Expert 6 dan Expert 7)
- “The search for hidden item game activity is exciting and easy to operate”. (Expert 3)
- “Selecting the dangerous item activity fit the safety topic”. (Expert 4)
- “Exciting interactive game. Rearranging letters into word activity is suitable for literate children”. (Expert 5)
- “Search for hidden object and select dangerous item interactive games are suitable for pre-schoolers”. (Expert 8)
- “Rearrange letters activity is suitable as there are images included”. (Expert 9)
- “Interactive games are attractive and relevant”. (Expert 10)

#### *The eSafety’s Strengths as an Exciting Interactive Learning Tools*

Overall, the experts agreed that eSafety is suitable to be used as an exciting interactive learning tools since the contents relate to the students’ experiences and existing knowledge on dangerous objects around them.

- “Learning contents in accordance with preschool DSKP”. (Expert 1)
- “Learning contents suitable for children”. (Expert 2)
- “Safety contents delivered matched the pre-school”. (Expert 3)
- “Focused and clear activities”. (Expert 4)
- “Interactive application software with various exciting game activities”. (Expert 5)
- “The software generally suitable and meet the pre-schoolers’ learning contents”. (Expert 7)
- “Contents compatible with pre-schoolers lessons and assessment made in line with safety topics”. (Expert 8)
- “Safety topic relevant with student’s existing knowledge”. (Expert 9)
- “Activities planned suits the topics”. (Expert 10)

#### *The eSafety’s Weaknesses as an Exciting Interactive Learning Tools*

- “Font and instruction have to be clearer (Expert1 dan expert 5)
- “Images are too crowded in the selecting dangerous item activity, which could confuse the children”. (Expert 9)
- “Using too much of existing materials, it is better to create own materials”. (Expert 2)

#### *Learning Tool’s Upgrading According to Experts’ View*

The eSafety application needs to be upgraded to ensure a better quality besides being more user-friendly. Experts recommended upgrading of the contents, performance design and the learning activities suitability.

“This application is suitable for pre-schoolers. However, need to consider alternative development which could be used offline in case of no internet access”. (Expert 3)

“This application is suitable for students who are able to spell and read. Teachers need to consider the different intelligent level of students in order for everyone to be able to operate the application without anyone being left behind during the teaching and learning process”. (Expert 6)

“Congratulations for successfully develop an interesting application with graphic selection suits the safety topics. However, the font need improvement and instruction button on slide should be clearer”. (Expert 1)

“Congratulations for creating exciting interactive game activities but most of the materials used are the existing ones. Would be better if could come out with own materials”. (Expert 2)

“There are instructions for the activities but the font used are not suitable, quite small for pre-schoolers. Bigger size font would make it easier for the children to read”. (Expert 5)

“Good job, the images provided in the learning activities could attract the children’s attention but the ones used in selecting dangerous items are too crowded and could confuse them”. (Expert9)

“Exciting interactive game but the rearranging letters into words are only suitable for literate students”. (Expert 5)

## **DISCUSSION**

Findings showed that the eSafety application could be implemented to the target audience. It meets the multimedia principles defined by Wiana [28] as there are graphic components comprising text, images, graphics, animation, audio, and video. The evaluator experts also give positive feedback for this application which could improve the preschoolers' understanding and knowledge of safety protection at home. The criteria were evaluated from application content, performance design, and suitability of learning activity aspects. The eSafety application received moderate approval among the experts in terms of its suitability for preschoolers.

The experts also agreed that the features such as graphics, font, colors, animation, audio, video, and navigation button are interactive and enable the students to pay attention and enjoy their learning session via the application. Li [18] regarded digital game-based learning as a teaching aid that can attract and excite children. The application contains a suitable syllabus and met the requirement outlined under Preschool Standard Curriculum and Assessment Document (DSKP). The activities are prepared per the Constructive Alignment Model selected in terms of the learning content order as well as ASSURE model from the aspect of device development. The information technology integration in this application could draw the students' interest and encourage them to focus on learning sessions while promoting self-learning skills at an early age.

## **CONCLUSION**

Parents, guardians, and babysitters should pay more attention to providing a safe environment at home, given the continuous accidents occurring among children. Preschoolers should be given adequate home safety education, awareness as well a better understanding of safety and accident prevention at home. The eSafety game-based learning tools developed could increase the awareness and knowledge on home accident risk and prevention. The past researches showed that game-based learning could excite the students in the study. Playing is no longer mere entertainment but it could also motivate students during the teaching and learning process.

This study has successfully developed the instructional interactive application based on digital game-based learning approaches which are the Domestic Safety Digital Learning for pre-school (eSafety). It is hoped that the eSafety application, with the moderate reliability score (0.725) in terms of its design and curriculum content, it is hoped that could assist the students in identifying dangerous objects at home and minimize injury risk and at the same time enable the teachers to teach the topic in an exciting manner.

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