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The Impact of STEAM Approach Integration on the Development of Cognitive and Communication Skills among Primary School Pupils

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Abstract

This study aims to examine the impact of integration of the Science, Technology, Engineering, Arts, and Mathematics (STEAM) approach on the development of cognitive skills and communication skills among primary school pupils. In the context of engineering 21st Century Education, the STEAM approach is seen as an integrated method that can promote creative thinking, critical thinking, and problem-solving skills. However, its implementation still faces challenges, particularly in designing learning experiences that can effectively enhance communication among students. This study uses a qualitative case study design and involves 76 Year 4 and Year 5 students from one of primary school in Malaysia. Participants were divided into 10 groups, each consisting of seven to eight students. The research instruments include document analysis and semi-structured interviews conducted after a STEAM-based project problem-solving activity was carried out. The findings of the study show that the integration of STEAM helps improve students' ability to communicate more creatively and critically, particularly in written contexts. However, weaknesses were still identified in oral communication, including language usage errors, inaccurate pronunciation, and unclear sentence structure. In written communication, students were found to make mistakes such as spelling errors, the use of mixed languages, and ungrammatical sentences. This study suggests that structured training and pedagogical support be added to strengthen the use of the language for communication skills in the STEAM approach as a whole.

Keywords: STEAM, Communication, Cognitive, Education, Language Integration

Introduction

Nowadays, among initiatives that are receiving attention in teaching and learning is STEAM (Science, Technology, Engineering, Arts, and Mathematics), which combines five main fields to form a more holistic and relevant education with current developments (Yusof, 2020). STEAM education aims to strengthen critical thinking skills, creativity and problem-solving through an integrated approach involving various disciplines (Rahim, Idris, & Salleh, 2018). In this context the integration of the STEAM approach is becoming increasingly significant, as it provides opportunities to master effective communication skills, and to increasing

understanding in technical and scientific fields. Narrative comics, as a form of visual media and literacy, serve as an attractive platform to convey STEAM knowledge through the module, combining text and image elements to engage students and simplify complex concepts. By incorporating a comic narrative writing module, students can apply science, technology, engineering, art, and mathematics concepts in creative stories while developing language skills to convey ideas clearly and effectively. The integration of language elements in STEAM is becoming increasingly significant due to opportunities to master effective communication skills, in addition to increasing understanding in technical and scientific fields (Chew & Lim, 2021).Comic narrative writing allows students to apply science, technology, engineering, art and mathematics concepts in the form of creative stories, while developing language skills to convey ideas and narratives clearly and effectively (Estrella, 2024). According to Ahmad, Bakar, and Rahman (2022), the use of comics in education can increase student engagement and help them understand abstract concepts through interesting visualizations.

However, the main challenge to this approach is to ensure that the materials provided are suitable for various cognitive levels and interests of students. Each student has different thinking abilities and learning styles, even at the same age (Gardner, 1983). In this context, the integration of STEAM using module requires appropriate modules to meet students' needs holistically (Aziz, Ismail, & Yunus, 2020). For example, irrelevant or overly complex modules can cause students to lose interest, thus affecting learning effectiveness (Nordin & Hashim, 2017). Researchers have detected several modules that are implemented cause students to be less interested due to challenges inherent in implementing them.

This study aims to explore the use of STEAM comic narrative writing module on students' interest in creating comics and identify the challenges faced in integrating language with STEAM elements. STEAM comic narrative writing module is an approach that combines science, technology, engineering, art and mathematics education with language skills using comics as a medium for delivering and applying these concepts (Fisher & Frey, 2021). This study also focuses on how the module can be adapted to meet various cognitive levels of students and their needs in 21st century teaching. This study is expected to contribute to the development of more effective and relevant teaching materials in STEAM education by integrating the STEAM approach into a structured, student-oriented comic narrative writing module. The results are expected to strengthen innovative teaching and learning approaches, and improve students' ability to think critically, solve problems, and communicate effectively. (Ministry of Education Malaysia, 2021).

Problem Statement

STEAM education has been identified as an important approach to strengthen students' skills in critical thinking, problem solving and effective communication. However, there are research gaps that have not yet been filled well. Among them is the lack of teaching modules that effectively integrate language elements in the context of STEAM education. Although various studies have shown that the use of visual media such as creating comics can increase student engagement and help with understanding abstract concepts, there is still a lack of teaching materials specifically designed to combine STEAM elements and language skills in one holistic module (Ahmad et al., 2022; Aziz et al., 2020).

In addition, existing teaching modules often do not take into account various cognitive levels and interests of students. This causes the learning materials produced to be either too complex or irrelevant to the needs of students. This situation hinders the effectiveness of STEAM approach, especially in helping students develop language skills through the context of science, technology, engineering, art and mathematics (Gardner, 1983; Nordin & Hashim, 2017). Without an appropriate approach, the full potential of STEAM and language integration cannot be fully utilized.

Furthermore, there are challenges in providing students with learning media that are engaging, relevant and easy to understand and suit different cognitive levels. Comics as a visual medium have been proven to be able to engage students, but in-depth studies on how to use them in STEAM teaching are still limited (Estrella, 2024; McCloud, 1993). Therefore, this study aims to fill this gap by developing and evaluating the effectiveness of a STEAM comic narrative writing module, in addition to identifying the challenges that arise in its use.

Scope of Study

This study examines the effectiveness of integration STEAM using comic narrative writing module that integrates linguistic elements across science, technology, engineering, art and mathematics. It focuses on enhancing student engagement, understanding of STEAM concepts, and identifying challenges in using the module as a learning tool. The findings aim to inform improvements to the module and contribute to the development of innovative, communication-focused teaching materials.

Objectives of the Study

1) Explore the impact of integrating the Science, Technology, Engineering, Arts, and Mathematics (STEAM) approach on the development of cognitive skills and communication skills among primary school pupils.
2) Identify challenges in integrating language and STEAM elements.

Literature Review

Previous studies have shown that the use of comics in Malay language education can increase students' interest in learning. Ali and Mohd (2021) in "The use of comics in Malay language learning" found that students are more interested in learning Malay when visual elements such as comics are used. Narrative comics that combine story elements and pictures provide students with a more enjoyable learning experience. The emphasis on the context depicted through pictures makes Malay language texts easier to understand, especially for students who may have difficulty with more complex traditional reading materials. Comics provide a new way to teach grammar, vocabulary, writing and reading skills (Husamah & In'am, 2024). A study by Nee and Sharaai (2022) also found that narrative comics are considered an effective tool in increasing student engagement in Malay language teaching. These comics help connect elements in the Malay curriculum with concepts in STEAM, such as science and mathematics, in a more interesting and accessible way. Thus, students showed an increase in their mastery of Malay vocabulary and sentence structure when they were involved in activities that used narrative comics. This indicates that narrative comics not only attract students' interest, but improve their language skills in various contexts.

Next, Muhammad Syafiq and Faizal (2022) also supported this finding by showing comics that contain narrative and visual elements provide students with the opportunity to think critically about the situations depicted. This gives them the opportunity to explore concepts in science and mathematics while improving their language proficiency at the same time. The use of these comics makes learning more contextual and appropriate to the way students interact with the world around them, which in turn can stimulate their interest in the Malay language subject.

Although there is great potential in the use of narrative comics to integrate STEAM and Malay knowledge, its implementation is not without challenges. One of the main challenges highlighted is the lack of quality resources and materials that combine these two elements in an effective way. Hanafi and Ahmad (2020) stated that most of the comics produced are more focused on entertainment and pay less attention to the delivery of educational information, especially in technical subjects such as science and mathematics. In teaching Malay language, it is important to produce comics that are not only interesting but also provide a deep understanding of relevant language aspects and STEAM concepts.

In addition, a study by Mohd Radzi (2021) showed that teachers face difficulties in adapting narrative comics into Malay language teaching. Its challenge is the lack of professional training and support among teachers. Most teachers are not formally trained in using comics as a teaching tool, especially in incorporating STEAM elements. This lack of skills makes it difficult for teachers to plan and implement lessons that effectively integrate comics in the classroom (Mohd Nordin, Azmi, & Abdul Hamid, 2019). Imperfect implementation can prevent students from fully benefiting from this approach, thereby reducing the expected positive effects.

Methodology

The research design for this study is qualitative, aiming to gain an in-depth understanding of how the STEAM module approach on the development of cognitive and communication skills and the challenges faced in integrating language and STEAM elements. An in-depth case study approach was employed to explore student experiences within a specific teaching context. The study focuses on examining the integration of STEAM in communication skills teaching, identifying related challenges, and providing insights for the development of enhanced teaching modules. Through this design, the research seeks to gather detailed data on how students interact with the module, how they engage with STEAM concepts, and how these experiences contribute to their language acquisition and cognitive development.

This study was conducted at Universiti Kebangsaan Malaysia and researcher invited students from one of southeastern primary school in Malaysia with a diverse student population. 76 students from the school was selected due to various cultural and cognitive backgrounds, providing an ideal setting for exploring how different students interact with the STEAM comic narrative writing module. Different age such as Year 4 and Year 5 allowed the researcher to observe students' natural learning behaviours while integrating STEAM concepts with language learning. The research aimed to examine how students from different backgrounds engaged with the module in their familiar and comfortable educational setting, thus offering a real-world perspective on the effectiveness of STEAM integration in enhancing Malay communication skills.

Researchers conduct the two-day programme consisted of four activities and involved 75 students. Each designed of four activities to align with the key elements of STEAM (Science, Technology, Engineering, Arts, and Mathematics). All the students had divided by 10 group and each group consist 7 or 8 students. Throughout the programme, the researchers use 100% module that integration of STEAM elements by creating comic narrative. In the 1 slot, students were required to create a character related to STEAM elements such as trees, robots, technology, and so on. In the 2 slot, students were divided into groups and tested through a physical activity, where the researcher conducted an "mini Treasure Hunt" to search for clues related to STEAM. This indirectly allowed the researcher to identify the students' abilities and interests towards STEAM teaching methods, whether through physical activities such as hands-on practice or writing.

These activities were carefully crafted to foster creativity and problem-solving, while also encouraging students to apply their language skills in the context of comic writing and narrative creation. By focusing on STEAM-based activities, the study aimed to assess how students interacted with these concepts and how they could enhance their language acquisition through this interdisciplinary approach.

Table 1
Activities involved by the participants which is divided into slots

No.	Slots	Participants (Students)	Activities
1.	Slot 1	75	Writing sentences using STEAM elements
2.	Slot 2	75	Treasure hunt STEAM elements
3.	Slot 3	75	Building capsules (such as robots, plants)
4.	Slot 4	75	Combination of all of the activities done in order to produce a comic narrative.

Based on the table 1 above activities involved by the participants which is divided into 4 slots. The slots is to observe students cognitive skills and language skills.

Throughout the programme, the researcher conducted interviews using interview protocol and direct observations of the students. Interviews were semi-structured, allowing the researcher to gather rich, qualitative data on the students' experiences, challenges, and perceptions of the module. In addition, the researcher also conducted interviews with the facilitators involved after the programme ended. This is because the facilitators played an important role in teaching and integrating STEAM elements to the students throughout the programme. The researcher also aimed to gather their feedback and perspectives on the students' cognitive development and communication skills. Next, observations were focused on students' engagement levels, group dynamics, and the integration of STEAM principles in their comic creation process. This observation method was conducted using an observation protocol. An observation protocol is a set of guidelines and procedures used to collect data through direct observation of behavior, interactions, and processes within a specific context. In educational research, this protocol helps researchers understand the dynamics within the classroom or student behavior. Belvis, Pineda, Armengol, and Moreno (2013) also stated that observation process proved to be a valuable tool for facilitating reflective practice among

educators regarding their teaching approaches. In addition, this study also employed document analysis. Throughout the programme, students' written outputs from the panels were collected, and upon the programme's completion, the researcher distributed small reflection notes to 75 students. In addition, the dialogues and all forms of written work produced by the students were collected by the researcher for analysis. The written outputs and returned reflections provided the researcher with valuable data, enabling the identification and development of key emerging themes.

The data obtained from the interviews and observations were analyzed thematically. Thematic analysis involved coding the data, identifying key themes, and relating those themes to the study's research questions. This method provided a detailed understanding of the students' learning experiences, their attitudes toward STEAM integration, and the effectiveness of the module in enhancing their communication and language skills.

Findings

Based on the two-day programme conducted at Universiti Kebangsaan Malaysia (UKM) which utilized a module intergration STEAM elements and language. The researcher carried out four activities, referred to as Slot 1 through Slot 4. All data obtained from observations or interviews were thematically analyzed. Thru thematic analysis have been constructed, the researcher will present the data in the form of the identified themes based on each research objectives.

The Impact of Integrating the Science, Technology, Engineering, Arts, and Mathematics (STEAM) Approach on the Development of Cognitive Skills and Communication Skills among Primary School Pupils

This section presents the findings of the study on how the integration of the STEAM approach influences the cognitive and language development of primary school pupils. Through a combination of observation, interviews, and document analysis, three major themes emerged.

Theme 1: Enhancement of Communication Skills

Language Skills

Based on the 75 students involved, the STEAM programme helped in vocabulary expansion. This is prove as students learned many new words throughout the 4 slots of the activities. This can be supported by student interviews and reflections at the end of the program, where students expressed that "this programme was fun because we got to learn new words related to science and technology." This is further supported by the researcher's observations of the comic panels and rubrics produced by the 75 students, where the majority wrote new vocabulary with the guidance of teachers. Although there were spelling errors, the students made an effort.

Listening Skills

Analysis of the second subtheme, majority of the students have listening skills. Based on observations, participants showed a high level of understanding based on the questions given by the researcher. For example, one of the students stated that

"best because of drawing.."

However, a student in semi structure interview did not understand the questions given due to noisy environment which caused participants to not understand the questions given. Based on reflection in Slot 4, some participants expressed embarrassment with the group members because they were not of the same class and not of the same age. This caused participants to be inactive throughout the activities. However, on average, participants listened and were able to produce assignments according to the questions given.

Speaking Skills

Based on observation, all the students are skilled in speaking when questioned by the researcher. They were able to answer questions confidently and do not feel shy to ask questions in front of a public audience. Based on observations, they were also actively involved in every activity carried out. They diligently carried out the tasks that have been given and are not shy to speak and answer questions in front of their friends. Although they speak "Rojak", they were able to communicate with the researcher.

Writing Skills

For the third sub-theme, the researcher could see that majority of the participants in this study could write and construct sentences but with the help of teachers or researchers. Based on the panel and reflection after every slot, all of the participants were able to express their feelings that they would miss and be sad because this programme would end. The participants also hoped that activities like this could be carried out in future because it could foster cooperation between each other

Theme 2: Improvement Social Interactions

Peers

Throughout the program, one of the most prominent developments observed was the improvement in social interactions among participants, particularly through peer collaboration. Based on during programme observations, students were seen actively communicating with their group members to ensure that their responses aligned with the given tasks. This included discussing answers, clarifying instructions, and collectively evaluating whether their work met the expectations outlined in the activities. In addition to collaboration within their own groups, the researcher also noted a pattern of intergroup interaction. Some participants proactively approached members from other groups to exchange ideas and seek inspiration. These spontaneous interactions demonstrated students' willingness to collaborate beyond their assigned teams, showing initiative and social confidence. Such exchanges allowed them to compare perspectives, gain new insights, and learn from peers with different approaches or understanding. Furthermore, reflections collected at the end of the programme revealed that many students recognized the social value of the experience. Several participants explicitly mentioned that the programme helped them make new friends, especially with peers they had not interacted with before. Facilitators also observed that as students became more engaged in the tasks, their communication became more purposeful and constructive. They listened to one another, offered suggestions, and divided roles effectively. This shift from passive or isolated behavior to active teamwork indicates a positive change in how students navigated social settings, ultimately enhancing their overall classroom experience.

Actively Exchange Ideas

The second sub-theme highlights the participants' engagement in exchanging ideas during collaborative tasks. Although such interactions did not occur consistently across all groups, there were instances where students were encouraged to work together, particularly when facilitators explicitly instructed them to complete tasks as a team. This form of structured collaboration provided a platform for students to share opinions, brainstorm solutions, and contribute individual ideas toward a collective goal. One notable example occurred during Slot 3, where students were tasked with constructing a capsule such as a robot using recycled materials. This activity, which required problem-solving, creativity, and physical construction, naturally encouraged collaborative effort. Students were seen discussing which materials would be most effective, how to balance the structure, and how to divide roles based on each team member's strengths. These discussions, though sometimes minimal in depth, represented valuable moments of active idea exchange that contributed to the learning process. Additionally, the presence and support of facilitators played a crucial role in fostering collaboration. In situations where students struggled to initiate discussions or coordinate tasks, facilitators stepped in to prompt dialogue, guide brainstorming sessions, and model effective communication strategies. This intervention not only helped to keep the activity on track but also provided students with examples of how to engage in constructive peer interactions. Participants' reflection notes further supported this observation, with several students mentioning that working in groups helped them understand the task better and allowed them to see different perspectives. Some even expressed a sense of pride in being able to contribute ideas that were accepted by the group, indicating a boost in confidence and a greater sense of belonging.

Facilitator

It was found that the participants stated that the facilitator helped a lot in carrying out the given tasks. The facilitator also stated that participants should play an important role in the group. If not, the students would walk and not do the work. Hence, the facilitator helped the students a lot when building sentences as in Slot 2 and Slot 4 because most students are not interested in writing, let alone building sentences. Students were only active when building weights, drawing and coloring. Based on reflection, students stated that facilitator helped them a lot and they will miss facilitator because of their kindness.

Theme 3: Engaging Students' Interests in STEAM Module

Interest in STEAM Comic Narrative Writing Module

Based on the findings, all participants that involved in STEAM Writing Module were more interested in creative activities such as drawing, coloring and creating robots but less interested in writing activities. At the same time, they can communicate with group members which indirectly can strengthen their relationship. This statement is supported in the reflection for Slot 4 stating "I like to make robots but I don't like to make sentences because I have no ideas" & "best but I don't like to write". Based on the researcher's observations, most students are less interested in activities for Slot 2 and Slot 4 because the activities in these slots mostly ask students to think and solve problems in writing. Also by interviewing the facilitator, most students do if the activities involve their creativity and not in writing "this student is really active, but if we ask him to make short sentences, he really doesn't want to. Because he said it's difficult. But if he's asked to draw or make robots, he's the number one to do it".

Challenges in Integrating Language and Steam Elements

This section discusses the key challenges identified in integrating language learning with STEAM elements in a primary education context. Through observation, interviews, and document analysis, researchers identified three main themes

Theme 1: Limitation of Ideas Among Participants

The analysis of this challenge is related to the experience of using STEAM comic narrative writing module among students, especially Level 2. Based on the study findings, it can be identified from the participants, as they mentioned:

> *"It's hard to do work because we don't know each other...it's embarrassing to talk to friends we don't know"*
> *"Some people don't cooperate because they are not close (don't know each other)"*

Passive Communication and Shyness

Based on the interviews with the participants and teachers, they stated that they were unable to complete the narrative comics due to shyness to communicate, not knowing each other and also differences in levels. As interviewed by teachers:

> *"some did not cooperate because they were not close (they did not know each other)"*

and the participants mentioned:

> *"It was difficult to do the work because we did not know each other. It was embarrassing to talk to friends we did not know"*

Story Continuity

Based on the observations gathered from the panels and the analysis of the comics produced by the participants, the researcher found that many of the students' stories lacked a coherent narrative structure from beginning to end. The majority of the comics did not demonstrate a clear progression of events, making it difficult for readers to follow the storyline or understand the intended message. One of the key reasons identified for this issue was the students' limited vocabulary and language proficiency, particularly in constructing grammatically correct and meaningful sentences. This limitation hindered their ability to articulate thoughts and connect ideas logically, which is essential in storytelling. As a result, many of the comics appeared fragmented, with disjointed scenes and inconsistent character actions or dialogue. Interviews with facilitators further supported these findings. Facilitators noted that while students were often enthusiastic about drawing and visual expression, they struggled significantly when it came to integrating text into their comics. Many pupils lacked confidence in their writing abilities and were hesitant to experiment with language, often relying on simple or repetitive phrases. Some facilitators also mentioned that students tended to focus more on the artistic aspect of the comic rather than the narrative flow, leading to visually appealing work that lacked narrative depth.

Theme 2: Collaborative Practice

As for this challenge, the analysis is related to the experience of using STEAM comic narrative writing module when it comes to the collaborative practice between the participants. Based on the study findings, it can be identified from the participants and facilitators, as they mentioned:

"Everyone cooperated very well because they like creating capsules."
"If you make something like a robot, what do students like if they make lazy sentences...if you make a robot, everyone works together..."

Passive Communication

Based on the results of the interview, participants said they thought students were active in communicating during the activity especially involving creation of robots, capsules and coloring activities. However, during writing activity in Slot 4, majority of the participants were passive because they did not like writing. Most of them felt it boring and not exciting. This is supported by the results of an interview with the participants, as they mentioned:

"It's best because you can make robots, color and draw, but I don't like the part about making sentences..".

Based on observations, students with passive communication tendencies mostly kept to themselves and did not interact with their group members. They perceived sentence-writing activities as boring and not worth discussing.

Theme 3: Student Attitudes

Another type of challenges that can be observed from these activities is involving student attitudes. This challenge plays an important role in analysing the success of the STEAM system for the participants. Based on some of the participants' interviews, they stated that:

" Not really interested..tired..sleepy..last night I went to bed late because I was playing games."
"Not interested in all activities because I was bored"

Participants' Tiredness and Felt Uninterested

According to the observations and interviews with the participants, it can be identified that there were participants who were not active at all during the activities. The students' disinterested and bored attitude caused them to choose not to participate in any activities. This was stated by the participants as *"Not really interested..tired..sleepy..last night I went to bed late because I was playing games.." and "Not interested in all activities because I was bored..".* Based on observations, the researcher found that some students were distracted, such as teasing their friends or running around with their peers, as they were not interested in thinking or constructing sentences. Additionally, according to the reflection papers at the end of the program, some students drew cartoons instead, as they were unwilling to write anything.

Visualization Ability

Visualization skills play an important role in process of producing STEAM narrative comics, but they are also a major challenge for students who are less skilled in drawing and have limited imagination for characters and storylines. As in the interview "I don't like drawing because I'm not good at it, so I can't really imagine characters...", this shows that a lack of drawing skills can make it difficult for someone to imagine and express ideas visually. This difficulty not only hinders creativity, but also affects the integration of language in comics because the individual may rely more on text than illustrations. In an interview with respondent 2, "I just like coloring, I don't like drawing because I'm not good at it, I've never read comics, so I don't understand drawing..if people know, I know", it can be seen that students who lacks experience in reading comics and does not have drawing skills may face

difficulties in effectively applying linguistic elements in comics. These individuals are more comfortable coloring drawings at the same time, indicating that they may be more inclined towards visual expression through color than detailed sketches and illustrations.

Media Influence

This digital era has inspired students to come up with ideas. This is evidenced in interview "I can draw because I see a lot of characters on TikTok, YouTube.. For example, superheroes like Kluang Man.. On TV.. all sorts of things" and "They are one of the ones who can draw because they see a lot of characters on Facebook because I follow cartoonists so that gives me ideas for drawing..", it is clear that the media has great influence in shaping drawing styles and ideas among individuals. However, this influence can also be a challenge in integrating comic elements of STEAM narratives because students tend to imitate existing styles without developing their own creativity and critical thinking.

Code Mixing

Based on observations of the comic panels produced by the students, the researcher found that there was a significant amount of code-mixing. Examples include phrases like "Saya rasa best kerana dapat belajar" ("I feel it's fun because I get to learn"), "team saya best" ("my team is great"), "saya ok je" ("I'm just okay"), and "Saya rasa happy" ("I feel happy"). In these comic panels, students mixed Malay and English languages uncontrollably, which can interfere with the reader's understanding. For instance, in a science-themed comic, students might use technical terms in English such as "gravity" or "name" without providing explanations in Malay, which could make it difficult for readers who are not proficient in English to grasp the intended concepts.

Discussion and Conclusion

This final chapter summarizes the study's findings on students' interest in using STEAM comic narrative writing module and the challenges of integrating language with STEAM elements. It also presents the implications of the findings.

Based on the findings from interviews, observations, and analysis documents most students showed interest in the STEAM comic narrative writing module. This was proven during the activities, as students actively participated from Slot 1 to Slot 4. The activities ran smoothly, and all tasks met the criteria and followed the requirements set by the researcher. The facilitators also played a very important role by assisting students in completing the assigned tasks. Throughout the programmed the researchers observe the students really love when their facilitators help them this also can proven by Luguetti, Oliver, and Parker (2021) Facilitators played a key role in supporting students by building strong, supportive relationships and using a collaborative approach. Instead of directing, they encouraged student involvement, which promoted social, emotional, and identity development. Their guidance created a positive environment that helped students grow both personally and academically.

However, it was also observed that students were less interested when it came to writing or constructing short sentences. For instances, not all the students cooperate well during writing session. For them, writing or building sentences was difficult due to a lack of vocabulary. Students struggled with grammatical sentence construction and experienced confusion in

word choice due to limited vocabulary knowledge (Alisha, Safitri, & Santoso, 2019). The students knew what to do, but when asked to write, they struggled. Therefore, the researcher noted that facilitators provided significant support in helping students complete the writing tasks. In addition, the researcher found that the impact of integrating the STEAM approach on the development of communication skills among primary school pupils is the expansion of students' vocabulary, especially in subjects such as science, mathematics, and technology. This, indirectly, can contribute to students' academic excellence.

The challenges in integrating language in STEAM narrative comics include four main aspects, namely limited ideas, collaborative practices, student attitudes, and language ability. Limited vocabulary and poor communication hinder students from composing clear narratives. Students showed low engagement in writing tasks, preferring hands-on activities like drawing and colouring. In addition, limited language skills also led to frequent code-mixing, affecting clarity. A more systematic teaching strategy is needed to help students overcome this challenge and produce quality comics of both visual and linguistic aspects.

Conclusion and Implications

This study provides meaningful insights into the impact of STEAM approach integration on the development of cognitive and communication skills among primary school pupils and challenges in integrating language and STEAM elements. The findings reveal that the integration of STEAM elements through the comic narrative writing module significantly enhanced students' engagement, creativity, and understanding of scientific concepts. The use of visual and hands-on activities such as drawing, coloring, and constructing models not only stimulated students' cognitive development but also increased their motivation to participate actively in learning.

However, the study also found that language-related tasks, particularly those requiring the construction of grammatically correct and coherent sentences, posed challenges for many students. While students demonstrated enthusiasm in creative aspects, they struggled with limited vocabulary and difficulty in structuring written narratives in Malay. This highlights the need for a more systematic and supportive approach in embedding language development within STEAM activities. Furthermore, the role of teachers and facilitators was found to be crucial in ensuring the success of the module. Effective guidance, interactive teaching strategies, and consistent encouragement enabled students to participate meaningfully and overcome learning barriers. In conclusion, the integration of the STEAM approach when implemented with appropriate support and pedagogical strategies has the potential to be a powerful educational tool that not only strengthens cognitive development but also improves communication skills. For future practice, it is recommended that STEAM modules be further refined to balance creative, cognitive, and linguistic components, ensuring they are inclusive and aligned with students' developmental levels. This study highlights the need for holistic, well-structured teaching modules to enhance students' mastery of both STEAM and language skills. Interactive teaching approaches help students engage with language in STEAM activities. The provision of interactive and contextual learning materials can help students understand STEAM concept more deeply and strengthen their language skills in meaningful situations. In addition, teachers need to be given adequate training in implementing STEAM approach in an integrated manner in teaching and learning. Comprehensive training not only enables teachers to understand STEAM concept clearly, but helps in planning more

interesting and effective activities for students. Therefore, supports from schools and policy makers is also needed to provide sufficient resources to ensure the effectiveness of the implementation of this module in the classroom. Project-based and collaborative learning, such as comic narrative activities, enhance student creativity, communication, and understanding of STEAM concepts. Furthermore, the integration of digital technology in STEAM learning can be one of the solutions to the challenges in language teaching. The use of interactive learning applications, virtual reality (VR) and digital simulations can help students understand more complex concepts more easily and interestingly. Therefore, continuous efforts need to be made to introduce this technology into the education system to improve the effectiveness of teaching and learning.

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