INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 14, Issue 5, (2024) E-ISSN: 2222-6990

Needs Analysis for the Development of Sequential-Digital-Applications-of-Arithmetic-Operations (DASAO) Emphasizing on Conceptual and Procedural Knowledge in Malaysia Primary Schools

Mohd Hafizuddin Mat Zuki[1], Norazlin Mohd Rusdin[1], Syaza Hazwani Zaini[1], Siti Rahaimah Ali[1], Mazita Ahmad[1], Nurihan Nasir[2], Farrah Dina Yusop[3], Shaharuddin Md Salleh[4]

[1]Faculty of Human Development, Universiti Pendidikan Sultan Idris, 35900 Tanjong Malim, Perak, Malaysia, [2]Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjong Malim, Perak, Malaysia, [3]Faculty of Education, Universiti Malaya, Lembah Pantai, 59100 Kuala Lumpur, Malaysia, [4]Faculty of Education, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

Corresponding Author Email: norazlin@fpm.upsi.edu.my

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v14-i5/21381 DOI:10.6007/IJARBSS/v14-i5/21381

Published Date: 04 May 2024

Abstract

This study examined the need for sequential digital applications of arithmetic operations to promote conceptual and procedural learning among primary school mathematics teachers. This study takes a quantitative approach with survey methods. This study's respondents included 500 primary school mathematics teachers from Malaysia's five zones namely north, central, eastern, southern, and Borneo. The data was collected via a questionnaire. The descriptive statistical analysis results highlight the practice of teaching methods that should be used in the application, such as animation movies, interactive quizzes, and online games. The results for teachers' perceptions of conceptual and procedural understanding in primary school mathematics teaching and learning (T&L) for the field of arithmetic operations are very high. Most teachers agreed that the acceptance and usefulness of sequential digital applications based on conceptual and procedural knowledge during the teaching and learning process is critical. The majority of teachers agreed that this application should be created based on a study of the level of digital application development requirements. This study's implications can assist researchers in constructing a sequential digital application of arithmetic operations (DASAO) to enhance conceptual and procedural learning in primary school mathematics.

Keywords: Need Analysis, Digital Application, Sequential Learning, Arithmetic Operations, Conceptual Knowledge, Procedural Knowledge

Introduction

Mathematics is a vital subject in any educational system, as it provides a foundation for further learning (Santos-Trigo, 2020). Once students have mastered basic arithmetic operations such as addition, subtraction, multiplication, and division, they can move on to more advanced concepts and problem-solving (Ilukena et al., 2020). Therefore, having a strong grasp of fundamental mathematics has a direct impact on a student's performance in mathematics. It is crucial for students to understand both the conceptual and operational aspects of these arithmetic operations to make progress in the subject (Szabo et al., 2020). Mathematical proficiency depends entirely on a student's ability to comprehend and apply these concepts and methods. Unfortunately, many students struggle with mathematical problem-solving because they lack a clear understanding of these fundamental concepts (Braithwaite & Sparugue, 2021; Al-Mutawah et al., 2019).

According to Supangat and Saringat (2020), the sequential learning model encourages students to learn by following instructions, simplifying and organizing things quickly, and gaining a quick overview of the lesson content. This model caters to the needs of students who prefer to learn in a step-by-step manner (Ph'ng, 2018). It implies that students work gradually to identify solutions and gain knowledge from small parts to the whole (Jamali & Mohamad, 2018).

As stated by Yuswan and Maat (2021), conceptual and procedural knowledge are two forms of information that students must possess in order to learn mathematics. Conceptual knowledge is described as the ability to reason about situations using conceptual definitions, relationships, or representations of both (Rittle-Johnson & Schneider, 2015). While procedural knowledge is defined as the ability to correctly integrate algorithmic processes and communicate algorithmic outcomes in the context of a problem (Rittle-Johnson, Siegler, 2022). Learning with technological apps allows children to see mathematical principles and then apply those concepts to their daily life (Yuswan & Maat, 2021).

Statement of Problem

Arithmetic operations, such as addition, subtraction, multiplication, and division, are fundamental concepts in mathematics. However, studies show that most students have not yet mastered all four of these concepts (Ping & Hua, 2015). Understanding the basics of mathematics is crucial in building a strong foundation for more complex mathematical concepts, since mathematics is a structured and hierarchical discipline (Ishak & Bakar, 2019). Unfortunately, many students struggle with basic mathematical procedures, which can lead to difficulties in learning more advanced topics. Based on the study conducted by Sakilah et al (2018), students who struggle with mathematics exhibit the following characteristics: (a) difficulty in presenting solution steps in a logical order, (b) difficulty in connecting mathematical concepts in problem-solving, and (c) difficulty in retaining newly learned information and recalling previously learned knowledge. This highlights the importance of establishing a strong foundation in mathematics before advancing to more complex concepts (Hwang & Son, 2021).

To effectively solve mathematical problems, students must have a good understanding of both conceptual and procedural knowledge simultaneously (Van Gon et al., 2020). If a student only learns conceptual information without mastering procedural knowledge, they may understand how to apply the concepts in problem-solving, but they will not be able to demonstrate the solution steps consistently (Wawan et al., 2019). On the other hand, if a student has mastery of procedural knowledge but lacks conceptual understanding, they may be able to demonstrate the solution steps, but they may not understand the reasoning behind those steps (Wawan et al., 2019). However, classroom mathematics instruction often focuses more on procedural understanding than on conceptual difficulties (Leong et al., 2020). Many Malaysian students rely on memorizing mathematical formulas and tricks to solve arithmetic problems, even if they do not fully comprehend them (Zainal 2005; Tan 2018). However, merely memorizing these formulas and tricks without understanding their underlying concepts does not help students retain knowledge in the long-term (Teng et al., 2017).

Literature Review

Fatimah et al (2020) argue that conceptual and procedural comprehension are inescapably interconnected. Both of these concepts are critical for solving problems in mathematics (Yurniwati, 2018). Students initially acquire conceptual knowledge, which they then apply to develop problem-solving strategies and procedures. Both skills are necessary since they will be used to deal with new and difficult situations (Sylviyani, 2017). Conceptual knowledge is the comprehension of mathematical ideas, procedures, and relationships. Procedural information is frequently presented in the form of a series or sequence of steps to be completed. Procedures refer to the knowledge of skills, algorithms, techniques, and approaches.

The purpose of teaching and learning mathematics at school is to enable students to understand mathematical concepts, explain the relationship between concepts and apply those concepts in solving problems (Siregar, 2019). The ability of an individual to understand mathematical ideas comprehensively and functionally is called conceptual understanding (Mayasari & Habeahan, 2021). Good mastery of conceptual understanding allows students to solve mathematical words problems (Bardach & Klassen, 2020) and in the context of real life more easily (Azis, 2019).

Students' proficiency in mathematical concepts can be assessed through their ability to: (1) verbally and in writing define concepts, (2) create examples and non-examples, (3) represent a concept using models, diagrams, and symbols, (4) convert one form of representation to another, (5) understand various interpretations of concepts, (6) identify the properties of concepts and the conditions that define them (NCTM, 2000). When children have a solid grasp of mathematical concepts, they can perform arithmetic operations with ease, particularly addition, subtraction, multiplication, and division.

Research Objective

This study aims at the need for the development of sequential digital applications of Arithmetic operations for the consolidation of conceptual and procedural learning in primary school Mathematics. Specifically, the objectives of the study are as follows:

1. Studying teachers' perceptions related to the practice of teaching methods towards the digital application of sequential arithmetic operations (DASAO) for the strengthening of conceptual and procedural learning in primary school mathematics.
2. Studying teachers' perception of conceptual and procedural knowledge in teaching and learning (T&L) of primary school mathematics for the field of basic operations.
3. Identifying the level of acceptance and applicability of teachers to use digital applications sequential arithmetic operations (DASAO) for strengthening conceptual

and procedural learning of primary school mathematics.

4. Identifying the level of development needs of sequential digital application of arithmetic operations (DASAO) based on conceptual and procedural knowledge of primary school.

Research Methodology

This study aimed to collect input from primary school mathematics instructors about their requirements for creating digital applications for teaching mathematical operations. The study used a survey approach and selected a sample of 500 primary mathematics teachers in Malaysia through simple random sampling. The sample was divided into five zones, including north, central, eastern, southern, and Borneo, with the reason that they are economically significant. The goal of the study was to obtain a clear picture of the instructors' needs for the creation of sequential digital applications for both conceptual and procedural learning.

The study employed a set of questionnaires as a means of conducting a needs analysis. The questionnaire that was chosen is based on Venkatesh's Unified Theory of Acceptance and Use of Technology (UTAUT), which was first published in 2003 and is still widely used by technology development researchers across the world. This questionnaire consists of five parts. Table 1 shows the parts of the questionnaire.

Table 1
Component of the questionnaire

Section	**Component**
Section A	Respondent demographics
Section B	Teachers' perceptions related to the practice of teaching methods towards the digital application of sequential arithmetic operations (DASAO) for the consolidation of learning conceptual and procedural in primary school mathematics.
Section C	Primary school math teachers' perception of conceptual and procedural knowledge in teaching basic operations.
Section D	The level of acceptance of primary school mathematics teachers to use the digital application of sequential arithmetic operations (DASAO) for the reinforcement of learning conceptual and procedural.
Section E	The level of needs toward development of digital application of sequential arithmetic operations (DASAO) based on conceptual and procedural knowledge for primary school mathematics.

Section B to D use a five-point Likert scale while section E uses a (Yes / No) shaped scale for teachers to express their degree of agreement with each item presented. Each score on the 5-point Likert Scale represents a certain level of agreement: 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree, and 5 for strongly agree.

To ensure the questionnaire's accuracy, we consulted three experts who are all lecturers: one specialized in mathematical education, one in information technology, and one in Malaysian language. These experts evaluated the research instrument for its construct and content validity. They analyzed and provided feedback on the questionnaire's structure, substance, organization, and writing style. The expert panel agreed that the questionnaire's format and content were sufficient for testing the constructs under examination. The expert panel suggested improving the questionnaire's linguistic structure and style to enhance comprehension among respondents.

The data collected was analyzed using descriptive statistical methods. The analysis included demographic analysis of respondents (Part A), analysis of teaching methods practices in relation to digital applications (Part B), analysis of the need for emphasizing conceptual and procedural knowledge in teaching and learning mathematics (Part C), and analysis of the level of acceptance and usability of teachers towards using digital applications (Part D). The mean value and standard deviation were calculated using SPSS version 28, and the analysis of the level is presented accordingly. Table 2 shows the interpretation of mean values adapted from Moidunny (2009) for part B, part C and part D.

Table 2
Interpretation of Mean Score

Range of Mean	Interpretation
1.00 to 1.80	Very Low
1.81 to 2.60	Low
2.61 to 3.40	Moderate
3.41 to 4.20	High
4.21 to 5.00	Very High

Inferential statistics are used to identify the relationship between Perception of Teaching Methods, Perception of Conceptual and Procedural Knowledge, Acceptance of Digital Applications and Needs of Digital Applications by using Pearson correlation analysis and this correlation analysis is assisted by SPSS version 28. Table 3 shows the interpretation of the correlation coefficient adapted from Riduwan & Sunarto (2012).

Table 3
interpretation of the correlation coefficient

Range of correlation coefficient	Interpretation
0.00 to 0.20	Very Weak
0.20 to 0.40	Weak
0.40 to 0.60	Moderate
0.60 to 0.80	Strong
0.80 to 1.00	Very Strong

Results
A total of 500 primary school mathematics teachers consisting of primary school teachers from five zones in Malaysia, namely the north, central, eastern, southern, and Borneo zones, have answered the questionnaire distributed by post and email. The findings of the study are presented in five sections.

Demographic Analysis of Respondents
The demographic distribution analysis of the respondents is as shown in Table 4.

Table 4
Demographics of study respondents

Gender	Frequency (%)	ICT Experience	Frequency (%)	ICT Skills Level	Frequency (%)
Male	120 (24.0)	1 to 5 years	75 (15)	Not skillful	1 (0.2)
Female	380 (76.0)	6 to 10 years	161 (32.2)	Less skillful	27 (5.4)
		11 to 15 years	162 (32.4)	Moderately skillful	286 (57.2)
		16 to 20 years	68 (13.6)	Skillful	178 (35.6)
		21 to 25 years	26 (5.2)	Very skillful	8 (1.6)
		26 to 30 years	5 (1.6)		
Total	500 (100%)	Total	500 (100%)	Total	500 (100%)

The results of the analysis also show that the highest data was recorded for female gender (76.0%), experience using ICT within 11 to 15 years (32.4%), and a moderate level of ICT skills (57.2%). The large difference between the number of male and female respondents is due to the lower enrolment of male teachers in the teaching staff in Malaysia. In terms of ICT skills, only one respondent admitted not being proficient (0.2%) while 8 respondents were very proficient (1.6%). The findings in terms of ICT use experience and ICT Skill Level show that the majority of teachers are accustomed to using ICT in their teaching profession.

Analysis of the practice of teaching methods against digital applications
In part B, there are 7 items to study teachers' perceptions related to the practice of teaching methods towards the digital application of sequential arithmetic operations (DASAO) for strengthening conceptual and procedural learning in primary school mathematics. Table 5 shows the mean, standard deviation and interpretation (based on table 2) of the practice of teaching methods.

Table 5
Analysis of the practice of teaching methods against digital applications

	Item	Mean (M)	Standard Deviation (SD)	Interpretation
B1	Presentation of the content of the arithmetic operations of mathematics according to the student's ability is necessary.	4.61	.542	Very high
B2	Active involvement of students to build understanding in learning arithmetic operations is necessary.	4.62	.522	Very high
B3	Sequential arrangement of lesson content in learning arithmetic operations effectively is necessary.	4.52	.625	Very high

B4	The use of digital applications in learning arithmetic operations effectively is necessary.	4.44	.656	Very high
B5	The use of animation videos in learning arithmetic operations effectively is necessary.	4.47	.677	Very high
B6	The use of interactive quizzes in learning arithmetic operations effectively is necessary.	4.54	.618	Very high
B7	The use of online games for learning arithmetic operations effectively is necessary.	4.51	.647	Very high

The study respondents showed a very high level of agreement regarding the need for the delivery of lesson content that suits the students' abilities (M = 4.61; SD = .542), involving students actively in building understanding in learning arithmetic operations (M = 4.62; SD = .522) as well as organizing the lesson content sequentially (M = 4.52; SD = .625). For effective learning of arithmetic operations, there is a very high need for the use of digital applications (M = 4.44; SD = .656), animated videos (M = 4.47; SD = .677), interactive quizzes (M = 4.54; SD = .618) and online games (M = 4.51; SD = .647).

Analysis of conceptual and procedural knowledge in teaching and learning mathematics

In part C, there are 14 items to examine the teacher's perception of conceptual and procedural knowledge in teaching and learning (T&L) of primary school mathematics for the basic operational area. Table 6 shows the mean, standard deviation and interpretation (based on table 2) of the practice of teaching methods.

Table 6
Needs Analysis of conceptual and procedural knowledge in teaching and learning mathematics

	Item	Mean (M)	Standard Deviation (SD)	Interpretation
C1	Mastery of conceptual knowledge in learning arithmetic operations is necessary.	4.57	.527	Very high
C2	Mastery of procedural knowledge in learning arithmetic operations is necessary.	4.57	.519	Very high
C3	Mastery of conceptual knowledge can increase students' ability to master arithmetic operations more effectively.	4.55	.536	Very high
C4	The mastery of procedural knowledge can increase students' ability to master arithmetic operations more effectively.	4.52	.553	Very high
C5	Mastery of conceptual knowledge can improve students' ability to solve mathematical problems.	4.51	.543	Very high
C6	Procedural knowledge mastery can improve students' ability to solve problems mathematics.	4.53	.546	Very high

C7	Mastery of conceptual knowledge can increase students' ability to master high order thinking skills (HOTS) in learning mathematics.	4.50	.557	Very high
C8	The mastery of procedural knowledge can increase students' ability to master high order thinking skills (HOTS) in learning mathematics.	4.51	.561	Very high
C9	Mastery of conceptual knowledge can increase students' ability to apply critical thinking in learning mathematics.	4.53	.557	Very high
C10	The mastery of procedural knowledge can increase students' ability to apply critical thinking in learning mathematics.	4.52	.571	Very high
C11	The application of various calculation strategies in digital applications of arithmetic operations can improve problem solving skills.	4.56	.596	Very high
C12	Mathematics teachers need to be able to strengthen conceptual and procedural knowledge for the students they teach.	4.65	.530	Very high
C13	The use of digital applications to increase mastery of conceptual and procedural knowledge in mathematics learning is necessary.	4.52	.641	Very high
C14	Digital applications of arithmetic operations need to provide immediate feedback on student answers to improve students' understanding.	4.57	.588	Very high

A significant of respondents strongly agree about the need to master conceptual (M = 4.57, SD = .527). and procedural (M = 4.57, SD = .519) knowledge in learning arithmetic operations This agreement is based on the importance of conceptual and procedural knowledge in improving students' ability to master arithmetic operations more effectively (C3: M = 4.55, SD = .536; C4: M = 4.52, SD = .553), solving mathematical problems (C5: M = 4.51, SD = .543; C6: M = 4.53, SD = .546) even through the application of various calculation strategies (M = 4.56, SD = .596), high order thinking skills (C7: M = 4.50, SD = .557, C8: M = 4.51, SD = .561) as well as critical thinking (C9: M = 4.53, SD = .557; C10: M = 4.52, SD = .571). Therefore, it is necessary to be able to strengthen conceptual knowledge and procedural students taught (M = 4.65, SD = .530) and integrated with the use of digital applications (M = 4.52, SD = .641) that provide immediate feedback on student answers (M = 4.57, SD = .588) to improve their understanding.

Analysis of the level of acceptance and usability of teachers to use digital applications

In part D, there are 14 items to study the level of acceptance and applicability of teachers to use digital applications of sequential Arithmetic operations (DASAO) for the strengthening of conceptual and procedural learning in primary school mathematics. Table 7 shows the mean, standard deviation and interpretation (based on table 2) of the practice of teaching methods.

Table 7
Analysis of the level of acceptance and usability of teachers to use digital applications

	Item	Mean (M)	Standard Deviation (SD)	Interpretation
	Performance Expectancy			
D1	I will find digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge useful in my teaching.	4.26	.729	Very high
D2	The use of sequential digital application of Arithmetic operations (DASAO) based on conceptual and procedural knowledge will allow me to complete teaching assignments more quickly.	4.27	.709	Very high
D3	The use of sequential digital applications of Arithmetic operations (DASAO) based on conceptual and procedural knowledge will improve my work productivity.	4.35	.684	Very high
	Effort Expectancy			
D4	My interactions with sequential digital applications Arithmetic operations (DASAO) will be clear and understandable.	4.21	.725	Very high
D5	I I feel that it is easy to be proficient in using digital applications sequential Arithmetic operations (DASAO).	4.22	.742	Very high
D6	I will find sequential digital applications Arithmetic operation (DASAO) is easy to use.	4.21	.756	Very high
D7	The use of digital applications sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge simplifies the task teacher.	4.26	.709	Very high
D8	A digital application of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge will make teaching work become more interesting.	4.39	.695	Very high
D9	Using digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge is fun.	4.40	.687	Very high
D10	I would love to have the opportunity to use sequential digital applications of operations calculate (DASAO).	4.39	.712	Very high
	Social Influence			

D11	Peers who influence my behaviour think I need to use digital applications in teaching.	3.82	.682	High
D12	An important colleague of mine thinks I should use digital applications in teaching.	3.86	.669	High
D13	The school supports the use of digital applications in teaching.	4.18	.691	High
	Facilitating Condition			
D14	I have the necessary resources to using digital applications in teaching.	4.07	.803	High
D15	I know how to use digital applications in teaching.	4.22	.758	Very high
D16	The digital application is compatible with other teaching methods that I use.	4.24	.754	Very high
	Anxiety			
D17	I feel apprehensive about using digital applications in teaching.	2.36	1.134	Low
D18	I'm worried about losing information when using a digital application due to pressing a key by mistake.	2.22	1.121	Low
D19	I am hesitant to use this digital application because it is possible that I will make a mistake that cannot be corrected.	2.17	1.088	Low
D20	The use of digital applications in teaching is something that scares me.	1.99	.990	Low
D21	I intend to use digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge within the next 24 months.	4.13	.801	High
D22	I plan to use digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge in the next 24 months.	4.11	.799	High
D23	I prepare to use digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge in the next 24 months.	4.10	.807	High
D24	I will definitely use digital applications of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge in the next 24 months.	4.07	.830	High
D25	I would encourage other teachers to use digital applications sequential arithmetic operations (DASAO).	4.18	.789	High

Findings show the mean value of item score D1 (mean = 4.26, SP = .729), D2 (mean = 4.27, SP = .709) and D3 (mean = 4.35, SP = .684) are at a very high level. This shows the performance expectations for the use of digital applications sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge can be used in teaching and learning sessions and facilitate teachers in increasing work productivity.

The mean score value of items D4 (mean = 4.21, SP = .725), D5 (mean = 4.22, SP = .742) and D6 (mean = 4.21, SP = .756) are at a very high level. This shows the expected effort towards the development of this digital application that is easy to handle and easy to understand clearly.

The mean score value of item D7 (mean = 4.26, SP = .709), D8 (mean = 4.39, SP = .695), D9 (mean = 4.40, SP = .687) and D10 (mean = 4.39, SP = .712) are at a very high level. This shows that the attitude of using digital applications can make the teacher's job easier, making teaching work more interesting and enjoyable.

The mean score value of items D11 (mean = 3.82, SP = .682), D12 (mean = 3.86, SP = .669) and D13 (mean = 4.18, SP = .691) is at a high level. This shows that the influence of social friends is a factor in the disclosure of application use among teachers during the teaching and learning process.

The mean score value of item D14 (mean = 4.07, SP = .803) is at a high level while D15 (mean = 4.22, SP = .758) and D16 (mean = 4.24, SP = .754) are at a very high level. This shows that the ease of using digital applications during the teaching and learning process.

The mean score values of items D17 (mean = 2.36, SP = 1.134), D18 (mean = 2.22, SP = 1.121), D19 (mean = 2.17, SP = 1.088) and D20 (mean = 1.99, SP = .990) are at low level. This is because the majority of teachers are not worried about using digital applications as a medium for them to teach in class.

The mean score value of items D21 (mean = 4.13, SP = .801), D22 (mean = 4.11, SP = .799), D23 (mean = 4.10, SP = .807), D24 (mean = 4.07, SP = .830) and D25 (mean = 4.18, SP = .789) are at a high level. This shows that the majority of teachers intend, plan, prepare and definitely use this application that they want to develop.

Analysis of the level of digital application development needs

Table 8 shows an analysis of the amount of demand for the development of digital applications sequential arithmetic operations (DASAO) based on primary school students' conceptual and procedural knowledge. Each respondent must select 'Yes' or 'No' for each item offered.

Table 8
Analysis of the level of digital application development needs

	Item	Frequency (%)	
		Yes	No
E1	Do you have enough materials for T&L for the topics of arithmetic operations in school?	403 (80.6)	97 (19.4)
E2	The development of digital applications sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge is necessary.	478 (95.6)	22 (4.4)
E3	The development of a digital application of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge will have a positive impact on the cultivation of problem-solving skills.	484 (96.8)	16 (3.2)
E4	The development of a digital application of sequential Arithmetic operations (DASAO) based on conceptual and procedural knowledge will benefit primary school mathematics teachers.	487 (97.4)	13 (2.6)
E5	The use of this digital application needs to be more user-friendly so that it can be easily mastered by teachers and students.	494 (98.8)	6 (1.2)

According to the findings of a descriptive statistical analysis employing percentages for item E1, most educators concur that there are enough materials available for teaching arithmetic operations in the classroom. Regarding issue E2, many educators responded in the affirmative (95.6%). This demonstrates that educators agree that this digital application should be created. According to item E3's most teachers concur that the application that will be created demonstrates their belief in it and has the potential to improve students' problem-solving abilities (96.8%). Most teachers responded positively to item E4 (97.4%). This demonstrates how the creation of this digital application can help primary school mathematics teachers. The proportion for item E5 indicates that the majority of instructors believe that this digital application should be designed to be user-friendly and simple to use during the teaching and learning process (98.8%).

Pearson Correlation Analysis of the relationship between Perception of Teaching Methods, Perception of Conceptual and Procedural Knowledge, Acceptance of Digital Applications and Needs of Digital Applications

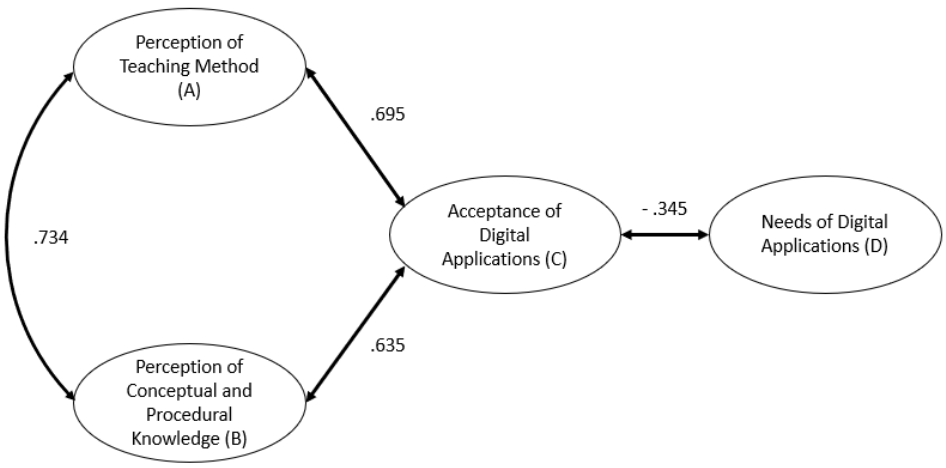

Figure 1: Pearson Correlation Analysis of the relationship between Perception of Teaching Methods (A), Perception of Conceptual and Procedural Knowledge (B), Acceptance of Digital Applications (C) and Needs of Digital Applications (D)

Based on the findings of this study, Figure 1 shows that there is a strong positive relationship between perception of teaching method and perception of conceptual and procedural knowledge with a value of r = 0.734, sig. = 0.000 ($p < 0.01$).

Next, a significant relationship between Perception of Teaching Methods and Acceptance of Digital Applications with a value of r = 0.695, sig. = 0.000 ($p < 0.01$). Based on the findings of this study, this shows that there is a strong positive relationship between Perception of Teaching Methods and Acceptance of Digital Applications.

In addition, a significant relationship between Perception of Conceptual and Procedural Knowledge and Acceptance of Digital Applications with a value of r = 0.635, sig. = 0.000 ($p < 0.01$). Based on the findings of this study, this shows that there is a strong positive relationship between Perception of Conceptual and Procedural Knowledge and Acceptance of Digital Applications.

A significant relationship between Acceptance of Digital Applications and Needs of Digital Applications with a value of r = -0.345, sig. = 0.000 ($p < 0.01$). Based on the findings of this study, this shows that there is a weak negative relationship between Perception of Conceptual and Procedural Knowledge and Acceptance of Digital Applications.

Discussion

This study was conducted to examine the need for the development of sequential digital applications of arithmetic operations for the strengthening of conceptual and procedural learning in primary school mathematics. Researchers need to conduct a needs analysis study to gather information about the context and situation of the study. Primary mathematics teachers are selected as target users for the construction of this digital application. Through the analysis that has been carried out, it has been found that teachers' perceptions related to the practice of teaching methods towards digital applications need to be diversified in terms of the use of animated videos, interactive quizzes and online games. This can indirectly engage students actively and pique their attention when utilizing this digital tool. According to Siti Salsidu et al (2017), the employment of multiple media makes an information presentation employing multimedia technology appear more alive, dynamic, and capable of capturing the attention of a large number of users. Akmalia *et* al (2021) discovered that animated features significantly improved pupils' comprehension of mathematical subjects. Interactive quizzes provide challenges and competitions that increase students' motivation, desire to discover even more, along with engagement (Sayed et al., 2023). Online educational games may boost students' cognitive abilities, capacity for problem-solving, and mathematics aptitude (Kocabatmaz & Saraçoğlu, 2024).

Many research has reported about teacher anxiety about adopting new technologies Wardat et al (2024); Wang et al (2020) and a propensity to remain in their comfort zone, using identical resources and methods that they are already accustomed to Yeonju et al (2022) are two factors that restrict their use of technology in on-site instructional contexts (Hwang, 2022). Anxiety faced by mathematics teachers regarding the adoption of reforms in pedagogical practices can affect the quality of teaching (Awofala et al., 2024). However, this study discovered a low level of anxiousness among responders. This demonstrates that the later use of digital applications should have no negative impact on the T&L learning process, and may instead promote a quality one.

In addition, the analysis that has been carried out also shows that teachers' perception of conceptual and procedural knowledge in teaching and learning (T&L) of primary school mathematics can solve problems in mathematics which involve various calculation strategies, HOTS and critical thinking. The findings of this study are in line with the study of Armanza and Asyhar (2020) stating that conceptual and procedural knowledge is needed in solving mathematical problems. Preparing this digital application as a T&L aid will be useful as teachers had limited time to learn about HOTS (Tanudjaya & Doorman, 2020). In addition, solving mathematical problems with HOTS requires the implementation of various strategies or heuristics that need to be presented in an interesting way to coop with learners' limited working memory capacity (Verschaffel et al., 2020). Next, the analysis that has been carried out also shows that the majority of teachers state that the level of acceptance and usability towards the use of sequential digital applications based on conceptual and procedural knowledge during the teaching and learning process is necessary. This is in line with the study NCTM (2020) which states that the effective use of technology in T&L mathematics supports students' conceptual and procedural understanding of mathematics and subsequently improves the quality of teachers' teaching practices consistently.

The results of the analysis also show that the sequential digital application of Arithmetic operations (DASAO) for strengthening the conceptual and procedural learning of primary school mathematics should be developed according to the level of need that has been stated in the findings of the study. The majority of teachers agree that this application should be developed and can indirectly have a positive impact on fostering problem-solving skills, especially for basic operational topics. According to Aliza and Zamri (2017), the digital application that is developed needs to consider the problems faced by teachers and existing needs so that the digital application that is produced can meet the needs of teachers.

Conclusion

In conclusion, this study delved into the imperative need for sequential digital applications of arithmetic operations to bolster both conceptual and procedural learning among primary school mathematics educators. Employing a quantitative approach via survey methods, the research engaged 500 primary school mathematics teachers across Malaysia's diverse zones, encompassing the north, central, eastern, southern, and Borneo regions. Through questionnaire-based data collection, the study yielded descriptive statistical analysis results that underscored the significance of diversified teaching methods, including animation movies, interactive quizzes, and online games, within digital applications. Notably, the findings unveiled overwhelmingly positive perceptions among teachers regarding the critical acceptance and usefulness of sequential digital applications grounded in conceptual and procedural knowledge during the teaching and learning process.

The implications of this study resonate strongly with the ongoing discourse surrounding the construction and integration of sequential digital applications of arithmetic operations (DASAO) to enrich conceptual and procedural learning in primary school mathematics. It suggests the necessity for researchers to conduct needs analysis studies to glean insights into the context and requirements of primary mathematics educators, thus facilitating the tailored design and implementation of digital applications. Furthermore, the study underscores the importance of diversified teaching methods within digital applications, such as animated videos, interactive quizzes, and online games, to actively engage students and foster their comprehension and motivation in mathematics learning.

However, it's essential to acknowledge certain caveats within the study. While the research sample comprised educators from diverse geographical zones, the generalizability of findings may be confined to the Malaysian context. Additionally, reliance on self-report measures and a quantitative approach may limit the exploration of nuanced perspectives and contextual factors influencing teachers' perceptions and practices. Future research endeavours should address these limitations by embracing more comprehensive and mixed-methods approaches to provide a deeper understanding of the multifaceted factors shaping technology adoption and instructional practices among primary school mathematics educators.

Moving forward, future research endeavours could benefit from adopting a mixed-methods approach to provide a more nuanced understanding of the complexities surrounding technology adoption and instructional practices among primary school mathematics educators. Longitudinal studies tracking the sustained effects of sequential digital applications on student learning outcomes and teachers' instructional approaches would offer valuable insights. Additionally, comparative studies across diverse educational contexts could inform the development of tailored interventions and resources to support technology integration in primary mathematics education. By adhering to these recommendations, future research can continue to advance mathematics teaching and learning through innovative digital solutions, thereby fostering enhanced conceptual and procedural learning among students.

Acknowledgement
This study was supported by the Fundamental Research Grant Scheme (FRGS), grant no. FRGS/1/2023/SSI07/UPSI/03/5 funded by Ministry of Higher Education (MOHE), Malaysia.

References

Akmalia, R., Fajriana, F., Rohantizani, R., Nufus, H., & Wulandari, W. (2021). Development of powtoon animation learning media in improving understanding of mathematical concept. Malikussaleh Journal of Mathematics Learning, 4(2), 105-116. https://doi.org/10.29103/mjml.v4i2.5710

Al-Mutawah, M. A., Thomas, R., Eid, A., Mahmoud, E. Y., & Fateel, M. J. (2019). Conceptual understanding, procedural knowledge and problem-solving skills in Mathematics: High school graduates work analysis and standpoints. International Journal of Education and Practice 7(3), 258–273. https://doi.org/10.18488/journal. 61.2019.73.258.273

Ali, A., & Mahamod, Z. (2017). Analisis Keperluan Terhadap Pengguna Sasaran Modul Pendekatan Berasaskan Bermain bagi Pengajaran dan Pembelajaran Kemahiran Bahasa Kanak-kanak Prasekolah. JUKU: Jurnal Kurikulum & Pengajaran Asia Pasifik, 3(3), 1-8.

Armanza, R., & Asyhar, B. (2020). Pemahaman Konseptual dan Prosedural Siswa SMA/MA dalam Menyelesaikan Soal Program Linier Berdasarkan Tipe Kepribadian. Jurnal Tadris Matematika, 3(2), 163-176. http://dx.doi.org/10.21274/jtm.2020.3.2.163-176

Awofala, A. O. A., Akinoso, S. O., Adeniyi, C. O., Jega, S. H., Fatade, A. O., & Arigbabu, A. A. (2024). Primary teachers' mathematics anxiety and mathematics teaching anxiety as predictors of students' performance in mathematics. ASEAN Journal of Science and Engineering Education, 4(1), 9-24. https://doi.org/10.17509/ajsee.v3i3.51065

Azis. (2019). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Cerita Pada Pembelajaran Matematika Kelas VIII. Media Pendidik an Matematika, 7(1), 72. https://doi.org/10.33394/mpm.v 7i1.1679

Bardach, L., & Klassen, R. M. (2020). Smart teachers, successful students? A systematic review of the literature on teachers' cognitive abilities and teacher effectiveness. Educational Research Review 30, 100-312. https://doi.org/10.1016/j.edurev.2020.100312.

Braithwaite, D. W., & Sprague, L. (2021). Conceptual knowledge, procedural knowledge, and metacognition in routine and nonroutine problem solving. Cognitive Science, 45(10), e13048. https://doi.org/10.1111/cogs.13048

Fatimah, A. T., Zakiah, N. E., Sunaryo, Y., Gumilar, I., & Rusmana, I. (2020). Pengetahuan kontekstual, konseptual, dan prosedural siswa SMK pada pemecahan tugas konteks jangkauan. Jurnal THEOREMS (The Original Research of Mathematics), 4(2), 147–154. https://doi.org/10.31949/th.v4i2.1592

Hwang, S. (2022). Examining the Effects of Artificial Intelligence on Elementary Students' Mathematics Achievement: A Meta-Analysis. Sustainability, 14(20), 13185. https://doi.org/10.3390/su142013185

Hwang, S., & Son, T. (2021). Students' Attitude toward Mathematics and Its Relationship with Mathematics Achievement. Journal of Education and e-Learning Research, 8(3), 272-280. https://doi.org/10.20448/journal.509.2021.83.272.280

Ishak, M. Z., & Bakar, N. A. (2019). Keberkesanan Model Response-to Intervention (RTI) dalam Menyelesaikan Masalah Matematik Berayat Murid Sekolah Rendah. Borneo International Journal of Education 1, 57 – 74. https://doi.org/10.51200/bije.v1i.1777

Ilukena, A. M., Utete, C. N., & Kasanda, C. (2020). Strategies Used by Grade 6 Learners in the Multiplication of Whole Numbers in Five Selected Primary Schools in the Kavango East and West Regions. International Education Studies, 13(3), 65-78. https://doi.org/10.5539/ies.v13n3p65

Jamali, A. R., & Mohamad, M. M. (2018). Dimensions of Learning Styles among Engineering Students. Journal of Physics: Conf. Series 1049, 012055, 1-8. https://doi.org/10.1088/1742-6596/1049/1/012055

Kocabatmaz, H., & Saraçoğlu, G. K. (2024). The Effect of Educational Digital Games on Academic Success and Attitude in 3rd Grade Mathematics Class. Participatory Educational Research, 11(2), 230-244. http://dx.doi.org/10.17275/per.24.28.11.2

Leong, T. G., Shah, R, M. R. L. Z., & Idrus, M. N. (2020). Analisis Keperluan Bagi Pembangunan Modul Untuk Pengekalan Pengetahuan Konseptual Dan Prosedural Matematik Tingkatan 1: Need Analysis for Form 1 Mathematics Module Development for Retention of Conceptual and Procedural Knowledge. Journal of Science and Mathematics Letters, 8(2), 86–99. https://doi.org/10.37134/jsml.vol8.2.11.2020

Mayasari, D., & Habeahan, N. L. S. (2021). The ability of students' conceptual understanding in completing story problems on mathematics. Jurnal Pendidikan Matematika dan IPA, 12(2), 123-136. http://dx.doi.org/10.26418/jpmipa.v12i2.43354

NCTM. (2020). Moving Forward: Mathematics Learning in the Era of COVID-19. National Council of Teachers of Mathematics

NCTM. (2000). Principles and Standards for School Mathematics. The National Council of Teachers of Mathematics.

Ph'ng, L. M. (2018). Teaching Styles, Learning Styles and the ESP Classroom. MATEC Web of Conferences, 150, 05082. https://doi.org/10.1051/matecconf/201815005082

Ping, O. W., & Hua, A. K. (2015). Mathematical operations from teacher to student: A case study of applied Division Wheel in primary school. International Journal of Scientific Engineering and Research,3(9),82-86. https://doi.org/10.6084/m9.figshare.1558023.v1

Rittle-Johnson, B., & Schneider, M. (2015). Developing conceptual and procerutal knowledge of mathematics. In The Oxford handbook of numerical cognition (pp. 1118-1134). Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780199642342.013.014

Rittle-Johnson, B., & Siegler, R. S. (2022). The relation between conceptual and procedural knowledge in learning mathematics: A review. The development of mathematical skills, Page 75-110.

Santos-Trigo, M. (2020). Problem-solving in mathematics education. Encyclopedia of mathematics education (pp. 686-693). https://doi.org/10.1007/978-3-030-15789-0_129

Sakilah, N. I., Rini, C. P., Magdalena, I. M., & Unaenah, E. (2018). Analysis of difficulties in mathematics learning in second grade of elementary school (case study in one of south Jakarta elementary schoold). The 1st PGSDUST International Conference on Education 1, 97 – 102. https://jurnal.ustjogja.ac.id/index.php/ICE/article/view/4210

Sayed, W. S., Noeman, A. M., Abdellatif, A., Abdelrazek, M., Badawy, M. G., Hamed, A., & El-Tantawy, S. (2023). AI-based adaptive personalized content presentation and exercises navigation for an effective and engaging E-learning platform. Multimedia Tools and Applications, 82(3), 3303-3333. https://doi.org/10.1007/s11042-022-13076-8

Supangat & Saringat, M. (2020). Development of E-learning System Using Felder and Silverman's Index of Learning Styles Model. International Journal of Advanced Trends in Computer Science and Engineering, 9(5), 8554-8561. https://doi.org/10.30534/ijatcse/2020/236952020

Siregar, H. M. (2019). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Tes Kemampuan Berpikir Kreatif Matematis Materi Ling karan. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 8(3), 497– 507. https://doi.org/10.24127/ajpm.v 8i3.2379

Sylviyani, H. (2017). Etnomatematika: Aplikasi bangun datar segiempat pada candi Muaro Jambi. AKSIOMA: Jurnal Matematika dan Pendidikan Matematika, 8(2), 99–110. https://doi.org/10.26877/aks.v8i2.1707

Tan, K. M. (2018). Creating a Modified Monopoly game for promoting students' higher- order thinking skills and knowledge retention (Tesis PhD yang tidak diterbitkan). University of Otago.

Tanudjaya, C. P., & Doorman, M. (2020). Examining Higher Order Thinking in Indonesian Lower Secondary Mathematics Classrooms. Journal on Mathematics Education, 11(2), 277-300. http://doi.org/10.22342/jme.11.2.11000.277-300.

Teng, K. W., Tajudin, M. N., & Masri, R. (2017). Pembinaan item dalam bidang perkaitan bagi mata pelajaran Matematik tingkatan empat berdasarkan model taksonomi pemprosesan maklumat. Jurnal Pendidikan Sains dan Matematik Malaysia (JPSMM UPSI), 7(2), 1 -18. https://doi.org/10.37134/jpsmm.vol7.no2.1.2017

Van Gog, T., Hoogerheide, V., & Van Harsel, M. (2020). The role of mental effort in fostering self-regulated learning with problem-solving tasks. Educational Psychology Review, 32(4), 1055-1072. https://doi.org/10.1007/s10648-020-09544-y

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: A survey. ZDM Mathematics Education, 52, 1-16. https://doi.org/10.1007/s11858-020-01130-4

Wang, S., Yu, H., Hu, X. & Li, J. (2020). Participant or Spector? Comprehending the Willingness of faculty to use Intellegent Tutoring Systems in the Artificial Intelligence era. Brithish Journal of Educational Technology 51(5), 1657-1673. http://dx.doi.org/10.1111/bjet.12998

Wardat, Y., Tashtoush, M., AlAli, R., & Saleh, S. (2024). Artificial Intelligence in Education: Mathematics Teachers' Perspectives, Practices and Challenges. Iraqi Journal for Computer Science and Mathematics 5(1), 60-77. https://doi.org/10.52866/ijcsm.2024.05.01.004

Wawan, Talib, A., & Djam'an, N. (2019). Analisis Pemahaman Konseptual dan Prosedural Siswa dalam Menyelesaikan Soal Matematika Berdasarkan Gaya Belajar. Issues in Mathematics Education (IMED), 1(2), 101–106. https://doi.org/10.35580/imed9469

Yeonju, J., Seongyune C., & Hyeoncheol K. (2022). Development and validation of an instrument to measure undergraduate students' attitudes toward the ethics of artificial intelligence (AT-EAI) and analysis of its difference by gender and experience of AI education. Education and Information Technologies, 27(8), 11635-11667. https://doi.org/10.1007/s10639-022-11086-5

Yurniwati. (2018). Improving the Conceptual and Procedural Knowledge of Prospective Teachers through Multisensory Approach: Experience from Indonesia. Journal of Research and Advances in Mathematics Education 3(2), 106–117. https://doi.org/10.23917/jramathedu.v3i2.6374

Zainal, T. Z. T. (2005). Pengetahuan pedagogi isi kandungan bagi tajuk pecahan di kalangan guru matematik sekolah rendah (Tidak diterbitkan Tesis PhD). Universiti Kebangsaan Malaysia.