Journal Visipena
Volume 16 , Number 2, 2025 pp. 383-397
P-ISSN 2086-1397 E-ISSN: 2502-6860
Open Access: https://ejournal.bbg.ac.id/Visipena

THE EFFECTIVENESS OF STEAM MEDIA IN IMPROVING CHILDREN'S UNDERSTANDING OF SELF-PROTECTION AT SAVE THE KIDS KINDERGARTEN, BANDA ACEH

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ARTICLE INFO

Article history:
Received: Sep 05, 2025
Revised: Oct 20, 2025
Accepted: Nov 05, 2025
Available online: Dec 05, 2025

Keywords:
STEAM media, child self-protection, early childhood education, sexual abuse prevention, quasi-experiment

ABSTRACT

Sexual violence against young children remains a real threat, while children's understanding of how to protect themselves is generally still low. This study aimed to examine the effectiveness of integrated science, technology, engineering, arts, and mathematics (STEAM) learning media in improving children's understanding of self-protection at Save The Kids Kindergarten in Banda Aceh. A quasi-experimental nonequivalent control group design with pretest and posttest measurements was used. The participants were 60 children aged five to six years, divided equally into an experimental group and a control group of 30 children each. The experimental group joined eight sessions themed "My Body Is Precious", while the control group received conventional instruction of the same duration. Understanding was measured with a picture-scenario assessment and analyzed using t-tests, the Mann-Whitney test, analysis of covariance, and normalized gain. The mean score of the experimental group rose from 23.03 to 33.30, whereas the control group rose from 22.60 to 25.87. The difference in posttest scores was statistically significant with a large effect size. The normalized gain was moderate for the experimental group (0.56) and low for the control group (0.04). It is concluded that the integrated STEAM media effectively improve children's understanding of self-protection because they are concrete, enjoyable, and engage multiple senses.

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INTRODUCTION

Protecting children from sexual violence is a shared responsibility of families, schools, communities, and the state. Law Number 35 of 2014 on Child Protection affirms that every child has the right to protection from sexual violence and crime (Republik Indonesia, 2014). However, conditions on the ground show that the threat to children has

not subsided. The Banda Aceh City Police handled 21 cases of rape and sexual abuse against children in 2022, more than the 19 cases in 2021 (ANTARA News Aceh, 2022). These figures reflect only reported cases, so the actual situation is likely worse because many victims do not understand that they are being treated inappropriately and do not know whom to tell.

Young children are in a highly vulnerable position because their language, reasoning, and courage to refuse adults are still developing. Children aged five to six learn best through direct experience, play, and concrete objects, as reflected in the learning principles contained in the National Standards for Early Childhood Education (Kementerian Pendidikan dan Kebudayaan, 2014). Abstract messages such as "take care of your body" or "do not let strangers touch you," delivered through lectures, are often meaningless to children. Children need opportunities to get to know their body parts, distinguish safe from unsafe touch, practice saying "no," and identify trusted adults they can tell.

Evidence from international research supports the importance of concrete and active approaches. A meta-analytic review by Gubbels et al. (2021) of school-based child abuse prevention programs showed moderate effects on children's knowledge (d = 0.57) and self-protection skills (d = 0.53). The effect on self-protection skills appeared considerably larger among preschool and kindergarten children than among elementary school children, and the use of puppets and of games or quizzes was associated with larger knowledge effects. These findings suggest that media designed as games and involving real objects deserve to be developed for young children.

One approach that is widely discussed in early childhood education today is integrated learning of science, technology, engineering, arts, and mathematics, or STEAM. Perignat and Katz-Buonincontro (2019) showed in their integrative literature review that STEAM emphasizes interdisciplinary integration and real-world problem solving through learners' active engagement. In Indonesia, studies of STEAM in early childhood have focused mainly on creativity and cognitive development (Fitri & Suryana, 2022; Prahartiwi et al., 2025). Research testing STEAM-based media for self-protection understanding with a control group remains very limited, especially in Aceh, where the sociocultural context may make talking with children about the body and sexuality taboo.

Brief Literature Review

Self-protection in early childhood is understood as a child's basic ability to recognize risky situations, refuse inappropriate treatment, and seek help from trusted

adults. In this study, understanding of self-protection is broken down into four indicators: recognizing private body parts, distinguishing safe from unsafe touch, refusing and saying "no," and reporting to a trusted adult. These four indicators form a logical sequence. A child who does not yet know their body has difficulty realizing that their personal boundaries have been violated, and a child who does not know whom to tell tends to keep what happened to themselves. Because young children cannot be relied upon to prevent abuse on their own, self-protection education is regarded as a complement to, not a replacement for, adults' responsibility for keeping children safe.

STEAM learning positions children as active explorers who investigate, design, create, and count within a single series of play activities (Perignat & Katz-Buonincontro, 2019). Each STEAM element can be linked to one aspect of self-protection. Science supports body recognition through exploration with the five senses. Technology provides interactive videos that capture attention and show examples of saying "no." Engineering provides the experience of assembling a body puzzle and building a "safe place" from blocks. Art offers a channel for expression through poster making so that children can convey their own self-protection messages. Mathematics helps children classify and match, for example by pairing pictures of safe and unsafe situations with matching facial expressions. These connections form the basis for the media design in this study.

Based on the above, this study aims to examine the effectiveness of STEAM media in improving the self-protection understanding of Group B children at Save The Kids Kindergarten in Banda Aceh. The null hypothesis (H0) states that there is no difference in the improvement of self-protection understanding between children who learn with STEAM media and children who learn conventionally, whereas the alternative hypothesis (H1) states that the improvement in the STEAM media group is higher. The results are expected to serve as a basis for teachers, parents, and policymakers in designing self-protection education that suits how young children learn.

RESEARCH METHOD

Research Design

This study used a quantitative approach with a quasi-experimental nonequivalent control group design (Sugiyono, 2019). This design was chosen because children could not be randomized individually without disrupting the class structure, so groups followed existing classes. Both groups received a pretest, then only the experimental group received the STEAM media treatment, and both groups were measured again after the

treatment (posttest). The design pattern is written as O1 – X – O2 for the experimental group and O3 – O4 for the control group.

Participants and Location

The study was conducted at Save The Kids Kindergarten in Banda Aceh in the odd semester of the 2026/2027 academic year. The population was all Group B children. The sample was selected purposively from two classes with equivalent characteristics, totaling 60 children aged five to six years. One class was designated the experimental group (30 children; 16 boys and 14 girls) and the other the control group (30 children; 15 boys and 15 girls). The experimental class was determined by lottery. The inclusion criteria were that parents gave written permission, the child was healthy, and the child attended at least seven of the eight sessions.

Treatment: STEAM Media Themed "My Body Is Precious"

The treatment consisted of eight sessions over four weeks (two sessions per week, 35 minutes each) led by the classroom teacher after brief training from the researcher. The media developed, named "Aku Tahu, Aku Bisa!" ("I Know, I Can!"), combines the five STEAM elements in play activities, as shown in Figure 1 and summarized in Table 1. All activities used simple language and pictures and did not show any scenes of violence.

Table 1. Design of the STEAM Media Themed "My Body Is Precious"

Element	Media and activity	Understanding built
Science	"What Is Safe?" experiment: children pour green (safe) and red (unsafe) colored water and match it with safe-touch and unsafe-touch cards	Distinguishing safe and unsafe touch
Technology	Interactive tablet video about a child character who says "no" to unsafe touch	Refusing and saying "no"
Engineering	"My Body Is Mine" puzzle (head, chest, stomach, hands, feet) and building a "safe place" from blocks marked "I Am Safe Here"	Recognizing private body parts and places of refuge
Art	Making a "My Body Is Precious" poster by drawing, coloring, and pasting	Expressing self-protection messages
Mathematics	Matching pictures of safe and unsafe situations with corresponding facial expressions and signs	Distinguishing safe and unsafe situations



Source: Research media design (2026)

Figure 1. STEAM Media "Aku Tahu, Aku Bisa!" for Recognizing Safe and Unsafe Touch (Original Media in Indonesian)

The control group studied the same theme over eight sessions of the same number and duration, but used conventional learning consisting of storytelling with picture books, question and answer, and responding to worksheets. In this way, differences in results can be attributed to the media and the way of learning, not to the length of exposure to the material.

Instruments and Data Collection

Self-protection understanding was measured with a picture-scenario assessment administered individually as a 10–15-minute interview. The assessment consisted of 10 items covering four indicators: (1) recognizing private body parts (3 items), (2) distinguishing safe and unsafe touch (3 items), (3) refusing and saying "no" (2 items), and (4) reporting to a trusted adult (2 items). Each item was scored 0–4 according to a rubric, so the maximum score was 40. Content validity was examined by three experts (two early childhood education lecturers and one child psychologist) with Aiken's V coefficients ranging from 0.84 to 0.93. A trial with 15 children at another school yielded a Cronbach's alpha of 0.82, and inter-rater agreement between two raters yielded a Cohen's kappa of 0.78. All of these values fall in the good category.

Research Procedure

The study was carried out in three stages. In the preparation stage, the researcher designed the activities and media, conducted expert review, piloted the instrument, and trained classroom teachers on how to lead the activities, answer children's questions, and respond if a child disclosed something concerning. In the implementation stage, all children took an individual pretest, after which the experimental and control groups each attended eight sessions during morning learning hours. In the final stage, the posttest was administered one week after the last session with the same instrument and raters. The order in which children were assessed was randomized at each measurement to reduce the effects of fatigue and boredom.

Research Ethics

The study obtained approval from the school and written permission from parents. Children could stop at any time without consequence. The scenarios used only pictures so that children were not asked to recount personal experiences. A child psychologist was on standby to follow up if any child showed signs of discomfort or disclosed something concerning. The control group received the STEAM media activities after all data collection was completed.

Data Analysis Technique

Data were analyzed descriptively and inferentially at a significance level of 0.05 using the Python programming language with the SciPy library. Normality was tested with the Shapiro-Wilk test and homogeneity of variance with Levene's test. Equivalence of initial ability was tested with the Mann-Whitney test because the pretest data were not normally distributed. Improvement within each group was tested with the paired-samples t-test and confirmed with the Wilcoxon signed-rank test. Differences in final scores between groups were tested with the independent-samples t-test, confirmed with the Mann-Whitney test, and with analysis of covariance with the pretest as the covariate. The magnitude of improvement was calculated with normalized gain (Hake, 1999) in Equation 1, with the categories high ($g \geq 0.70$), moderate ($0.30 \leq g < 0.70$), and low ($g < 0.30$). Differences in gain between groups were tested with the Mann-Whitney test.

$$g = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}} \quad (1)$$

Effect size was expressed as Cohen's d (Cohen, 1988) in Equation 2, where s_p is the pooled standard deviation of the two groups (M_E and M_C are the means of the

experimental and control groups, respectively). A d value of about 0.2 is categorized as small, 0.5 as medium, and 0.8 or greater as large.

$$d = \frac{M_{\mathrm{E}} - M_{\mathrm{C}}}{s_{\mathrm{p}}} \quad (2)$$

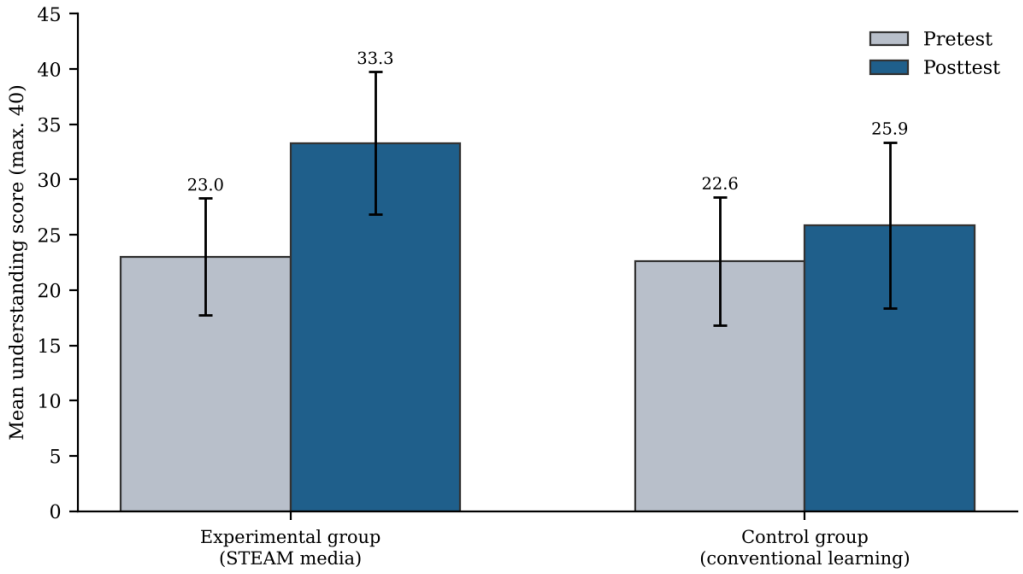
RESULTS AND DISCUSSION

Description of Self-Protection Understanding

Table 2 presents the descriptive statistics of self-protection understanding scores. At the initial measurement, the means of the experimental group (23.03) and the control group (22.60) were almost the same, equivalent to 57.6% and 56.5% of the maximum score. After the treatment, the experimental group's mean rose by 10.27 points to 33.30 (83.3%), whereas the control group's mean rose by 3.27 points to 25.87 (64.7%). Improvement occurred in both groups, but it was much greater in the experimental group. Figure 2 shows this pattern.

Table 2. Descriptive Statistics of Self-Protection Understanding Scores (Maximum Score 40)

Group	Measurement	n	Range	Mean	SD	Achievement (%)
Experimental	Pretest	30	13–30	23.03	5.28	57.6
	Posttest	30	15–40	33.30	6.47	83.3
Control	Pretest	30	13–30	22.60	5.82	56.5
	Posttest	30	13–40	25.87	7.52	64.7



Source: Research data (2026)

Figure 2. Mean Self-Protection Understanding Scores Before and After Treatment (Error Bars = Standard Deviation)

Prerequisite Tests and Equivalence of Initial Ability

The Shapiro-Wilk test showed that pretest scores were not normally distributed in either the experimental group ($p = 0.048$) or the control group ($p = 0.010$), so the equivalence of initial ability was tested with the Mann-Whitney test. The result was not significant ($U = 476.0$; $p = 0.705$), meaning that the two groups had equivalent initial ability. Posttest scores were not normally distributed in the experimental group ($p = 0.002$) but were normal in the control group ($p = 0.274$), and the variances were homogeneous (Levene's test: $F = 0.99$; $p = 0.324$). The difference between scores before and after treatment was normally distributed in both groups ($p = 0.356$ for the experimental group and $p = 0.201$ for the control group), so the paired t-test was appropriate. Because the posttest scores of the experimental group were not normal, the comparison of final scores between groups was confirmed with the Mann-Whitney test.

Test of the Effectiveness of STEAM Media

A summary of the hypothesis test results is presented in Table 3. The paired-samples t-test showed a significant improvement in the experimental group ($t(29) = 6.47$; $p < 0.001$; $dz = 1.18$), whereas in the control group the improvement was not significant ($t(29) = 1.61$; $p = 0.118$; $dz = 0.29$). The Wilcoxon test gave the same conclusion: significant in the experimental group ($p < 0.001$) and not significant in the control group ($p = 0.145$). This means that a meaningful increase in scores occurred only among children who learned with STEAM media, whereas conventional learning produced only a small

increase. The between-group comparison remains the basis for assessing the effectiveness of STEAM media.

On final scores, the independent-samples t-test showed a significant difference between the experimental and control groups ($t(58) = 4.10$; $p < 0.001$) with an effect size of $d = 1.06$, which is classified as large. The Mann-Whitney test confirmed this finding ($U = 707.0$; $p < 0.001$; $r = 0.57$). The analysis of covariance controlling for pretest scores also showed a similar result: an adjusted mean difference of 7.57 points in favor of the experimental group ($t(57) = 4.27$; $p < 0.001$). The normalized gain of the experimental group (mean 0.56; SD 0.45) was in the moderate category, with 14 children (46.7%) in the high category, 9 children (30.0%) in the moderate category, and 7 children (23.3%) in the low category. In the control group, the mean gain was only 0.04 (SD 0.63) and in the low category: 3 children (10.0%) were in the high category, 11 children (36.7%) in the moderate category, and 16 children (53.3%) in the low category. The difference in gain between groups was significant based on the Mann-Whitney test ($U = 673.0$; $p = 0.001$; $r = 0.50$). Thus, the research hypothesis is accepted.

Table 3. Summary of Statistical Tests

Test	Comparison	Statistic	p	Effect size
Mann-Whitney	Experimental vs. control pretest	U = 476.0	0.705	r = 0.06
Paired t	Experimental pretest–posttest	t(29) = 6.47	< 0.001	dz = 1.18
Paired t	Control pretest–posttest	t(29) = 1.61	0.118	dz = 0.29
Independent-samples t	Experimental vs. control posttest	t(58) = 4.10	< 0.001	d = 1.06
Mann-Whitney	Experimental vs. control posttest	U = 707.0	< 0.001	r = 0.57
ANCOVA	Posttest adjusted for pretest	t(57) = 4.27	< 0.001	7.57 points
Mann-Whitney	Normalized gain	U = 673.0	0.001	r = 0.50

Achievement on Each Indicator

Table 4 shows that the improvement in the experimental group occurred on all four indicators. The largest improvement was in the ability to refuse and say “no,” from 56.2% to 87.5%. The indicators of reporting to a trusted adult, distinguishing safe and unsafe touch, and recognizing private body parts rose by about 28, 26, and 20 percentage points, respectively. In the control group, the increase on each indicator ranged only between 5 and 14 percentage points.

Table 4. Understanding Achievement on Each Indicator (%)

Indicator	Experimental pretest	Experimental posttest	Control pretest	Control posttest
Recognizing private body parts	60.6	80.3	56.1	65.8
Distinguishing safe and unsafe touch	56.1	82.2	57.8	62.5
Refusing and saying "no"	56.2	87.5	55.4	69.2
Reporting to a trusted adult	56.7	85.0	56.2	61.7

Discussion

The main finding of this study is that STEAM media were more effective than conventional learning in improving the self-protection understanding of Group B children. This result is in line with the finding of Gubbels et al. (2021) that school-based child abuse prevention programs improve knowledge and self-protection skills, with larger effects among preschool children. The effect size in this study (d = 1.06) was larger than the mean of that meta-analysis (d = 0.57 for knowledge). The difference is understandable given that this study was small-scale, short in duration, and measured understanding through picture scenarios directly related to the material taught, not children's behavior in real situations. Therefore, the effect size should be read as an indication of a strong direction, not as a figure that will be repeated in every school. The same direction of findings was reported at the elementary school level by Atmojo et al. (2021), who compared a natural science class using STEAM-based augmented reality with a control class and obtained a significant difference (t-count 2.874 > t-table 1.980) with a normalized gain of 0.72 (high category), whereas the gain in this study was 0.56 (moderate category). This comparison should be read with caution because the educational level, subject matter, and form of media differ between the two studies.

There are several reasons that may explain the superiority of STEAM media. First, the media turn abstract messages into concrete experiences. Children do not merely hear that there are body parts that must not be touched by just anyone, but assemble a body puzzle, pour green and red water to sort touches, and build a safe place from blocks. This is consistent with the characteristics of young children, who learn through manipulating objects and play (Kementerian Pendidikan dan Kebudayaan, 2014). Teachers in the study by Ashadi et al. (2025) also reported that explaining material became easier and abstract concepts became more tangible when children learned through direct experience embedded in each activity. Second, the integration of science, technology, engineering,

arts, and mathematics provides many entry points to the same understanding. The concept of "unsafe touch" is encountered repeatedly through the color experiment, video, puzzle, blocks, poster, and picture-matching game, so that a child who is less responsive to one approach can still be helped by another. Novitasari et al. (2022) explained that learning that activates multiple senses, namely visual, auditory, kinesthetic, and tactile, better suits the needs and psychological characteristics of preschool children. Perignat and Katz-Buonincontro (2019) noted that the strength of STEAM lies in active engagement and meaningful problem solving.

Third, the use of games and concrete activities is consistent with the results of Gubbels et al. (2021), who found larger knowledge effects in programs that used games or quizzes (d = 0.97 versus 0.49), in addition to programs that used puppets (d = 1.10 versus 0.50). This study extends that evidence to children aged five to six years with a more integrated package of activities. Similar results have also been reported for children of the same age. Ashadi et al. (2025) developed a STEAM-based busy book and found that children were enthusiastic, asked questions actively, and tried to solve problems when using it, with a response score of 4.45 (very good category), while Lestari and Handayani (2024) reported an increase in the creativity scores of children aged five to six years from 6.9 to 11.9 after STEAM learning (Wilcoxon test, p = 0.003). It should be noted that neither of these studies involved a comparison group, and the study by Lestari and Handayani (2024) involved only 11 children in a one-group design, so the increase cannot be separated from the effect of repeated measurement. The control-group design in this study provides a stronger basis for concluding that the improvement is indeed related to the media used.

The control group experienced only a small, non-significant increase (gain 0.04). This result should be read with caution. The increase that did occur probably came from exposure to the same material through stories and question and answer, as well as the effect of repeated testing (children became familiar with the picture-scenario format), while 13 of the 30 children actually obtained lower posttest scores than pretest scores. A control-group design remains important: if there were only an experimental group, the entire 10.27-point increase would be attributed to the STEAM media, whereas the difference attributable to the media is better read from the between-group comparison, namely about 7.57 points after controlling for the pretest.

At the indicator level, improvement occurred in all four aspects, with the largest surge in the ability to refuse and say "no." This is natural because the interactive video

and the practice of saying "no" together with the child character were directly aimed at that ability, whereas the color experiment and picture-matching game supported the distinction between safe and unsafe touch. The indicator of reporting to a trusted adult deserves special attention. Gubbels et al. (2021) found that programs focusing on identifying trusted adults were actually associated with smaller effects on self-protection skills (d = 0.14 versus 0.72), and parental involvement was associated with larger effects (d = 0.93 versus 0.34). This means that a child's ability to tell does not necessarily translate into real action without support from the home environment. Teachers need to provide follow-up activities with parents, for example by sending home a "trusted adult" worksheet for children to complete with their families. Adult guidance is also needed in the use of technology. Wulandari and Arifah (2023) cautioned that introducing technology to young children, for example through applications, must be supervised by teachers and parents, so the interactive video in this study should always be guided by the teacher.

These findings also have implications for the Banda Aceh context. The rising number of cases of sexual violence against children handled by the police (ANTARA News Aceh, 2022) shows that prevention efforts from an early age cannot wait. STEAM media do not require expensive equipment; plastic cups, colored water, paper puzzles, blocks, and picture cards can be prepared by teachers from simple materials. The use of materials around the child was also adopted by Lestari and Handayani (2024), who used soap wrappers, used plastic cups, twigs, and leaves in their STEAM activities, although Wulandari and Arifah (2023) noted that implementing STEAM still requires adequate facilities and infrastructure. Material durability needs attention because Ashadi et al. (2025) found that this aspect received a relatively lower rating for their busy book media. The use of polite language, pictures, and play activities also makes it possible to discuss sensitive topics in an age-appropriate way and in line with local values of modesty, so that teachers do not confront the taboo head-on. This is in line with Wulandari and Arifah (2023), who emphasized that early childhood learning should not be forced and should be packaged enjoyably so that children do not feel they are being taught. Schools can integrate it into daily lesson plans and pair it with parent education.

The mapping between STEAM elements and self-protection indicators also offers lessons for the design of future media. Engineering activities, namely assembling the body puzzle and building a safe place, turn ideas about private body parts and places of refuge that were originally abstract into tasks that children can see and hold. Art activities give

shy children room to convey messages through posters, so that children do not feel "tested." Science and mathematics activities make the concepts of safe and unsafe into rules that can be sorted by color and paired with pictures. Thus, each element does not merely add variety but has a clear pedagogical function. A design like this is better than merely attaching the word STEAM to activities that remain lectures.

In terms of practice, the results of this study suggest simple steps for teachers. Begin with activities for getting to know the body and naming body parts correctly, then continue with a touch-sorting game, practice saying "no" together with the character in the video, and finally practice identifying trusted adults. Teachers need to repeat these activities periodically, not just once, because young children need repetition to remember. Teachers also need to make clear to children that an unpleasant event is not the child's fault and that the child may always tell. Gubbels et al. (2021) found that teaching this was associated with larger knowledge effects (d = 0.78 versus 0.41). Teachers' mastery of the STEAM approach also needs to be strengthened. Novitasari et al. (2022) reported that in a training of 38 early childhood teachers, STEAM material was the least mastered (score 74.3) compared with multisensory material (94.96) and loose parts (77.4), and teachers were still confused about how to place STEAM in learning. Lestari and Handayani (2024) likewise advised that teachers prepare themselves and master the STEAM method before applying it.

This study has several limitations. First, group assignment was not randomized at the individual level, so other differences between classes may still exist, although initial ability was shown to be equivalent. Second, the study was conducted at only one school with a limited number of participants. Third, measurement was carried out immediately after the treatment without follow-up measurement, so the durability of understanding is not yet known. Fourth, some scores were not normally distributed and some children showed a decrease in scores, so the results were confirmed with nonparametric tests. Fifth, the assessment measured understanding through picture scenarios, not children's behavior in real situations, and the raters knew which group the children belonged to. Future research is advised to use multiple schools, raters blinded to group, follow-up measurement several months later, and structured parental involvement.

CONCLUSIONS AND RECOMMENDATIONS

STEAM media themed "My Body Is Precious" are effective in improving the self-protection understanding of Group B children at Save The Kids Kindergarten in Banda

Aceh. Children who learned with these media reached much higher final scores than children who learned conventionally, with an adjusted difference of about 7.57 points out of a maximum score of 40 and a large effect size. Improvement occurred on all four indicators, namely recognizing private body parts, distinguishing safe and unsafe touch, refusing and saying "no," and reporting to a trusted adult. This advantage is thought to stem from learning experiences that are concrete, enjoyable, and multisensory through the combination of science, technology, engineering, arts, and mathematics.

Based on these conclusions, kindergarten teachers are advised to incorporate STEAM-based self-protection activities into their lesson planning and to involve parents so that children's ability to report can be applied at home. School administrators and relevant agencies are advised to provide teacher training and easy-to-replicate activity guides. Future researchers are advised to test these media in more schools with follow-up measurement and with behavior assessments closer to real situations.

ACKNOWLEDGMENTS

The authors thank the principal, teachers, parents, and children of Save The Kids Kindergarten in Banda Aceh who supported the implementation of this study.

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