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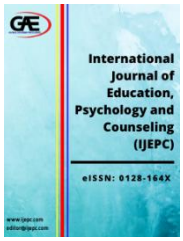

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DEVELOPMENT OF MINECRAFT EDUCATION DIGITAL STORYTELLING (MEDS) MODULE FOR PRIMARY GEOMETRY LEARNING

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Abstract:

The integration of digital technologies in mathematics education has created opportunities to enhance students' engagement and conceptual understanding through interactive learning environments. Nevertheless, many primary school students continue to experience difficulties in learning geometry, particularly in visualising geometric shapes and understanding perimeter, area, and volume. Although Minecraft Education and digital storytelling have been used independently in educational settings, limited research has focused on developing a structured instructional module that systematically integrates both approaches for primary geometry learning. Therefore, this study aimed to develop the Minecraft Education Digital Storytelling (MEDS) Module for primary geometry learning using the ADDIE instructional design model involving five phases: Analysis, Design, Development, Implementation, and Evaluation. The needs analysis involved 10 primary school mathematics teachers and 100 Year 4 students, while five experts participated in the content validation process and 20 Year 5 students participated in the pilot implementation. The MEDS Module was developed as an eight-week instructional programme that integrates Minecraft Education, Digital Storytelling and Gamified Project-Based Learning to support geometry learning through collaborative construction, mathematical explanation, storytelling, and machinima production activities. The evaluation findings showed that the MEDS Module achieved high content validity (CVI = 0.89) and high reliability (Cronbach's Alpha = 0.87), indicating satisfactory content validity and internal consistency. The module is valid, reliable, and suitable for implementation in primary mathematics classrooms. Overall, the MEDS Module provides teachers with a structured instructional resource for teaching

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perimeter, area, volume, and geometry problem-solving while supporting students' spatial visualisation, creativity, communication, collaboration, and critical thinking.

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Digital Storytelling, Game-Based Learning, Geometry Learning, Minecraft Education, Module Development, Primary Mathematics

Introduction

The use of digital technologies in education has rapidly evolved and transformed learning, leading to new opportunities to engage, collaborate and learn in new ways. In today's educational landscape, technology has become an integral part of the learning environment as a valuable tool for nurturing twenty-first-century skills, especially critical thinking, creativity, communication, and problem-solving (Mishra & Koehler, 2006; Voogt & Roblin, 2012). In this evolving educational context, educators are encouraged to leave behind traditional teaching methods and consider ways that technology can enhance students' learning process. In the field of mathematics education, digital environments can offer opportunities for students to interact with and make sense of concepts that can be abstract without them (UNESCO, 2023).

Geometry is an important area of primary mathematics because it involves spatial reasoning, visualisation, measurement, and problem-solving skills (Battista, 2007; Clements & Sarama, 2011; Harris et al., 2024). However, many primary school students experience difficulties in understanding geometric concepts, especially when they are required to visualise shapes, interpret spatial relationships, and apply concepts such as perimeter, area, and volume in meaningful situations. Previous studies have reported that students may confuse geometric terms, struggle to distinguish between related measurement concepts, and face difficulties when applying formulas to real-life problems (Mulligan & Mitchelmore, 2009; Hartini Ismail et al., 2020; Tangkui, 2022; Putri et al., 2025). These challenges suggest that geometry should not be taught primarily through static diagrams, memorised formulas, and procedural exercises. Instead, students need opportunities to manipulate, construct, explore, and discuss geometric ideas in visual and contextualised learning environments (Noor Atiqah Hashim et al., 2023).

A potentially fruitful path involves the integration of Gamified Project-Based Learning (GPBL) which combines game-based learning with project-based learning, providing meaningful opportunities for students to communicate, collaborate, solve authentic problems, and actively

construct mathematical knowledge (Huang et al., 2023; Himmi et al., 2025). Game platform as Minecraft Education enable students to explore maths concepts in a three-dimensional space, allowing them to make concepts more real and accessible to them (Short, 2012; Nebel et al., 2016; Karsenti & Bugmann, 2017). Digital storytelling can further strengthen this learning process by providing students with opportunities to organise, explain, and communicate their mathematical understanding through narrative, visuals, audio, video, and reflection (Robin, 2008; Lambert, 2013; Ohler, 2013). When digital storytelling is integrated with Minecraft Education, students do not only construct geometric models in a virtual environment. They are also encouraged to explain the mathematical ideas represented in their constructions, justify their calculations, and communicate their learning through scripts, storyboards, narration, and machinima production. This integration may therefore connect visual construction with mathematical reasoning, communication, creativity, and reflection.

Although previous studies have examined Minecraft Education, game-based learning, project-based learning, and digital storytelling in different educational contexts, these approaches are often studied or implemented separately. There remains a need for a structured and validated instructional module that systematically combines Minecraft Education, Digital Storytelling, and GPBL specifically for primary geometry learning. Without a clear instructional framework, teachers may find it difficult to integrate these technologies into coherent classroom activities that are aligned with curriculum objectives and meaningful mathematical learning.

To address this need, the Minecraft Education Digital Storytelling (MEDS) Module was developed using the ADDIE instructional design model. The module integrates Minecraft Education, Digital Storytelling, Gamified Project-Based Learning, and structured geometry activities within an eight-week instructional programme. This article describes the systematic development of the MEDS Module and presents its theoretical foundations, instructional components, implementation procedures, content validation, and pilot evaluation.

Literature Review

Social Constructivism and Gamified Project-Based Learning in MEDS Module

Social Constructivism theory provides the theoretical foundation for the development of the MEDS Module. According to Vygotsky (1978), learning is an active process in which individuals construct knowledge through social interaction, collaboration, and meaningful experiences. From this perspective, students develop understanding by interacting with peers, teachers, and their learning environment while communicating ideas, exploring concepts, and solving problems together. The concept of the Zone of Proximal Development (ZPD) further emphasises the importance of scaffolding and peer support in helping learners progress beyond what they can accomplish independently (Vygotsky, 1978). Previous research has shown that collaborative learning environments can foster deeper conceptual learning, critical thinking and active engagement of students in the learning process by allowing students to negotiate meaning and work collaboratively to solve problems (Bell, 2010; Krajcik & Blumenfeld, 2006). The principles of Minecraft Education are very similar, as the students collaborate to build virtual artifacts, coordinate ideas and solve real-world problems in shared virtual worlds. Digital Game-Based Learning (DGBL) and Gamified Project-Based Learning (GPBL) are also used as pedagogical designs in the MEDS Module. DGBL incorporates learning content into the game scenarios, resulting in the learning process in DGBL becomes learning through exploration, interaction and problem solving (Gee, 2003; Prensky, 2007). Previous studies have

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demonstrated that game-based learning improves motivation, engagement, conceptual understanding, and higher-order thinking skills, especially in mathematics where the abstract concepts can pose challenges for learning (Plass et al., 2015; Qian & Clark, 2016; Huang et al., 2023). Likewise, GPBL integrates real-world project tasks with motivational games to stimulate active learning, collaboration, creativity and sustained engagement toward the learning process (Deterding et al., 2011; Su & Cheng, 2015). Research has shown that project-based and gamified learning environments facilitate meaningful knowledge construction and enhanced the ability of the students to apply mathematical concepts in real world contexts (Bell, 2010; Himmi et al., 2025). These viewpoints offer a solid theoretical and pedagogical basis for the development of the MEDS Module. In the MEDS Module, the gamification of project-based learning is realised by collaborative geometry task, digital story making task and Minecraft construction task, which allows students to learn not just from game play but also from actual project completion.

Minecraft Education for Geometry Learning

Minecraft Education has turned out to be a digital learning platform that supports creativity, collaboration, and construction-based learning in 3D virtual worlds (Short, 2012; Davies, 2016; Nebel et al., 2016). Conventional geometry instruction methods usually rely on static diagrams, formula-based explanations and procedural exercises. In contrast, Minecraft Education allows students to construct, manipulate and explore the virtual objects through interactive building activities. This enables abstract concepts to be more concretized and made visually meaningful. In geometric learning, these affordances are of special importance because students must learn about spatial relationships, visualise geometric structures and use expressions of measure in meaningful contexts.

The use of Minecraft Education in mathematics has been found to have positive learning outcomes. Tangkui (2022) concluded that the learning using Minecraft had a positive influence on the improvement of primary students' understanding of perimeter and area, as well as their motivation and engagement. Apart from the above, Rayner and Tan (2020) found that students who engaged in Minecraft-based learning activities demonstrated increase in mathematical achievement and concept understanding. In addition to mathematics achievement, this platform has been shown to promote collaboration, communication, creativity, and problem-solving by engaging students in collaborative construction projects and in authentic learning experiences (Karsenti & Bugmann, 2017; Alawajee & Delafield-Butt, 2021). These findings indicate that Minecraft Education can function as more than an entertaining digital game. It can provide an active learning environment in which students construct, explore, and communicate mathematical ideas. Its interactive and spatial features may be particularly useful for visualising and manipulating geometric concepts that are difficult to represent through traditional classroom materials alone.

Digital Storytelling in Mathematics Education

Digital storytelling combines conventional storytelling with digital media such as images, audio, video, animation, and other multimedia elements to support learning and communication (Robin, 2008; Lambert, 2013; Ohler, 2013). It is a student-centred pedagogical approach that enables learners to produce, represent, and communicate their understanding through meaningful narratives. Instead of functioning only as recipients of information, students take

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an active role in organising ideas, creating content, and presenting knowledge in multiple forms.

Research across different educational contexts has associated digital storytelling with increased engagement, reflection, communication, and conceptual understanding (Robin, 2008; Ohler, 2013; Frazel, 2011). In mathematics education, storytelling can make abstract concepts more accessible by placing them within relevant and familiar contexts (Lemonidis & Kaiafa, 2019). It also give the student a chance to justify their answers, state method for solving a problem, and relate mathematical concepts to everyday life. These opportunities are particularly valuable in geometry, where students may struggle to understand perimeter, area, and volume when the concepts are presented only through abstract formulas or decontextualised exercises.

Digital storytelling allows students to embed geometric ideas within a meaningful narrative and communicate their mathematical thinking through scripts, visual representations, narration, and reflection. When combined with Minecraft Education, digital storytelling extends learning beyond the construction of virtual geometric models. Students are required to explain the mathematical ideas represented in their constructions, describe dimensions and calculations, justify design decisions, and communicate their reasoning through digital artefacts. In this way, Minecraft construction becomes part of a broader process of mathematical explanation, reflection, and communication.

The literature suggests that the educational value of technology depends on how digital tools are connected to appropriate learning theories and student-centred pedagogical approaches. Accordingly, the MEDS Module is grounded in Social Constructivism and applies DGBL and GPBL through Minecraft Education and Digital Storytelling. Minecraft Education functions as the collaborative virtual learning environment, while digital storytelling provides a medium through which students can explain, reflect on, and communicate their mathematical understanding. These theoretical, pedagogical, and technological components are integrated through the ADDIE instructional design model to produce a structured module intended to support meaningful primary geometry learning.

Objective

This study aims to create the Minecraft Education Digital Storytelling (MEDS) Module in geometry learning for primary schools. The development of MEDS Module used ADDIE instructional design model and to present its instructional content and key components.

Methodology

This study employed Design and Development Research (DDR) to develop and validate the Minecraft Education Digital Storytelling (MEDS) Module for primary geometry learning. DDR involves the systematic design, development, validation, and refinement of educational products in response to identified instructional needs (Richey & Klein, 2007). The development process was guided by the ADDIE instructional design model, which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009; Molenda, 2003).

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The ADDIE model was selected because it provides a systematic framework for developing instructional materials that are aligned with learners' needs, curriculum requirements, pedagogical principles, and intended learning outcomes. Through this model, Minecraft Education, Digital Storytelling, and Gamified Project-Based Learning were integrated into a structured learning experience for primary geometry.

Participants were involved at different stages of the module development process. During the analysis phase, 10 primary school mathematics teachers from the Barat Daya District, Penang, and 100 Year 4 students from four primary schools participated in the needs analysis. Five experts with expertise in mathematics education, educational technology, STEM education, curriculum implementation, and Minecraft Education were involved in evaluating the content validity of the module.

Purposive sampling was used to select participants who were appropriate for the requirements of each phase of the study (Gay et al., 2006). For the pilot implementation, 20 Year 5 students were selected because they had previously learned the Year 4 geometry curriculum. These students participated in selected MEDS activities and provided feedback on the clarity, usability, and suitability of the module activities. Each student was provided with access to a digital device, an internet connection, and Minecraft Education to enable participation in the module activities.

Data were collected using a teachers' needs analysis questionnaire, a students' needs analysis questionnaire, an expert module validation form, and a pilot implementation questionnaire. Descriptive statistics, including frequencies and percentages, were used to summarise the needs analysis findings. The Content Validity Index (CVI) was used to determine the relevance and appropriateness of the module based on the experts' evaluations. Cronbach's alpha was calculated to examine the internal consistency of the pilot questionnaire.

Findings and Results

The development of the MEDS Module was carried out systematically according to the five phases of the ADDIE instructional design model: Analysis, Design, Development, Implementation, and Evaluation. The findings from each phase are presented in the following sections.

Analysis Phase

The analysis phase was conducted to identify the instructional context, learners' needs, curriculum requirements, and challenges associated with primary geometry learning. The findings of both teachers and students were considered in developing the Minecraft Education Digital Storytelling (MEDS) Module in order to meet learners' need and reality in the classroom.

Teachers' Needs Analysis

The teacher questionnaire was used to gain insight into the challenges that teachers face in teaching geometry, their availability of teaching materials and their perception of potential use of the MEDS Module. Table 1 gives the results of the teachers' needs analysis.

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Table 1: Teachers' Perceptions of Teaching and Learning Geometry

Item Code	Statement	N	Agree	(%)	Disagree	(%)
TP1	Students face difficulties in understanding concepts of Space (Geometry) through traditional teaching methods.	10	9	90%	1	10%
TP2	There is a lack of effective teaching aids or ICT tools to support the teaching of Space (Geometry).	10	8	80%	2	20%
TP3	Teaching the topic Space requires innovative strategies to increase students' engagement and understanding.	10	9	90%	1	10%
TP4	The use of technology can make the teaching and learning of Space (Geometry) more interactive and meaningful.	10	8	80%	2	20%
TP5	I believe the use of game-based learning such as Minecraft Education can improve students' understanding of Space.	10	10	100%	0	0%
TP6	I believe the MEDS Module can help students calculate perimeter and area of a shape in a more engaging way.	10	9	90%	1	10%
TP7	I believe the MEDS Module can help students understand the volume of a solid (cubes and cuboids) better.	10	8	80%	2	20%
TP8	I believe the MEDS Module can provide problem-solving activities that connect geometry with real-life contexts.	10	9	90%	1	10%
TP9	I believe the MEDS Module will increase student motivation and interest in learning Mathematics.	10	9	90%	1	10%

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TP10	I am willing to adopt the MEDS Module in my teaching if training and support are provided.	10	10	100%	0	0%

Despite some variations in answers across teachers, it is apparent from the results in Table 1 that there is much shared sentiment surrounding the difficulties for teaching geometry and the need for more innovative methods in teaching geometry. Typically, teachers found that students are struggling in understanding geometric concepts in a traditional education, specially construct meaning and visualization of abstract concepts. In addition, their answers suggested a need for approaches to teaching that might foster higher-order thinking and deepen their understanding. Simultaneously, many teachers felt that there was a lack of suitable teaching materials and ICT tools to assist them in their teaching of geometry effectively and to help overcome the problems they faced in the classroom.

In addition, teachers were positively engaging in technology-enhanced teaching and geometry-based learning tasks in geometry teaching. Minecraft Education, in particular, was viewed as a potential platform to interact with geometry and learn about it through the medium of gameplay. The proposed MEDS Module was also perceived to be a helpful teaching tool of perimeter, area, volume, and geometry problem solving. Teachers also showed great readiness to engage it in their teaching, with the need of accompanying training and support also being noted. The following is a collection of these responses that can guide the creation of a systematic technology-based teaching resource for more personalized and meaningful geometry experiences. Here are some of these answers together, which can help in the development of a structured technology-based instructional resource for richer and more meaningful learning experiences in geometry.

Students' Needs Analysis

This student questionnaire aimed to explore students' challenges in learning geometry and to find out students' perception of the state of the teaching and learning of geometry. The results of students' geometry learning problems are shown in Table 2.

Table 2: Students' Problems in Learning Geometry

Problems Faced by Students	Item	N	Agree	%	Disagree	%
P1	I find it difficult to differentiate between angles, lines, perimeter, area, and volumes.	100	75	75%	25	25%
P2	I cannot visualise the shapes (2D and 3D).	100	80	80%	20	20%
P3	I often confuse mathematical terms. Example: acute angle,	100	65	65%	35	35%

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	perpendicular lines, equilateral triangles.					
P4	I have difficulty applying geometry formulas to real-life problems.	100	70	70%	30	30%
P5	There is limited teaching aids used during mathematics lessons.	100	78	78%	22	22%

There were several types of challenges that were reported by the students presented in Table 2. The most common problems cited was the visualisation of 2-D and 3-D shapes suggest that a large percentage of students may have problems creating a mind image of 2-D and 3-D shapes. Some challenges were also encountered with the application of geometric formulas into real life situations and defining between the concept of perimeter, area and volume. Also, a number of students had some difficulties in understanding the geometry related terms and lacked access to instructional supports in mathematics classes. Combined, these results suggest that learning experiences with more visual, interactive and contextual support are needed, especially when it comes to conceptual understanding and spatial reasoning in geometry.

Table 3: Students' Perceptions of Teaching and Learning for the Topic of Geometry

Student	Item	N	Agree	%	Disagree	%
S1	The topic of Geometry Space is important and useful in my daily life.	100	82	82%	18	18%
S2	Mathematics lessons for Geometry Space are usually interesting and enjoyable	100	45	45%	55	55%
S3	My teacher uses ICT or digital tools (e.g., videos, games) when teaching Space.	100	30	30%	70	70%
S4	I prefer learning through group activities when learning Geometry. (eg. building or exploring shapes)	100	85	85%	15	15%
S5	I think using technology or games (e.g., Minecraft) would make learning Geometry more fun.	100	92	92%	8	8%

From Table 3, students' overall attitudes towards learning geometry were found mostly positive but with raised concerns with the present learning of geometry. A good number of the students understood the applications of geometry in their everyday life. Less than half found the study of geometry lessons interesting and enjoyable. Also, the reported usage of ICT and digital tools

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in geometry lessons was not significant, meaning that there were limited opportunities for students to engage with a technology enhanced learning using ICT.

However, students expressed a high degree of interest in collaborative learning experiences and a great interest in using technology and the gamification approach for the study of geometry using tools such as Minecraft Education. In general, the given answers reflect willingness to be subjected to a more interactive, collaborative and technological approach to education that would support better accomplishment of the role of engagement and motivation in geometry learning.

Design Phase

In the design phase, the structure of the instruction plan, learning goals, content organization, learning activities, assessment plan, and technology components for the Minecraft Education Digital Storytelling (MEDS) Module were planned. This result was applied to design a learning module which aimed to solve students' difficulties in geometry. During the analysis phase, information gathered were converted to specific design features within the MEDS Module in Table 4.

Table 4: Needs Analysis Findings into MEDS Module Design Features

Analysis Findings	Design Response in MEDS
Difficulty visualising shapes	3D building activities in Minecraft Education
Difficulty understanding perimeter, area, volume	Guided geometry construction tasks
Limited ICT use	Minecraft Education and other ICT tools
Preference for collaborative learning	Group-based projects
Interest in game-based learning	Gamified project-based challenges
Need for contextual learning	Digital storytelling

Social Constructivism Theory (1978) was applied in designing MEDS Module, this theory focuses on knowledge construction by social interaction, collaboration and meaningful experiences. Besides, this module applied the concepts of Digital Game Based Learning (DGBL), Digital Storytelling and Gamified Project Based Learning (GPBL) to create an interactive learning atmosphere that fosters active learning, creativity, communication, collaboration and problem-solving skills.

A conceptual framework was developed to design the MEDS Module. The framework shows how the DGBL and GPBL are the pedagogical methods and how the Social Constructivism is the umbrella theory. It was the module's learning environment, Minecraft Education and Digital Storytelling, that these pedagogical elements have been integrated into. This involved a series of structured learning activities where students would be expected to build and construct their knowledge of geometry, at the same time cultivating twenty-first century skills; creativity, collaboration, communication and critical thinking.

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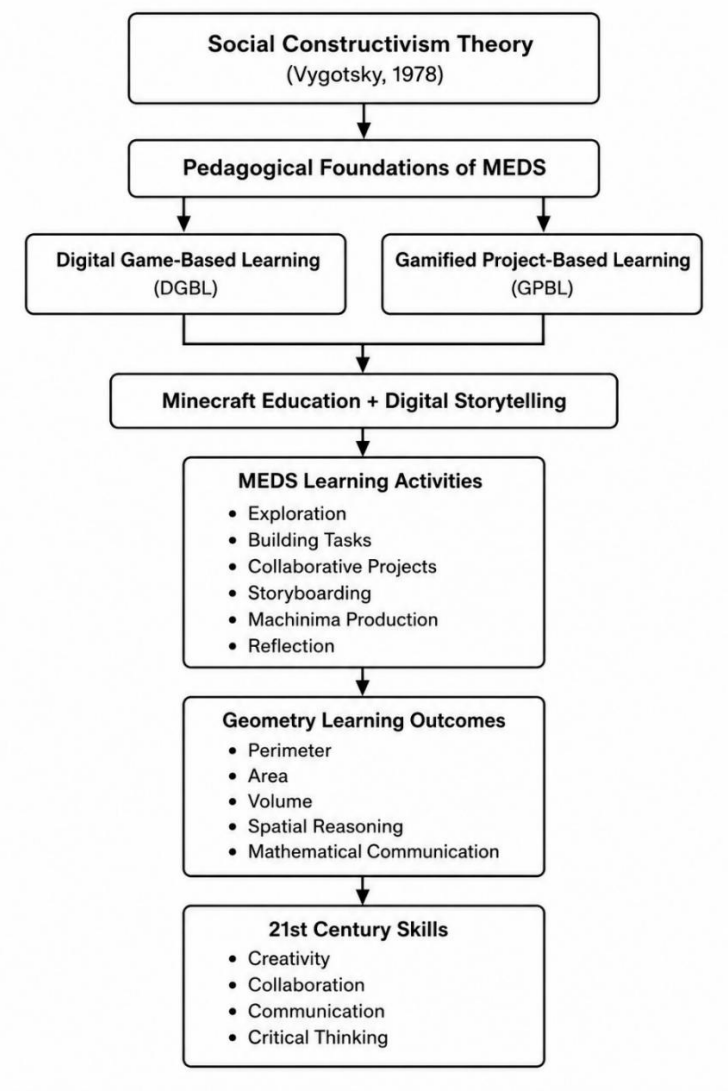

Figure 1: Conceptual Framework of MEDS Module

The conceptual framework was operationalised through the BRAINSSBUR technique, which guided students in integrating geometry learning, Minecraft Education, and Digital Storytelling. The technique consists of four stages: Brain, Scriptwriting and Storyboarding, Build, and Record.

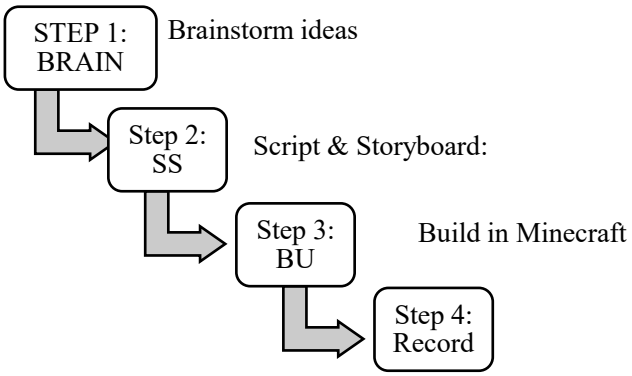

Figure 2: BRAINSSBUR Technique to Integrate Minecraft Education and Digital Storytelling

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BRAINSSBUR is comprised of 4 elements: Brain, Scriptwriting and Storyboarding, Build, and Record. In the Brain stage, students brainstorm and discuss concepts and themes about geometry. During the SS stage, stories are planned and sequences of story ideas are organised to inform, develop and conduct other learning activities. Students use geometry in a virtual setting when they build virtual models and work on project tasks in Minecraft Education in the Build stage. The final Record stage involves students in capturing, telling, and creating their own machinima videos that convey their mathematical understanding, project results and reflections. Taken together, these stages foster the incorporation of geometry in the process of creating digital stories, working collaboratively, and project-based learning into a cohesive system of learning.

There was further assessment elements added in to track pupils' learning during this module. These included project-based tasks, worksheets, structured tasks, storyboarding, machinima production and rubrics of assessment. The focus of assessment design was on mastery and on communication, creativity, collaboration and problem-solving skills in relation to geometry concepts. The existing needs analysis data was used to create the overall design, which incorporated learning theories, pedagogical strategies, digital technologies, learning activities, and assessment components. The next stage of the ADDIE model was then to develop the MEDS Module based on this instructional blueprint.

Development Phase

The MEDS Module was developed in alignment with the Year 4 Mathematics Curriculum and Assessment Standard Document (DSKP), particularly the Space (Geometry) content related to perimeter, area, volume, and problem-solving. The learning objectives, pedagogical approaches, activities, instructional materials, and assessment components identified during the design phase were translated into practical teaching and learning resources. Minecraft Education, Digital Storytelling, and Gamified Project-Based Learning (GPBL) were systematically integrated to create a coherent and engaging learning experience.

The module was organised as an eight-week instructional sequence. Through collaborative Minecraft Education activities, students were given opportunities to explore geometric concepts, construct and visualise two-dimensional and three-dimensional representations, and apply their knowledge in contextualised tasks. Digital storytelling and machinima production were incorporated to enable students to explain their mathematical reasoning, reflect on their learning, and communicate their ideas through digital artefacts. In addition to supporting geometry learning, the activities were designed to promote creativity, communication, collaboration, problem-solving, and digital literacy.

Structure of the MEDS Module

The MEDS Module is comprised of five main components: the module objectives, weekly learning activities, instructional resources, assessment resources, and a final Geometry City project. The components have been developed to facilitate a logical sequence of topics that investigates essential concepts in geometry, before applying knowledge within realistic tasks that involve projects.

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Table 5: Structure of the MEDS Module

Component	Description
Module Objectives	Learning objectives aligned with Year 4 Mathematics DSKP (Geometry)
Weekly Learning Activities	Eight-week sequence covering perimeter, area, volume, and problem-solving
Instructional Resources	Teacher guidelines, storyboard templates, machinima recording guide, and GPBL rubric
Assessment Resources	Worksheets, progress records, screenshot evidence, and machinima assessment
Final Project	Geometry City project and machinima presentation

The module also incorporated several distinctive features that differentiate it from conventional geometry instruction. The learning activities were organized in an 8-week progression that helped students build upon the key geometry concepts and finish an integrated Geometry City project. The learning progression was brought together based on ideas for GPBL and Digital Storytelling, in which conceptual ideas were established before learning activities and projects that demand the use of knowledge in increasingly higher challenges.

Table 6: Weekly Mapping of the MEDS Module

Week	Activity	Geometry Focus	Learning Output
1	Perimeter Park Rangers	Perimeter	Screenshot evidence
2	Fence It Heroes	Perimeter	Storyboard and reflection
3	Town Builders	Area	Constructed models
4	Area Detectives	Area	Floor plan design
5	Volume Vault Architects	Volume	Cube and cuboid constructions
6	Geometry Case Detective	Problem Solving	Group solution presentation
7	Geometry City Designers	Integration of Concepts	Geometry City project
8	Geometry City Film Makers	Showcase and Reflection	Final machinima video

The weekly sequence progressively developed students' understanding from perimeter and area to volume and integrated problem-solving. The final Geometry City project required students to apply these concepts collaboratively and communicate their mathematical reasoning through a machinima presentation.

Integration of Minecraft Education and Digital Storytelling

Throughout the module, students applied geometric concepts by constructing two-dimensional and three-dimensional models in Minecraft Education. Rather than learning only through static representations, students were able to build, manipulate, and examine geometric objects within

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a dynamic and interactive three-dimensional environment. These activities provided opportunities for students to visualise geometric structures, explore spatial relationships, and apply measurement concepts through hands-on digital construction.

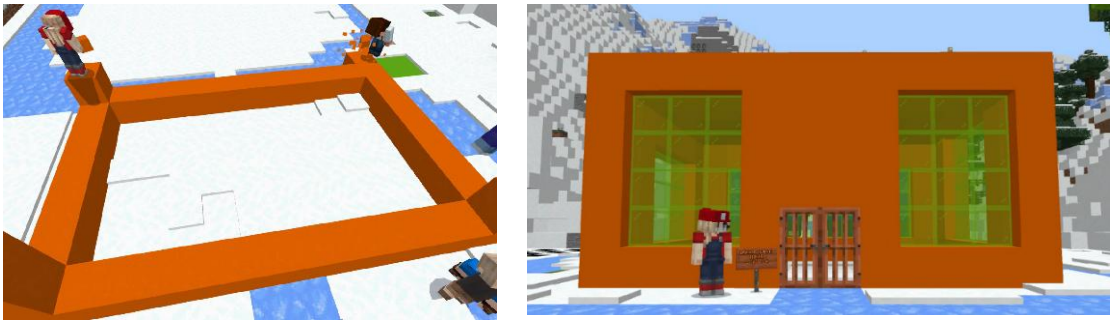

Figure 3: Students Constructing 3D Geometry Models in Minecraft Education

Along with investigating properties of three-dimensional shapes and its volume, students' build cubes and cuboids in Minecraft Education, as shown in Figure 3. Students were able to play a virtual environment, and viewers could drag the students' constructions and explore them from multiple angles, as well as correlate dimensions to the concept of volume. Minecraft Education thus offered a context for students to explore geometric representations and understand sense of spatial relationships within digital construction activities.

The BRAINSSBUR framework was used to guide the integration of digital storytelling into the module. Students reported and shared their learning in geometry using their machinima video created from their projects in Minecraft Education. Students had the opportunity to verbalize mathematical content, describe their problem-solving approaches and discuss the mathematics learning process as they scripted, storyboarded, narrated and produced the video. Digital Storytelling was therefore not only used as a presentation activity but to communicate the mathematical thinking embedded in students' buildings within the game of Minecraft.

Figure 4: Students Producing Machinima Videos in Minecraft Education

Figure 4 illustrates the process of playing to create a machinima and tells the story of how students construct a digital artefact based on their Minecraft geometry project. For example, student was expected to explain "This building is a rectangular library, that is eight units long and three units wide, so the perimeter is 8 + 3 + 8 + 3 = 22 units." With this conversation, students first learn to recognize shapes, to describe their size, to explain mathematical operations and to interpret their results in a meaningful context within a narrative.

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In the MEDS Module, with the aid of virtual construction and storytelling, the emphasis was moved from building models of geometric objects to narrating the ideas of mathematics that can be encountered within the models. The context helped students to make more meaningful links between geometry and stories and provided an opportunity to think and communicate mathematically. Visual construction, mathematical thinking, storytelling and making meaning, and communication are therefore core components of the MEDS Module, being tied in to, and integrated within, a learning experience of Minecraft Education.

Instructional and Assessment Resources

A set of teaching and learning materials with assessment instruments was developed to support the implementation of the MEDS Module. The instructional materials included teacher guidelines, storyboard templates, a machinima recording guide, and a GPBL assessment rubric. These resources were designed to help teachers conduct the learning activities systematically and to guide students through each stage of the module.

Assessment was integrated throughout the module, including worksheets, project-related tasks, screenshots and end-of-module productions of the learning outcomes of the machinima. The components allowed for several instances of measuring, understanding and using perimeter, area and volume as well as geometry problems solving. The project-based activities and final digital products also allowed a view of the desired broader competencies, such as creativity, communication, collaboration, and critical thinking. Assessment resources were designed to include a variety of different forms of evidence over the course of the learning process to capture not only students' concept of geometry, but the whole set of competencies embedded in the MEDS learning activities.

The development phase produced a learning module with a coherent learning experience, combining all elements of the development (theoretical and pedagogical foundations, digital technologies, pedagogical activities, and assessment). Minecraft Education offers children the space for learning, digital storytelling offers opportunities for reflection and communication, and GPBL helps them organize for cooperative and meaningful project work. After the development of these activities and materials, the MEDS module moved on to the next two stages of the ADDIE model: Implementation and Evaluation.

Implementation Phase

The implementation phase consisted of preparing the teachers to teach the module Minecraft Education Digital Storytelling (MEDS) and implementing it during a pilot to look at its viability and usability. The researcher designed and conducted two-day training workshops for two mathematics teachers. The workshop led the participants to understand the goals, structure and main teaching and learning aspects of the MEDS Module, especially the inclusion of Minecraft Education, Digital Storytelling, GPBL and the production of machinima. Teachers also had hands-on experience with Minecraft Education and got directions about how to help lead the collaborative learning activities integrated throughout the module.

Weekly lesson plans were created to ensure consistency and aligned to the Year 4 Mathematics Curriculum and Assessment Standard Document (DSKP). The learning objectives, instructional procedures, students' activities and assessment strategies were outlined for each lesson plan for the respective week. The learning sequence involved the student building blocks

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on previous learning from perimeter and area to volume and geometry-related problem solving. The learning experiences finally culminated in the Geometry City project, where students could utilize their geometric knowledge in a cooperative project-based activity.

Table 7: Activities Conducted During the Implementation Phase

Activity	Purpose
Teacher Training Workshop	Familiarise teachers with MEDS Module components and implementation procedures
Minecraft Education Training	Develop teachers' competency in using Minecraft Education
Pilot Implementation	Examine practicality and usability of the module
Student Feedback Collection	Gather feedback on learning activities and module design
Module Refinement	Improve module quality before evaluation

In addition to this, a pilot was carried out with 20 Year 5 students. The students were chosen as they had completed geometry taught in Year 4 in their previous years of schooling and thus were familiar with the geometric content taught in the module. In the pilot, students participated in selected MEDS activities such as Geometric construction tasks in Minecraft Education, the collaborative work project, Digital storytelling and making Machinima. This pilot proved enlightening in its implementation and permitted an assessment of the potential areas for further development of the module. Participation of students was monitored during the activities, and student feedback was collected on the activities regarding the organisation, clarity and usefulness of the module. During the pilot, no significant issues with implementation arose. Some minor changes were made to clarify the directions for teaching and assessment. These changes were made in the module prior to moving to the next level and have left a version that is well organized for classroom use.

Lastly, the finalised MEDS Module was implemented with 60 Year 4 students in the actual study. The group of learners that the module was designed for, and procedures for the pilot experience, were employed in this implementation. Results on the effectiveness of the MEDS Module are not provided in this paper because the present paper concentrates mainly on its development and testing.

Evaluation Phase

The evaluation phase was to determine the validity and reliability of the Minecraft Education Digital Storytelling (MEDS) Module. This phase involved expert validation, pilot testing, and reliability analysis to ensure that the module was appropriate for implementation in primary geometry learning. Feedback obtained during the evaluation process was used to refine and improve the quality of the module before its actual implementation.

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Content Validity

Content validation was conducted by five experts with expertise in mathematics education, educational technology, curriculum implementation, STEM education, and Minecraft Education. The experts evaluated the module in terms of its content accuracy, alignment with the Year 4 Mathematics Curriculum and Assessment Standard Document (DSKP), instructional design, learning activities, clarity of language and suitability of the components in the module. The evaluation results indicated that the MEDS Module achieved Content Validity Index (CVI) value of 0.89, indicating a high level of content validity (Russel,1974). This finding suggests that the learning objectives, instructional activities, assessment components, and technological features were appropriately aligned with the intended learning outcomes and curriculum requirements.

Table 8: Content Validity Results by Evaluation Aspect

Evaluation Aspect	Validity Percentage (%)
Module Objectives	89.6
Module Content	88.0
Learning Activities	90.4
Digital Storytelling Integration	88.8
Assessment Components	87.2
Overall Content Validity	88.8

In addition to the quantitative evaluation, experts provided several recommendations to further improve the module. One expert highlighted those additional visual examples and scaffolding strategies to support students' understanding of volume concepts and three-dimensional visualisation.

Furthermore, feedback related to the digital storytelling component contributed to the refinement of the machinima production process, leading to the development of the BRAINSSBUR framework. These recommendations were incorporated into the final version of the module before pilot implementation.

Reliability Analysis

The reliability of the MEDS Module was examined using a pilot questionnaire administered after students completed the interventions. The questionnaire consisted of 15 items measuring six dimensions: clarity of instructions, suitability of task difficulty, time allocation, understanding of geometry through digital storytelling, machinima activities, and overall learning experience.

Reliability analysis using Cronbach's Alpha yielded a coefficient value of 0.87, indicating a high level of internal consistency and exceeding the minimum acceptable threshold of .70 (Nunnally & Bernstein, 1994). This result indicates that the pilot questionnaire demonstrated

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satisfactory internal consistency and was appropriate for evaluating students' perceptions of the MEDS Module.

The findings indicate that the questionnaire items consistently measured students' perceptions of the MEDS Module and that the module demonstrated satisfactory reliability for implementation in primary geometry learning.

Overall, the evaluation findings provided evidence supporting the content validity and reliability of the MEDS Module. Feedback from experts and pilot participants informed further refinements to the module before its final implementation.

Discussion

The MEDS Module was systematically developed based on the instructional needs identified by teachers and students and was based on relevant theoretical and pedagogical principles. The needs analysis identified some problems in primary geometry learning such as low achievement, lack of conceptual understanding, visualisation problems of geometric relationships, and the use of technology-based instructional resources is low. The results are in line with the previous studies that found that primary school students tend to have difficulties in understanding geometric concepts due to the lack of opportunities for active exploration and the lack of spatial reasoning skills (Hartini Ismail et al., 2020; Noor Atiqah Hashim et al., 2023; Tangkui, 2022). The positive responses of teachers and students to the technology-enhanced and game-based learning also contributed to the development of the MEDS Module as an alternative instructional resource for primary geometry learning.

The design of the MEDS Module was informed by Social Constructivism Theory, which emphasises learning through social interaction, collaboration, and the active construction of knowledge (Vygotsky, 1978). These principles were operationalised through the integration of Minecraft Education, Digital Storytelling, and Gamified Project-Based Learning (GPBL). Rather than receiving geometric knowledge passively, students were provided with opportunities to work collaboratively, construct virtual models, apply geometric concepts in authentic tasks, and communicate their mathematical reasoning through digital narratives. This design is consistent with research indicating that constructivist and project-based learning can promote conceptual understanding, collaboration, and meaningful engagement by involving students in authentic and purposeful learning activities (Bell, 2010; Krajcik & Blumenfeld, 2006).

One of the unique contributions of the MEDS Module is the systematic incorporation of Minecraft Education and Digital Storytelling using the BRAINSSBUR machinima framework. Digital storytelling and Minecraft learning have been shown to be effective learning tools in their own right in previous studies (Robin, 2008; Karsenti & Bugmann, 2017). However, relatively limited attention has been given to how these approaches can be combined within a structured instructional programme for primary geometry learning. The MEDS Module addresses this gap by positioning Minecraft construction not as an isolated game-based activity but as part of a broader process involving mathematical planning, narrative development, explanation, production, and reflection.

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The BRAINSSBUR framework provides students with a structured pedagogical sequence that includes brainstorming, scriptwriting and storyboarding, constructing virtual environments, recording, and producing machinima. Through this process, students do more than build geometric objects in Minecraft Education. They have to use these to represent mathematical ideas, describe the dimensions and properties of their constructions, share their reasoning in stories and think about what they learnt. Collaborative construction, mathematical explanation, digital narrative and reflection are thus integrated into the pedagogical use of Minecraft Education and can be extended beyond the virtual act of building to a more meaningful application of geometry knowledge.

The evaluation findings further support the quality and suitability of the MEDS Module. The content validity index of 0.89 indicated a high level of agreement among the experts regarding the appropriateness of the module's objectives, content, learning activities, digital storytelling components, and assessment procedures. In addition, the pilot questionnaire demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.87. Feedback from the pilot implementation also indicated that students were able to participate in the Minecraft-based activities and complete the associated digital storytelling tasks. Collectively, these findings suggest that the MEDS Module demonstrates satisfactory content validity, reliability, and practical applicability for implementation in primary geometry learning. Nevertheless, these findings primarily establish the quality and feasibility of the module; further evaluation is required to determine its effectiveness in improving students' geometry achievement and attitudes towards mathematics.

The development of the MEDS Module has several educational implications. First, it provides teachers with a structured approach for connecting curriculum-based geometry content with Minecraft Education, project-based learning, and digital storytelling. Second, the three-dimensional environment of Minecraft Education may help students visualise and manipulate geometric representations that are difficult to understand through static diagrams alone. Third, the inclusion of digital storytelling and machinima production creates opportunities for students to explain mathematical ideas, collaborate with peers, solve problems, and communicate their reasoning in meaningful contexts. These features are aligned with contemporary educational priorities that emphasise subject knowledge alongside creativity, communication, collaboration, critical thinking, and digital competence. Overall, the MEDS Module contributes a theoretically grounded and systematically developed instructional design that transforms Minecraft Education from a construction platform into a medium for mathematical meaning-making, communication, and reflection.

Conclusion

In conclusion, the Minecraft Education Digital Storytelling (MEDS) Module is a theoretically grounded, systematically developed, and validated instructional module designed to support the teaching and learning of primary geometry. The module integrates Minecraft Education, Digital Storytelling, Gamified Project-Based Learning, and the BRAINSSBUR framework within an eight-week instructional programme aligned with the Year 4 Mathematics curriculum.

Through collaborative construction, mathematical modelling, storytelling, and machinima production, the module provides students with opportunities to develop conceptual understanding, apply geometric knowledge, work collaboratively, and communicate their

mathematical reasoning in meaningful contexts. The evaluation indicates that the MEDS Module demonstrates satisfactory content validity, reliability, and practical suitability for primary school learners. However, further research involving larger and more diverse samples across different educational contexts is recommended to examine its effectiveness in improving geometry achievement, spatial reasoning, attitudes towards mathematics, and related twenty-first-century skills.

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