JURNAL PENDIDIKAN SAINS DAN MATEMATIK MALAYSIA
Volume 14 Issue 1 2024 / ISSN 2232-0393 / eISSN 2600-930

Leveraging the ASSURE Model: The Integrated STEAM Module Development for year four Geometry Problem Solving

Memanfaatkan Model ASSURE: Reka Bentuk Modul STEAM Bersepadu untuk Penyelesaian Masalah Geometri Tahun Empat

Farah Aizar Zaipul Bahari* & Salmiza Saleh

School of Educational Studies, Universiti Sains Malaysia,
11800 USM, Pulau Pinang, MALAYSIA

*Corresponding Author: farahaizar@yahoo.com

Published: 14 January 2024

To cite this article (APA): Zaipul Bahari, F. A., & Saleh, S. (2024). Leveraging the ASSURE Model: The Integrated STEAM Module Development for year four Geometry Problem Solving. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, *14*(1), 1–11. https://doi.org/10.37134/jpsmm.vol14.1.1.2024

To link to this article: https://doi.org/10.37134/jpsmm.vol14.1.1.2024

ABSTRACT

This study delves into the exploration of the process of designing an instructional module, the integrated STEAM module, utilising the ASSURE Model. An instructional module, also known as a teaching and learning module, serves as a structured educational tool designed to enrich the teaching and learning experience. This study employs the ASSURE Model, a systematic instructional design framework for developing comprehensive educational materials and engaging learning activities. The ASSURE Model entails six key stages, namely: Analyze learners, State standards and objectives, Select strategies and resources, Utilise resources, Require learner participation, and Evaluate and revise. The overarching aspiration for this module is that it will serve as an effective tool in improving the proficiency of students in problem solving and creative thinking, ultimately contributing to their performance in geometry problem solving and overall achievement in the field of mathematics.

Keywords: Instructional Module, Instructional Design Model, ASSURE Model, Geometry Problem Solving Integrated STEAM, STEAM Approach, STEAM Education

ABSTRAK

Kajian ini mendalami penerokaan proses mereka bentuk modul pengajaran, modul STEAM bersepadu, menggunakan Model ASSURE. Modul pengajaran, juga dikenali sebagai modul pengajaran dan pembelajaran, berfungsi sebagai alat pendidikan berstruktur yang direka untuk memperkayakan pengalaman pengajaran dan pembelajaran. Kajian ini menggunakan Model ASSURE, rangka kerja reka bentuk pengajaran yang sistematik untuk membangunkan bahan pendidikan yang komprehensif dan aktiviti pembelajaran yang menarik. Model ASSURE melibatkan enam peringkat utama, iaitu: Analyze learners, State standards and objectives, Select strategies and resources, Utilise resources, Require learner participation, dan Evaluate and revise. Aspirasi menyeluruh bagi modul ini ialah ia mampu berfungsi sebagai alat yang berkesan dalam meningkatkan kemahiran murid dalam menyelesaikan masalah dan berfikir kreatif, akhirnya menyumbang kepada prestasi mereka dalam penyelesaian masalah geometri dan pencapaian keseluruhan dalam bidang matematik.

Kata Kunci: *Modul Pengajaran, Model Reka Bentuk Pengajaran, Model ASSURE, Penyelesaian Masalah Geometri, STEAM Bersepadu, Pendekatan STEAM, Pendidikan STEAM*

INTRODUCTION

Geometry problem solving represents a multifaceted topic that demands a comprehensive understanding. Numerous research studies have pointed out the challenges associated with acquiring proficiency in geometry problem solving. Specifically, these studies emphasise that a considerable portion of pupils encounters difficulties in the process of honing their geometry problem solving skills (Boo, 2016; Idris, 2006, 2009). Students at the primary school level often confront challenges when attempting to navigate problem solving tasks within the realm of geometry (Nadzeri et al., 2022). Students often encounter difficulties when trying to grasp fundamental geometric concepts. The most common obstacle faced by students is the abstract nature of geometry concepts (Ng & Rosli, 2023). Geometry learning encompasses abstract ideas like shapes, angles, lines, and spatial relationships, making it challenging for students to visualize (Fattah et al., 2021). Besides, when it comes to solving geometry problems, students have difficulties in applying mathematical formulas effectively. Therefore, it is crucial to recognize these challenges because they can impact students' overall mathematics performance and their ability to grasp more advanced mathematical concepts in the future. This suggests that there is a notable need for effective instructional approaches and interventions in this domain. Teachers should tackle these difficulties by employing efficient teaching techniques and resources, such as the integrated STEAM module in this research, to render geometry more approachable and captivating for primary school students.

The instructional module acts as a reservoir of educational content, containing clear teaching methods aimed at fostering a favourable learning environment for effective learning within a specific teaching unit, while also facilitating its development and assessment (Suratnu, 2023). In other words, the instructional module is a structured educational resource designed to facilitate and assist teachers in carrying out the teaching and learning process in order to promote effective learning by providing a clear and organized pathway for pupils to acquire new knowledge or skills.

Numerous instructional design models have been developed to aid individuals in effectively navigating the intricacies of the instructional design process for instructional module development (Martin, 2013). Instructional design encompasses a systematic approach to the development of teaching materials with clear objectives, strategies, feedback, and evaluation (Moore & Kearsley G., 1996), drawing from learning and instructional theories to ensure high-quality education (Bajracharya, 2019), involving the translation of broad teaching and learning principles into guidelines for instructional materials and activities (Branch & Gustafson, 1998), all driven by a scientific methodology to create precise blueprints for educational materials aimed at improving learning outcomes and performance (Martin, 2013). This research explores the development of the instructional module which is the integrated STEAM module that was designed and created through the utilization of the ASSURE model, a well-established framework in instructional design.

LITERATURE REVIEW

Mastery of geometry problem solving stands as a cornerstone within the vast landscape of mathematics. Within the realm of mathematics, the proficiency in solving geometry problems is regarded as essential as it forms the core of this discipline (Schoevers et al., 2020). In the Malaysian education system, the instruction of geometry problem solving commences as early as the first year of primary school. In the initial year, students are introduced to fundamental concepts encompassing two-dimensional and three-dimensional shapes (Curriculum Development Centre, 2016). However, as students progress through their education, the content and complexity of geometry problem solving instruction intensify. For example, year four students explore more advanced concepts, including the computation of perimeter and area, along with the measurement of the volume of three-dimensional objects (Curriculum Development Centre, 2018). Nonetheless, a substantial body of previous research has consistently highlighted the challenges faced by a significant number of students when it comes to effectively addressing and solving geometry-related problems in their educational journey (Agustinsa et al., 2021;

Dosinaeng et al., 2019; Haryanti et al., 2019; Safrina et al., 2022; Shofyan et al., 2021). Hence, there is an urgent need to create and integrate pragmatic instructional approach into the teaching and learning to address and improve the efficiency of geometry problem solving among students.

The STEAM approach encompasses the integration of art disciplines into science, technology, engineering, and mathematics curricula (Katz-Buonincontro, 2018), interpreting science and technology through engineering and arts while incorporating mathematical elements (Yakman, 2008), and employing the fusion of science, technology, engineering, arts, and mathematics to empower students in solving real-world problems (Zamorano et al., 2018). According to Kim et al. (2012), through the integration of STEM and arts, creative abilities can be cultivated by uniting conventional dualistic perceptions that label science as rational and art as irrational. It motivates students to delve into the crossroads, where scientific investigation can ignite artistic creativity, and artistic creativity can, in turn, enrich problem solving abilities within the STEM disciplines.

The STEAM approach seamlessly integrates the five domains of science, technology, engineering, arts, and mathematics, cultivating an interdisciplinary learning environment. When the principles of STEAM are applied to connect mathematics with various subjects and real-world situations, it creates a dynamic and enriching learning experience. This integration, especially when applied to the study of geometry, enhances students' enthusiasm and engagement with mathematics. Ramadani's research in 2020 demonstrated that the utilization of the STEAM approach, particularly in the context of geometry learning, can lead to numerous beneficial effects on students' educational experiences.

Besides, STEAM education nurtures students' creative thinking abilities and functions as a means to enhance their problem solving skills in real-life scenarios (Perignat & Katz-Buonincontro, 2019; Tabiin, 2020). Research by Conradty and Bogner in 2018 provides empirical support for the belief that including artistic elements in STEAM education contributes to fostering creative thinking abilities in learners. Kamil and HR (2023) also posit that the STEAM approach has the capacity to cultivate creative thinking, as substantiated by the consistent presence of a wide array of creative activities associated with it. Through the infusion of artistic components into subjects traditionally centered on STEM, students are stimulated to engage in more imaginative thinking, consider various viewpoints, and tackle problem solving tasks with innovative approaches.

The Malaysian education system has highlighted the importance of shifting instructional methods to prioritize a more interactive and experiential approach within the classroom (Curriculum Development Centre, 2016, 2018). This involves placing greater emphasis on engaging students through hands-on activities in order to enhance their learning experiences. Essentially, the aim is to depart from conventional instructional methods and embrace a teaching approach that actively involves students in practical and meaningful learning experiences. This is where an instructional module can play a crucial role in equipping teachers with the necessary guidance to implement student-centered and effective teaching strategies, thereby enhancing the teaching and learning process. The purpose of this study is to develop an instructional module that integrates multiple subjects, including science, technology, engineering, arts, and mathematics, namely the integrated STEAM module for year four students in the topic of geometry problem solving in order to enhance and promote the skills of problem solving and creative thinking.

RESEARCH OBJECTIVE

1. To develop an integrated STEAM instructional module for year four geometry problem-solving, utilizing the ASSURE Model as a guiding framework.

RESEARCH QUESTION

1. How can the ASSURE Model be applied to systematically design an instructional module for year four geometry problem-solving?

METHOD

This study investigates the development of an instructional module utilizing the ASSURE model on geometry problem solving, tailored for year four students that focused on the STEAM integration approach, combining science, technology, engineering, arts, and mathematics. The ASSURE model was pioneered in 1999 by Heinich, Molenda, Russell, and Smaldino. According to Andrews and Goodson (1980), teachers frequently employ the ASSURE model in the classroom to construct more effective educational environments. Besides, according to Smaldino et al. (2018), the development of the module via the use of the ASSURE model not only holds the promise of offering effective learning activities but also provides efficiency in terms of time and expenses. The utilization of the ASSURE model as an instructional design framework for developing modules in primary mathematics is deemed suitable for cultivating creative and innovative lesson plans (Wahyudi & Winanto, 2018). The rationale behind the implementation of the ASSURE model for this study lies in its straightforward and methodical stage structure that makes it easy for the researcher in the process of developing the module. The model's reliability is well-established, having been widely employed by numerous educators in the instructional process (D. Kim & Downey, 2016).

FINDINGS AND DISCUSSIONS

The acronym ASSURE, as highlighted by Smaldino et al. (2018), represents the incorporation of six interconnected stages that drive the process of developing instructional modules, which include:

1. **A**nalyze learners.
2. **S**tate standards and objectives.
3. **S**elect strategies and resources.
4. **U**tilise resources.
5. **R**equire learner participation.
6. **E**valuate and revise.

Figure 1 illustrates the integrated STEAM module development process using the ASSURE model, as outlined below.

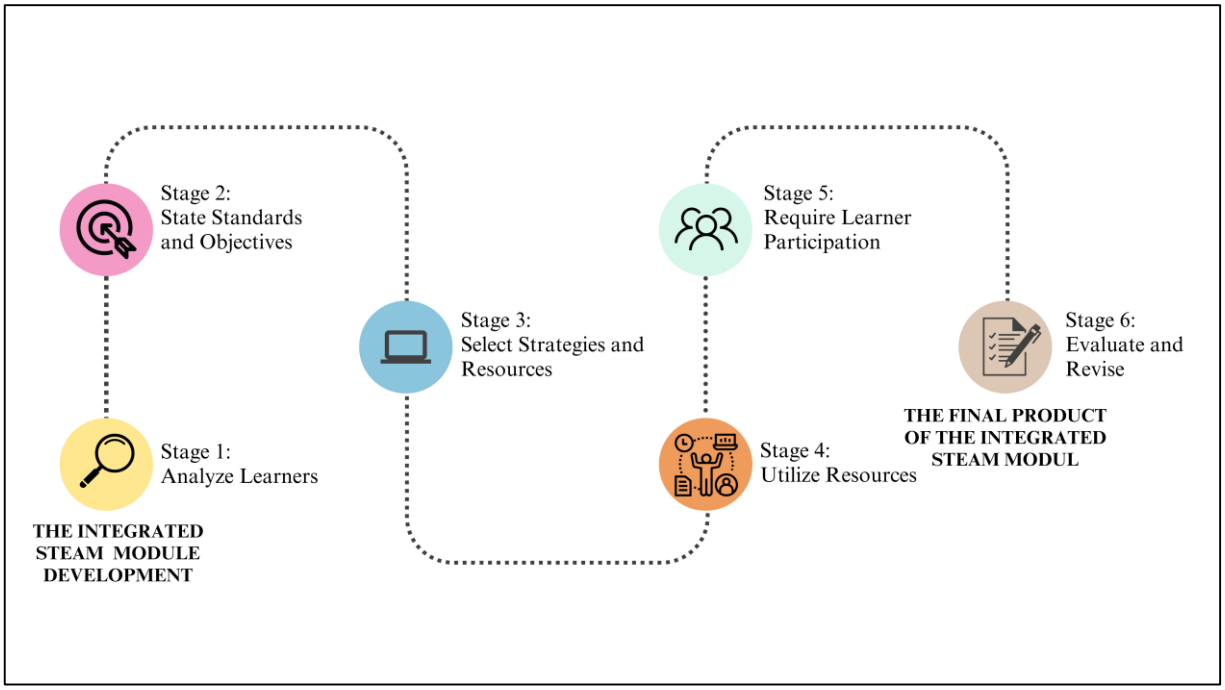

Figure 1: The Development Process of the Integrated STEAM Module using the ASSURE Model

Stage 1: Analyze Learners

The first stage of the ASSURE model encompasses the analysis of learners. Qualitative needs assessments are performed to examine both teachers' and students' requirements. These assessments are typically carried out to identify what is essential, what is deficient, and what requires attention within the context of geometry problem-solving teaching and learning. The aim of this procedure is to guarantee that the instructional design created aligns with the genuine requirements of the students. The researchers employ semi-structured interviews to assess the needs of both teachers and students. Specifically, this analysis involves six year four students and three primary mathematics teachers. These participants are selected using the purposive sampling method. Within the scope of the study, the analysis process encompasses two principal categories:

1. Students' needs analysis.
2. Teachers' needs analysis.

Students Needs Analysis

During the analysis stage of gathering information related to the needs analysis of the year four students, key inquiries are posed, including:

1. What problems do you face when solving geometry problem solving questions?
2. How do you learn the topic of geometry problem solving?
3. What learning activities can help you solve geometry problems?
4. What is your opinion about the incorporation of other subjects into geometry problem solving learning?

Teachers Needs Analysis

Meanwhile, in the context of collecting data related to the needs analysis of teachers, essential questions are asked during the analysis stage, including:

1. What are the main problems faced in geometry problem solving teaching and learning?
2. What teaching methods do you often use in geometry problem solving teaching and learning?
3. State how you improve students' problem-solving skills in geometry problem solving.
4. State how you improve students' creative thinking skills in geometry problem solving.
5. What do you think about the integration of other subjects in geometry problem solving teaching and learning?
6. What do you think about the use of an instructional module for geometry problem solving?
7. List the characteristics/content for the geometry problem-solving learning module that is expected.

In summary, it is crucial to address these key questions in the initial stage of the study. The responses obtained at this stage serve as valuable inputs for the subsequent design stage for the development of the instructional module for this research.

Stage 2: State Standards and Objectives

The second stage of developing the instructional module according to the ASSURE model involves articulating the objectives. Clarity in stating the standards and learning objectives for the lesson is essential (Smaldino et al., 2018). In the context of this study, two distinct categories of objectives have been identified by the researcher:

1. The objectives for the instructional module.
2. The standards and objectives for the teaching and learning sessions involving the topic of geometry problem solving.

The Instructional Module Objectives

In this research, the integrated STEAM module is created to enhance geometry problem-solving through STEAM integration. It aims to provide teachers with an innovative instructional approach, encouraging students' natural curiosity and creativity. The module also acts as a teaching guide, incorporating Van Hiele Instructional Phase and teaching aids. Additionally, it expands existing teacher resources, especially in mathematics and geometry. For students, the integrated STEAM module aims to develop problem-solving and creative thinking abilities. It aims to promote active participation in STEAM-integrated learning activities, aligning with social constructivist and experiential learning theories. This approach allows students to apply prior knowledge from various subjects, making geometry problem-solving more engaging and efficient.

The Standards and Objectives for Geometry Problem Solving Teaching and Learning Sessions

The integrated STEAM module is developed to enhance geometry problem-solving through STEAM integration for year four geometry problem-solving, primarily focusing on space-related topics. It features daily lesson plans and specific problem-solving tasks for each of the six teaching and learning sessions. These sessions also include group activities. The integrated STEAM module establishes explicit learning standards and objectives for each teaching and learning session, aligning them with the Year Four Mathematics Curriculum and Assessment Standards Document (DSKP) (Curriculum Development Centre, 2018), as shown in Table 1.

Table 1: The Standards and Objectives for Teaching and Learning Sessions

Teaching and Learning Session	Learning Standard	Learning Objective
1	Solve space-related problems.	Pupils will be able to solve perimeter-related problems at the end of the lesson.
2	Solve space-related problems.	Pupils will be able to solve area-related problems at the end of the lesson.
3	Solve space-related problems.	Pupils will be able to solve perimeter and area-related problems at the end of the lesson.
4	Solve space-related problems.	Pupils will be able to solve perimeter and area-related problems at the end of the lesson.
5	Solve space-related problems.	Pupils will be able to solve volume-related problems at the end of the lesson.
6	Solve space-related problems.	Pupils will be able to solve volume-related problems at the end of the lesson.

Stage 3: Select Strategies and Resources

This study adopts a STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach, which distinguishes itself from the traditional STEM approach by incorporating the arts alongside science, technology, engineering, and mathematics. In teaching and learning geometry problem-solving with STEAM integration, teachers combine two or more STEAM subjects. Here's a concise summary of the integrated STEAM subjects in teaching and learning geometry problem-solving, each with a brief description:

1. Science - Exploring science concept, handling and interpreting data.
2. Technology - Using computer software and online resources.
3. Engineering - Developing inventive solutions.
4. Arts - Imagining and expressing geometric shapes and patterns
5. Mathematics - Learning mathematical concepts and computations

In addition to the STEAM approach, the researcher integrates the Van Hiele Instructional Phase as the basis for delivering teaching and learning sessions. This phase consists of five stages: (i) Information, (ii) Guided Orientation, (iii) Explicitation, (iv) Free Orientation, and (v) Integration, which are incorporated into the integrated STEAM module to depict the learning progression in geometry problem-solving.

These phases are clearly detailed in the daily lesson plan (RPH) to aid teachers in understanding their implementation in STEAM-based geometry problem-solving. In essence, the planned activities for teaching and learning geometry problem-solving follow social constructivism principles, emphasizing active engagement and interpersonal communication, leading to creativity.

In terms of teaching and learning resources, the integrated STEAM module incorporates various instructional media for teachers, including the daily lesson plans, geometry problem-solving tasks, blank answer sheets for students, and suggested answers for teachers. The resources are designed to serve as valuable references for teachers who will implement the module in their teaching.

Stage 4: Utilize Resources

The fourth stage, in alignment with the ASSURE Model, revolves around utilizing technology, media, and materials. This phase entails two primary components:

1. Module Prototype.
2. Learners and Environment Preparation.

Module Prototype

During the development of the integrated STEAM module, the researchers create an instructional module prototype. Canva, a widely accessible online graphic design tool, is utilized for this purpose, providing the flexibility of designing the module from anywhere with an internet connection. This prototype serves as a replica of the actual module, crucial for validation and pilot testing.

Learners and Environment Preparation

To initiate a pilot study, thirty year four students from a primary school are engaged. Prior to commencing the pilot study, the researchers carefully tailor a conducive learning environment to complement the planned geometry problem-solving activities. The researchers collaborate closely with the school to ensure that the learning place and all the necessary equipment are provided for the smoothness of the teaching and learning sessions.

Stage 5: Require Learner Participation

The fifth stage of developing the integrated STEAM module emphasizes the requirement for learner participation. To facilitate this phase, the researchers conduct a pilot study at a primary school with the participation of thirty year four students. During this stage, the focus is on preparing both the teacher and the students for active involvement in the teaching and learning process.

Stage 6: Evaluate and Revise

In the final stage of the development of the integrated STEAM module, the critical steps are addressed, as illustrated in Figure 2.

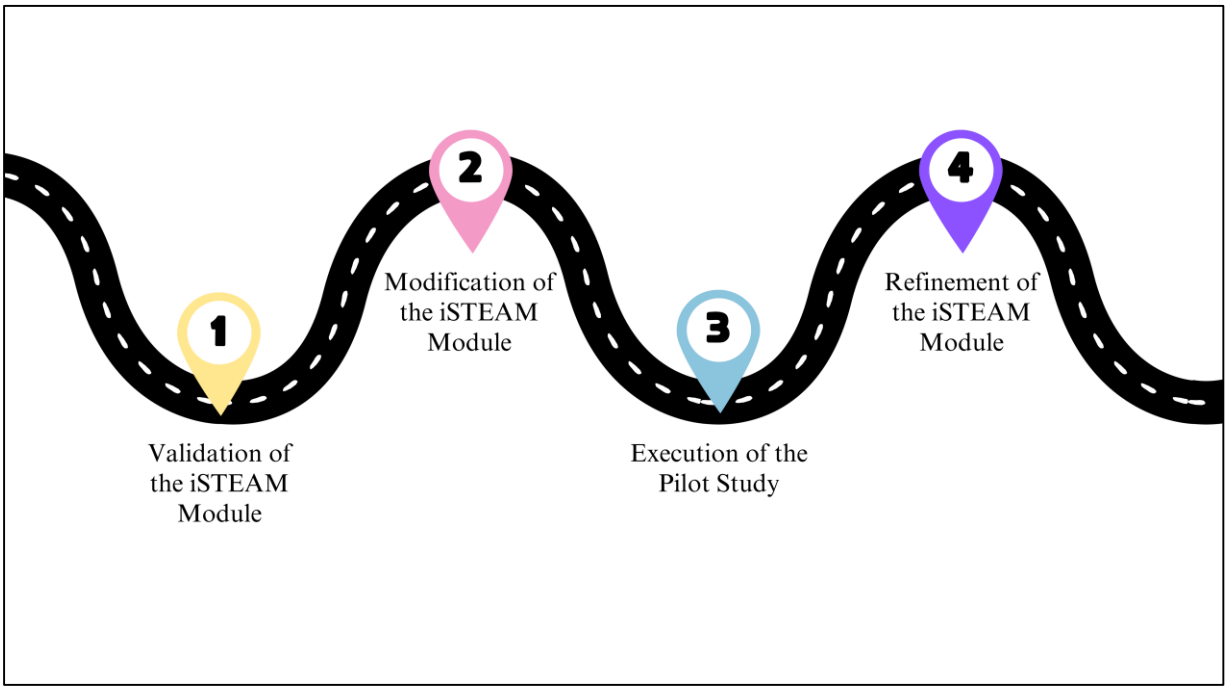

Figure 1: The Development Process of the Integrated STEAM Module using the ASSURE Model

Validation of the integrated STEAM Module

The module undergoes validation by a panel consisting of six experts, focusing on both face and content validity. Experts evaluate the module's language, spelling, and punctuation (face validity), as well as its alignment with Year Four Mathematics Curriculum and Assessment Standards (content validity). The module achieves content validity score of 91.56%, surpassing the 70% threshold set for indicating strong content validity (Mohd Noah & Ahmad, 2005). Hence, it can be confidently asserted that the module exhibits a notable degree of content validity.

Modification of the integrated STEAM Module

Feedback and recommendations from experts guide the modification process, addressing any identified issues or areas for improvement.

Execution of the Pilot Study

A pilot study involving thirty year four students is conducted to assess the module's practicality, strengths, and weaknesses in the teaching and learning. Feedback gathered during the pilot study inform refinements to the module.

Refinement of the integrated STEAM Module

Using insights from the pilot study, the module undergoes further refinement, ensuring that identified weaknesses are addressed.

CONCLUSION

The development of an instructional module for geometry problem-solving is crucial in assisting educators in conducting structured and innovative teaching and learning sessions. This research demonstrates the effectiveness of the ASSURE Model as a systematic framework for designing and developing the integrated STEAM module, which comprises six stages: (i) Analyze learners, (ii) State standards and objectives, (iii) Select strategies and resources, (iv) Utilize resources, (v) Require learner participation, and (vi) Evaluate and revise. This module serves as a valuable resource for teachers, enabling them to efficiently and effectively instruct students in teaching and learning geometry problem solving. By integrating elements of science, technology, engineering, and arts into geometry problem solving within mathematics instruction, teachers can acquire new skills and effective pedagogical approaches, fostering engaging and successful teaching practices.

RECOMMENDATION

Future studies may explore how the integrated STEAM module influences the development of geometry problem-solving abilities in year four students, aiming to enhance their proficiency in tackling geometry problems. Additionally, similar research can be extended to students at different grade levels, and further studies can investigate various topics within mathematics.

ACKNOWLEDGEMENT

This research was made possible through the invaluable support of the Education Sponsorship Division of the Ministry of Education Malaysia and the School of Educational Studies at Universiti Sains Malaysia (USM). The authors would like to express their profound gratitude to both of these institutions.

REFERENCES

Agustinsa, R., Muchlis, E. E., & Maizora, S. (2021). Level of student understanding in solving geometry problems based on taxonomy of SOLO (Structure of Observed Learning Outcomes). *Journal of Physics: Conference Series*, *1731*(1). https://doi.org/10.1088/1742-6596/1731/1/012055

Andrews, D. H., & Goodson, L. A. (1980). A comparative analysis of models of instructional design. *Journal of Instructional Development*, *3*(4). https://doi.org/10.1007/BF02904348

Bajracharya, J. R. (2019). Instructional design and models: ASSURE and Kemp. *Journal of Education and Research*, *9*(2). https://doi.org/10.3126/jer.v9i2.30459

Boo, J. Y. (2016). Teaching and learning of geometry in primary school using GeoGebra. *Proceedings of the 21st Asian Conference on Technology in Mathematics, December*.

Branch, R. M., & Gustafson, K. L. (1998). *Re-visioning models of instructional development*.

Curriculum Development Centre, M. of E. M. (2016). *Dokumen Standard Kurikulum dan Pentaksiran Matematik Matematik Tahun 1*. Putrajaya: Bahagian Pembangunan Kurikulum, KPM.

Curriculum Development Centre, M. of E. M. (2018). *Dokumen Standard Kurikulum dan Pentaksiran Matematik Matematik Tahun 4*. Putrajaya: Bahagian Pembangunan Kurikulum, KPM.

Dosinaeng, W. B. N., Leton, S. I., & Lakapu, M. (2019). Kemampuan mahasiswa dalam menyelesaikan masalah matematis berorientasi HOTS. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *3*(2). https://doi.org/10.33603/jnpm.v3i2.2197

E. Smaldino, S., Lowther, D. L., & Russell, J. D. (2018). Instructional technology and media for learning tenth edition. In *Journal of Materials Processing Technology* (Vol. 1, Issue 1).

Fattah, A., Yahya, T., Siraj, F. H., Kurniawan, S., & Mat Zain, H. (2021). Need Analysis for Development of Pedagogical Model Integration of Visualization Technology to Enhance Performance in Geometry. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, *11*(2).

Haryanti, M. D., Herman, T., & Prabawanto, S. (2019). Analysis of students' error in solving mathematical word problems in geometry. *Journal of Physics: Conference Series*, *1157*(4). https://doi.org/10.1088/1742-6596/1157/4/042084

Heinich, R., Molenda, M., Russell, J., & Smaldino, S. (1999). Instructional media and technologies for learning. In *University of Georgia* (6th ed.).

Idris, N. (2006). *Teaching and learning of mathematics make sense and developing cognitives abilities* (1st ed.). Utusan Publications & Distributors Sdn Bhd.

Idris, N. (2009). The impact of using geometers' sketchpad on Malaysian students' achievement and Van Hiele geometric thinking. *Journal of Mathematics Education*, *2*(2).

Kamil, N., & HR, E. A. (2023). Implementation of STEAM in Preschool as a 21st-Century Learning Innovation. *JOYCED: Journal of Early Childhood Education*, *3*(1), 54–65.

Katz-Buonincontro, J. (2018). Gathering STE(A)M: Policy, curricular, and programmatic developments in arts-based science, technology, engineering, and mathematics education introduction to the special issue of arts education policy review: STEAM focus. In *Arts Education Policy Review* (Vol. 119, Issue 2). https://doi.org/10.1080/10632913.2017.1407979

Kim, D., & Downey, S. (2016). Examining the use of the ASSURE model by K–12 teachers. *Computers in the Schools*, *33*(3). https://doi.org/10.1080/07380569.2016.1203208

Kim, E. J., Kim, S. H., Nam, D. S., & Lee, T. W. (2012). Development of STEAM program Math centered for Middle School Students. *Proceedings of the 20th International Conference on Computers in Education, ICCE 2012*.

Martin, F. (2013). Development of an Interactive Multimedia Instructional Module. In *The Journal of Applied Instructional Design* • (Vol. 3, Issue 3). https://www.researchgate.net/publication/272151941

Mohd Noah, S., & Ahmad, J. (2005). *Pembinaan modul: Bagaimana membina modul latihan dan modul akademik.* Penerbit Universiti Putra Malaysia.

Moore, M. G., & Kearsley G. (1996). *Distance education: A systems view*. Wadsworth Publishing Company.

Nadzeri, M. B., Chew, C. M., Musa, M., Mohd Noor, M. A., Abu Hassan, A. H., & Ismail, I. M. (2022). Analysis of misconceptions on learning geometry for second-grade primary school pupils. *Jurnal Pendidikan Sains Dan Matematik Malaysia Matematik Malaysia*, *12*(1), 16–23. https://doi.org/https://doi.org/10.37134/jpsmm.vol12.1.2.2022

Ng, A. P., & Rosli, R. (2023). Systematic Literature Review: The Use of GeoGebra Software in Geometry Learning: Sorotan Literatur Bersistematik: Penggunaan Perisian GeoGebra dalam Pembelajaran Geometri. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, *13*(1), 64–78.

Perignat, E., & Katz-Buonincontro, J. (2019). What does creativity look like in the STEAM classroom. *Circe Magazine: Steam Edition*, 66.

Ramadani, E. (2020). Pengembangan Handout Matematika Berbasis Pendekatan STEAM (Science, Technology, Engineering, Arts, and Mathematics) pada Materi Bangun Ruang Sisi Datar untuk Siswa Kelas VIII SMP. *Pada Materi Bangun Ruang Sisi Datar Untuk Siswa Kelas VIII SMP*.

Safrina, Y., Ikhsan, M., & Zubainur, C. M. (2022). Improving student geometry problem-solving skills through spatial training. *Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, 30–37.

Schoevers, E. M., Leseman, P. P. M., & Kroesbergen, E. H. (2020). Enriching mathematics education with visual arts: Effects on elementary school students' ability in geometry and visual arts. *International Journal of Science and Mathematics Education*, *18*(8). https://doi.org/10.1007/s10763-019-10018-z

Shofyan, A., Sunardi, Yuliati, N., Nuryami, & Rizkika, P. (2021). The development of worksheet oriented by visual learning style to measure geometry problem-solving skills. *Journal of Physics: Conference Series*, *1839*(1). https://doi.org/10.1088/1742-6596/1839/1/012011

Smaldino, S. E., Lowther, D. L., & Mims, C. (2018). *Instructional technology and media for learning* (12th ed.). Boston: Pearson Education, Inc.

Suratnu, R. (2023). The adoption of the ADDIE model in designing an instructional module: The case of Malay language remove students. *IJIET (International Journal of Indonesian Education and Teaching)*, *7*(2), 262–270. https://doi.org/10.24071/ijiet.v7i2.3521

Tabiin, A. (2020). Implementation of STEAM Method (Science, Technology, Engineering, Arts And Mathematics) for Early Childhood Developing in Kindergarten Mutiara Paradise Pekalongan. *Early Childhood Research Journal (ECRJ)*, *2*(2). https://doi.org/10.23917/ecrj.v2i2.9903

Wahyudi, W., & Winanto, A. (2018). Development of Project-based Blended Learning (PjB2L) Model To Increase Pre-Service Primary Teacher Creativity. *Journal of Educational Science and Technology (EST)*. https://doi.org/10.26858/est.v4i2.5563

Yakman, G. (2008). STEAM education: An overview of creating a model of intergrative education. *Pupils Attitudes Towards Technology 2008 Annual Proceedings*, *53*(9).

Zamorano, T., García, Y., & Reyes, D. (2018). Educación para el sujeto del siglo XXI: principales características del enfoque STEAM desde la mirada educacional. *Contextos: Estudios de Humanidades y Ciencias Sociales*, *41*.