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Performance of Early Childhood Education Teachers in STEAM Learning

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ABSTRACT:
The purpose of the study was to analyze the performance of early childhood education teachers in implementation STEAM learning through classroom supervision. The research method was mixed quantitative and qualitative methods. The researcher selected 8 Kindergartens with 8 supervisors conduct performance appraissal to teachers at there. The sampling technique used purposive sampling. Collection data used classroom supervision's instrument with event-sampling observation technique, and documentation. The results showed from 8 samples of Kindergarten teachers, their performance did not meet the requirements according to performance standards even though the overall average teacher performance score in STEAM learning was in the sufficient category with a mean score of 72,62 The results of the observation significantly supported the gap in teachers performance, namely that the performance of early childhood education teachers during STEAM learning needed to be improved in phases, imclude explore, extend, engage, and evaluate. Constructive feedback included teachers having to be more proactive, clear, and organized in teaching practices in STEAM learning. The implications of this supervision are the basis for the importance of development and improvement teacher skills in implementation STEAM learning with innovative professional development programs.

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1. Introduction

The key to the success of early childhood education organizations is in the work performance of teachers. Teacher performance in early childhood education plays a very important role in determining the performance of schools, especially at the kindergarten level. Early childhood education as foundation on child's future development and some studies suggest has a significant impact on six areas child's development include cognitive, language, physical motor, religious-moral, social-emotional, and art. Furthermore early childhood education teachers play a crucial role in stimulation to ensure optimal growth and development kids.

The acronym of STEAM is Science, Technology, Engineering, Arts, and Mathematics. In recent years Early childhood education teachers in the world face challenges when implementation about STEAM learning. For example in South Korea is growing concern increase students' motivation to study mathematics and science, China focus how to cope with the lack of high-level talents in these subjects, and Australia is preparing for the future in an effort to equip its citizens with the skills necessary to succeed in the changing job market with focus in mathematics, analytical thinking, and problem-solving abilities (Monkeviciene et al., 2020). The Indonesian government has created a roadmap for Indonesian education 2025-2045. One of them is the development of STEAM-based learning and improving the quality of teaching and learning, especially in early Chilhood Education(Kementerian PPN/Bappenas, 2025).

Early childhood education teachers must explore various teaching strategies, including selecting appropriate methods, materials, and conducting evaluations of the learning process (Yaswinda et al., 2021) At this time, early childhood education teachers face professional challenges about STEAM learning. Surprisingly, result interview shown some of teacher in Jember unfamiliar with term STEAM and then they still need clarification to apply it to their students. The teachers in kindergarten under IGTKI Jember have difficulty in understanding the STEAM learning model and its implementation. Many teachers have difficulty in developing STEAM ideas in their teaching modules then they unable to provide learning media that match the concept of the STEAM learning model. Correspondingly, early childhood education teachers think STEAM is impractical, although loose parts materials can be used as STEAM learning materials (Amri et al., 2024). Previous results of community service also shown data on the barriers faced by PAUD teachers regarding STEAM material including the lack of support from schools, the availability of tools and materials to support the creation of STEAM media, and the lack of knowledge and insight of teachers regarding STEAM (Ningsih & Farida,

2023). In a recent study by Erni Rika Safitri indicated inhibiting factors for the implementation STEAM include incomplete learning media, teacher insufficient mastery of STEAM, and adaptation to independent curriculum (Safitri, 2024).

However early childhood education teachers have an important role in STEAM learning. So that principal must be able to manage the performance of teachers in his school mainly to improving overall teacher performance in STEAM learning by academic supervision. Through academic supervision early childhood education teachers will be aware about their weaknesses and strengths and seek ways of self improvement their performance. Effective supervision supports teachers in enhancing their performance, building the skills and confidence for effective classroom practices, fostering professional growth, and improving overall teacher quality (Sunaryo, 2020). Moreover, result survey from World Bank showed the quality of teachers in Indonesia is considered low. This low quality is seen not only in their teaching skills and knowledge but also in their ability to connect with students emotionally. In addition, result from International Student Assessment (PISA) survey showed Indonesia ranks among the lowest in education, coming in at 72 out of 78 countries (Hartati, 2024). This highlights the significant challenges Indonesia faces in improving education system.

Therefore, effective academic supervision should not only compare the actual performance with the standard performance of early childhood education teachers but also identify their strengths and weaknesses. The existing literature has not adequately explored performance early childhood education teachers in STEAM learning from planning until implementation. Moreover few studies have investigated and analyzed performance early childhood education teachers in implementation STEAM learning by academic supervision from principal school's perspectives.

Based on background information on the problem, the purpose of this research was to analyze the performance of early childhood education teachers in implementing STEAM learning. Then this study is guided by the leading research questions 1) how is the level of performance of early childhood education teachers in STEAM learning?; 2) how is performance of early childhood education teachers during the STEAM learning practices?. During this research, we identify their strengths and weaknesses of each teacher when implementation STEAM learning.

2. Methodology

This research method used mixed method quantitative and qualitative approach. Researcher contact of administrators of Association IGTKI District Jember who were involved in the development STEAM learning, then as part of purposive sampling, researcher asked recommendation to contact principal kindergarten who were involved in pratices STEAM learning. The participants this research considered based on they have been actively in practices STEAM learning, involved in managerial roles as supervisor in their school, working in state/public and private early childhood education institutions at Jember, and actively involved in integrating STEAM learning into the Indonesian national curriculum. Participants were eight supervisor evaluate eight early childhood education teachers from 8 different schools.

Table 1 Summarises the participants involved in this study

ID participants	Level group	Topic lesson plan	School	Type of kindergarten
ID1	**B**	Car	TK Dharma Wanita Balung Jember	Private school
ID2	**A**	Fish	TKN Pembina Jenggawah Jember	Public school
ID3	**B**	Orange	TK Al Hikmah Wuluhan Jember	Private school
ID4	**A**	Plant	TK Muslimat NU 54 Jember	Private school
ID5	**A**	Rainbow	TK PGRI Tangjungrejo 06 Wuluhan Jember	Private school
ID6	**A**	My School Garden	TK PGRI Sukoreno Jember	Private school
ID7	**B**	Banana fruit	TK Al Hikmah Panti Jember	Private school
ID8	**A**	Water transportation	TK Baitul Ghufron Ajung Jember	Private school

A total of 8 responses were collected from a survey that examined teacher performance appraisal in two areas include lesson plan and classroom observations. The anothers technique besides observation also documentation. The teacher performance appraisal consist of elements a pre-observation meeting to set schedule visit class, a classroom observation where principals school directly observe STEAM learning activities in class, a rating of the teacher's overall performance, and a post-observation meeting to review the results and a private meeting technique when giving guidance to teachers.

Instrument observations used checklist event-sampling observation technique. Supervisor used this instrument with brief and straightforward and can be completed easily during a lesson period of approximately 60 minutes. Moreover, there were STEAM learning activities from documents shared by teachers, consist of learning materials and a series of activities. The statistical analysis was carried out with the SPSS Program version 26, using descriptive statistics to conclude level performance of early childhood education teachers during the STEAM learning practices. The categorization of norms for processing descriptive data from score result assessment teacher performance in table 2:

Table 2 Norms score result assessment

Range score	Category and Formula	Result level
$X \leq 62$	Unsatisfactory; $X \leq$ Mean – 1,5 Deviation Standard	Performance is consistenly unacceptable
$62 < X \leq 68$	Below expectations; Mean– 1,5 Deviation Standard $< X \leq$ Mean – 0,5 Deviation Standard	Performance fails to meet job requirements
$68 < X \leq 74$	Meets expectations; Mean – 0,5 Deviation Standard $< X \leq$ Mean + 0,5 Deviation Standard	Performance is regularly competent and dependable
$74 < X \leq 80$	Exceeds expectations Mean + 0,5 Deviation Standard $< X \leq$ Mean + 1,5 Deviation Standard	Performance is routinely above job requirements
$X > 80$	Outstanding; Mean + 1,5 Deaviation Standard $< X$	Performance is consistenly superior

The analyze data descriptive qualitative used to identify strengths and weaknesses of each teacher when implementation STEAM learning. The first step is reduction data which is the process of focusing and selecting the most relevant data from the results of observations and documentation. The second step is data display (data presentation) is carried out in the form of narrative descriptions, matrices, or thematic categories to facilitate interpretation and further analysis of strengths and weaknesses of each teacher when implementation STEAM learning. The Final step is verification and conclusions, where researcher made analyzed critically to strengths and weaknesses of each teacher when implementation STEAM learning supported by data field findings during observations.

3. Result/Findings

3.1. Quantitative Result

The data analysis quantitative number of samples of 8 early childhood education teachers found that the most performance level of the early childhood education teacher have a performance fails to meet job requirements. There are 3 teachers which performance teachers fail to meet job requirements with a percentage of 37.5%. There are 2 teachers which performance is regularly competent and dependable with a percentage of 25%. There are 2 teachers which performance is routinely above job requirements with with a percentage of 25%. Furthermore only one teacher with performance is consistenly superior. Overall average performance of teachers at level performance is regularly competent and dependable with mean score 72,62.

Table 3. Average performance teachers

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Performance	8	18	63	81	72.62	2.275	6.435	41.411
Valid N (listwise)	8							

Table 4. Level performance early childhood education teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Performance fails to meet job requirements	3	37.5	37.5	37.5
	Performance is regularly competent and dependable	2	25.0	25.0	62.5
	Performance is routinely above job requirements	2	25.0	25.0	87.5
	Performance is consistenly superior	1	12.5	12.5	100.0
	Total	8	100.0	100.0	

3.2. Qualitative Results

Based on the results of observations with respondents, it can be seen about strengths and weaknesses of each teacher when implementation STEAM learning.

Table 5. Results of observations

Participant	Data observation excerpts	Indicator
ID1	The *media used in this learning included* white buffalo paper, crayons, markers, gutting, double tape, ice cream sticks, and car pictures. *The materials used were quite varied*, but it needed to be emphasized that, in the use of sharp objects, *the teachers had not taught optimally regarding the use of scissors specifically when children used and held scissors correctly and when returning scissors to their place*.	The teacher's skills in the extend phase is good The teacher's skills in the engage phase need improvement
	During STEAM learning, *the teachers still dictated* to the children, which *kept the learning centered on the teacher*. As a result, *the teachers were less able to explore the extent of the children's knowledge about the material presented that da*y, and the children *were not yet able to convey their ideas optimally*.	The teacher's skills in the explore phase need improvement
ID2	The *preparation lesson plan of the steam learning was good*, however, *the term "fish house" was still used, which was not entirely correct and should have been replaced with the term "fish habitat*"	The teacher's skills in the lesson planning is good Teacher's skills in ensuring the acquisition of new vocabulary need improvement
	The results found that students preferred plastic cups and other natural materials over the cardboard materials that had been provided, which were more appropriate for the ability level of group A children aged 4-5 years. The activities included cutting and sticking pictures of fish, decorating fish habitats with grass and stones, and forming fish from plasticine. However, *there were still instances of children fighting over the use of learning media. After watching the video, students were not invited to discuss it through several open-ended questions*.	The teacher's skills in the explore phase need improvement
		
ID3	The *media used in this learning included* oranges, glasses, squeezers, water, plastic cups, ice cubes, sugar, spoons, knives, and so on. The results of the observation of the *use of this media revealed a lack of other materials*, such as loose parts, which could have helped improve children's development in learning STEAM. The teacher *did not make an effort to encourage the children's curiosity or prompt them to ask questions*.	The teacher's skills in the extend phase need improvement The teacher's skills in the explore phase need improvement

Participant	Data observation excerpts	Indicator
	The result of this learning was that *children only focused on the material delivered by the teacher*. The lack of learning media led to limited thinking opportunities for the children.	

ID4	It would have been better if *literacy for students had been increased.* The results found that students preferred plastic cup materials and *painted the plastic cups with their own paint, rather than using the flower pots that had been provided.* 	Teacher's skills in ensuring the acquisition of new vocabulary need improvement
ID5	There was still inappropriate *use of the phrase "Making a rainbow."* The results found that students preferred the rainbow materials and other natural materials that had been provided, which were more appropriate for the ability level of group A children aged 4-5 years. The teacher *gave unclear directions to the children, which caused them to not understand what was being explained.*	Teacher's skills in ensuring the acquisition of new vocabulary need improvement The teacher's skills in the engage phase need improvement
ID6	The media/learning resources used included playdough, fruit plant videos, and guava trees. The *teacher was unable to encourage the children to use the media optimally.* **Explore Phase:** In this phase, *the teacher was unable to stimulate the children's curiosity. The teacher did not ask provocative questions, and the children tended to play alone.* **Extend Phase:** In this phase, the teacher did well in giving children challenges, but there was still room for improvement in helping them find materials or discover things on their own. For example, when asking children to name the materials used to make fruit replicas or to describe the shape of the fruit, the *teacher's approach was still not optimal.* **Engage Phase:** In this phase, the teacher was effective. The teacher successfully engaged the children with the materials and encouraged them to stay busy making their favorite fruits. **Evaluate Phase:** In this phase, *the teacher was not optimal in evaluations.* This was partly because it was break time, and some children cried, feeling that they were unable to make fruit replicas.	The teacher's skills in the explore phase need improvement The teacher's skills in the extend phase need improvement The teacher's skills in the engage phase is good The teacher's skills in the evaluate phase need improvement
ID7	The media used in this learning included bananas, plastic cups, condensed milk, grated cheese, spoons, plastic knives, banana stems, and stamping tools. The results of the observation of *the use of this media showed a lack of other materials*, such as loose parts, which could have helped improve children's development in STEAM learning. *The children only focused on the material presented by the teacher, and the limited availability of learning media resulted in restricted ways of thinking for the children.*	The teacher's skills in the extend phase need improvement The teacher's skills in the engage phase need improvement
ID8	The learning media/resources *were less diverse, such as the use of recycled materials*, straws, and origami paper. *The findings showed a lack of initial agreement.* When children presented their work and played with water, some children still went straight into the pool.	The teacher's skills in the extend phase need improvement The teacher's skills in the engage phase need improvement

Participant	Data observation excerpts	Indicator



STEAM learning model facilitates four play experiences for early childhood included explore, extend, engage, and evaluate (Tim GTK DIKDAS, 2021). Based on the results of observations above, it can be seen that performance of early childhood education teacher during STEAM learning need improvement in various areas included explore, extend, engage, and evaluate. Furthermore teacher's skills in ensuring the acquisition of new vocabulary need improvement.

Table 6. Feedback for improvement

Participant	Feedback supervision
ID1	Teachers should always remind children how to use sharp objects safely. They often act as instructors rather than facilitators for the children.
ID2	After watching the video, students need invite to discuss it through several questions to assess how much their knowledge had developed. Coordination in the use of materials/media ran smoothly and orderly, so the students did not have to fight over which media tool to choose one another
ID3	Coordination in the use of learning media should be organized and smooth, so that students do not have to compete with each other to access the selected media tools. The provision of learning media is limited.
ID4	After watching the video, students need invite to discuss it through several questions to assess how much their knowledge had developed. Coordination in the use of materials/media ran smoothly and orderly, so the students did not have to fight over which media tool to choose one another
ID5	Teachers should use a clearer and simpler approach and ensure that children understand well through concrete examples or other appropriate methods
ID6	Teachers need to improve their approach by providing questions that stimulate children's curiosity and actively involve them in learning activities. They should be more proactive in offering guidance and encouragement, helping children explore materials, and facilitating their search for information to enrich the learning experience. Additionally, teachers must pay more attention to evaluations, support children who are struggling, and ensure they have enough time to complete the activities.
ID7	Coordination in the use of learning media should be organized and smooth, so that students do not have to compete with each other to access the selected media tools. The provision of learning media is limited.
ID8	The use of various media will enhance children's imagination. Teachers should establish an initial agreement to ensure the activities are implemented more effectively

Performance appraissal which is carried out to systematically assess teacher performance and provide space for leaders to provide constructive feedback (Supiansyah et al., 2025). Based feedback supervision above can be concluded as follows:

1. Early childhood education teachers play a crucial role in ensuring the safety and development of children, particularly when using sharp objects or engaging in various learning activities.
2. Teachers should act as facilitators, providing guidance and actively involving students in learning through stimulating questions and clear explanations.
3. Coordination in the use of learning materials and media must be well-organized and efficient, preventing competition among students and ensuring equal access to resources.
4. Early childhood education teachers should support children's curiosity by encouraging exploration and providing necessary support to those who face challenges.
5. Ensuring sufficient time and resources, teachers can enhance children's imagination and create a more effective learning environment.

6. Establishing initial agreements and improving overall coordination will lead to smoother and more productive learning experiences for all students.

4. Discussion

Performance early childhood education teachers very important contributor to organizational effectiveness in recent years. Quality early childhood education depend from performance their teachers cause the success of education and students is closely related to the quality of the performance of the teachers. One of indicator to assessment a teacher's performance can be measured by their work results, assignment outcomes, or activity results within a specific period of time (Joen et al., 2022) Teachers performance is a form of behavior of a teacher's activity in the learning process that is how a teacher make lesson planning, carries out learning activities, and evaluate learning outcomes (Sunaryo, 2020). Making lesson planning, carrying out instruction, and assessing learning results for example indicators of teachers performance (Kilag et al., 2023). The main implication of this research is that it highlights the importance of clearly defining expectations for each teacher in advance. How can teachers function effectively if they do not know what they are being measured against? On the other hand, if teachers clearly understand the expectations, they can evaluate their own performance and make timely adjustments as they carry out their duties without having to wait for the formal evaluation review.

Performance appraisal can be defined as a process of evaluating the accomplishments of teachers, both in the past and present. Performance teachers in STEAM learning assess through indicator lesson plan, implementation STEAM learning, and evaluation learning. This assessment is based on their work environment and their future potential. The purpose of performance appraisal is to identify teachers who contribute positively to the progress and quality of schools (Halmaida et al., 2022). The data analysis quantitative found the most performance level of the early childhood education teachers have a performance fails to meet job requirements although overall average performance of teachers at level performance is regularly competent and dependable with mean score 72,62. This suggested that, although average performance appeared acceptable, there were significant areas where teachers did not fully meet the expectations for their role when implementing STEAM learning. Result performance appraissal showed performance gap between mean score for average performance teachers and level performance of each teachers. Therefore, while the average performance score suggests some degree of reliability, but many teachers failure to meet job requirements. Based on the data, teacher performance in Indonesia was still not satisfactory, then acccording to the results of a World Bank survey conducted in 2020, the quality of teachers in Indonesia was categorized as still low (Hartati, 2024).

The data above confirmed that efforts to improve teacher performance were crucial for schools early childhood education to achieve their established standards. The principal needed to consistently supervision as part performance appraissal early childhood education teachers. Findings previous research showed the higher the quality of supervision, the higher teacher's performance in learning activities (Wardana et al., 2023) Early childhood education teachers face challenges interpreting and enacting STEAM in their classrooms. They have understanding STEAM as a series of activities and tasks rather than a holistic approach to learning then even if after participating in a semester-long course on STEAM integration, teachers in one study reported concern about their lack of experience with STEAM and continued confusion about integrating particular disciplines within STEAM (Boice et al., 2021)

In this study it is known strengths and weaknesses of each teacher when implementation STEAM learning. Correspondingly, result descriptive qualitative describe the teacher's skills in each phase four play experiences for early childhood included explore, extend, engage, and evaluate (Tim GTK DIKDAS, 2021). In the exploration phase, children explore materials using various senses while the teacher tries to encourage children's curiosity and encourages them to ask questions. The extend phase provides further challenges by inviting children to conduct investigations. The teacher provides open challenges for children to solve problems with materials that the teacher has provided or that the children find themselves (collect) materials around them that they will use to solve the problem. Engage phase, children kept involved in the learning experience. For example, teachers provide a little help to some children who need help. In the evaluation phase, the teacher provides time for reflection and evaluation. Based on the results of observations above, it can be seen that performance of early childhood education teacher during STEAM learning need improvement in various areas included explore, extend, engage, and evaluate. Furthermore teacher's skills in ensuring the acquisition of new vocabulary need improvement.

Participant ID1, used media quite varied, but the teachers had not taught optimally regarding the use of scissors specifically when children used and held scissors correctly and when returning scissors to their place. During STEAM learning, the teachers still dictated to the children, which kept the learning centered on the teacher. Participant ID2, preparation lesson plan of the steam learning was good, but need change vocabulary "fish house" should have been replaced with the term "fish habitat" then she were not invited the children to discuss it through several open-ended questions after seen video and let children fighting over the use of learning media. Participant ID3, the teacher did not make an effort to encourage the children's curiosity or prompt them to ask questions. Participant ID4, the teachers would have been better if literacy for students had been increased. Participant ID5, the teacher need change use of the phrase "making a rainbow", but the rainbow materials and other natural materials that had been provided, which were more

appropriate for the ability level of group A children aged 4-5 years. The teacher gave unclear directions to the children, which caused them to not understand what was being explained. Participant ID6, the teacher was unable to encourage the children to use the media optimally then in explore phase the teacher was unable to stimulate the children's curiosity, she did not ask provocative questions, and the children tended to play alone. Furthermore in extend phase, the teacher's approach was still not optimal although in engage phase she successfully engaged the children with the materials and encouraged them to stay busy making their favorite fruits, then in evaluate phase the teacher was not optimal in evaluations. Participant ID7, the the teacher's approach was still not optimal so the children only focused on the material presented by the teacher. Participant ID8, the teacher showed a lack of initial agreement so when children presented their work and played with water, some children still went straight into the pool.

Performance appraissal is the process of recapitulating, analyzing, and advancing the work that an teacher performs with goal to highlight strengths and weaknesses then identify prospects for the development and improvement of skills of teachers (Okemwa & Nyamwaya, 2019). The result research above we seen more closely at the importance of accurately addressing strengths and weaknesses in performance reviews. This findings reinforce that teachers need support, learn, and coach to implementation STEAM learning. Furthermore the constructive feedback delivered during a performance appraisal can inspire growth and boost teachers performance. Comments and feedback from supervisor suggested that teachers had to be proactive, clear, and organized in their teaching, ensure smooth coordination in media use, engage students through stimulating discussions, and provide support and evaluations to foster a productive learning environment in STEAM learning. Early childhood education teachers must provide clear and simple instructions, using concrete examples to make children understand. Moreover teachers must proactive to stimulate children through provocative questions then use various of media to expand children's imagination. Teachers ready make coordination in the use of learning materials and media to avoid competition among students for access. Teachers should ensure a smooth, organized process so that all students can use the media tools without conflict. Additionally, the availability of learning media is limited and must be managed effectively. Then to ensure the effectiveness of activities STEAM learning, teachers should set clear initial agreements regarding the structure and goals of the tasks.

Under supervision teachers will receive coaching to identify their weaknesses and make changes to become professional educators (Kilag et al., 2023). In practice, academic supervision should ideally focus on supporting teachers throughout the learning process, offering constructive feedback, and helping them enhance their teaching skills (Handayani et al., 2025). This supervision have benefits, namely identify teaching problems in STEAM learning, describe teachers performance, to highlight strengths and weaknesses, and then identify prospects for the development and improvement of skills of teachers in process implementation STEAM learning.

5. Conclusion

STEAM learning can be organized in four phase play experiences for early childhood included explore, extend, engage, and evaluate. This research produced several important findings. Result performance appraissal showed performance gap between mean score for average performance teachers and level performance of each teachers. The overall average score of 72,62 indicates that most teachers perform at a competent and dependable but in reality process implementation STEAM learning showed evident that a significant number of teachers fail to meet the required job standards. There are areas of improvement needed for some teachers to fully meet the expectations of their roles. This problem showed prospects for the development and improvement of skills of teachers in process implementation STEAM learning by coaching, learning, training, and building learning communities among teachers.

The performance appraisal feedback helps teachers effectively identify their professional strengths and weaknesses. Constructive feedback from supervisors emphasized key areas for improvement in teachers' approach to STEAM learning. It was highlighted that teachers need to be more proactive, clear, and organized in their teaching practices. Additionally, effective media coordination, engaging students in stimulating discussions, and providing consistent support and evaluations are critical for fostering a productive learning environment. Teachers must provide clear, simple instructions and use concrete examples to facilitate understanding. Proactive engagement, such as asking provocative questions and incorporating various media, is necessary to stimulate children's curiosity and expand their imagination. Coordination in the use of learning materials and media is crucial to prevent competition for access and ensure that all students can engage with the tools without conflict.

The researcher suggested that further studies should be conducted innovative professional development programs by supervision about STEAM learning, then asssessing teacher-student interaction in STEAM learning and effects of professional development on STEAM teaching practices and student outcomes.

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