EDUCATUM JSMT Vol. 10 No.2 (2023)
ISSN 2289-7070 / e-ISSN 2462-2451 (58-69)
https://ejournal.upsi.edu.my/index.php/EJSMT/index

Development and Validation of ConProRet-A Module for the Retention of Algebraic Conceptual and Procedural Knowledge for Form 1 Student

Teh Guan Leong[1*] & Raja Lailatul Zuraida Raja Maamor Shah[2]

[1,2]Department of Mathematics, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, Malaysia

*Corresponding author: tehguanleong@gmail.com

Published: 30 December 2023

To cite this article (APA): Leong, T. G., & Raja Maamor Shah, R. L. Z. (2023). Development and Validation of ConProRet-A Module for the Retention of Algebraic Conceptual and Procedural Knowledge for Form 1 Student. *EDUCATUM Journal of Science, Mathematics and Technology*, *10*(2), 58–69. https://doi.org/10.37134/ejsmt.vol10.2.7.2023

To link to this article: https://doi.org/10.37134/ejsmt.vol10.2.7.2023

Abstract

Prior knowledge is crucial in acquiring new mathematical concepts, yet students frequently forget what they have learnt, which hampers their acquisition of new mathematical concepts. It has been observed that poor mastery of algebraic conceptual and procedural knowledge leads to poor knowledge retention, which in turn impairs learning in other areas of mathematics. Rote learning was assumed to be the definite way to grasp algebraic conceptual and procedural knowledge, but it has now been demonstrated that such knowledge rots when not used. This paper describes the development and validation of the ConProRet-A module for use in mastery and retention of algebraic conceptual and procedural knowledge for Form 1 students. Hence, the ASSURE model, APOS theory, Scaffolding theory, and Atkinson and Shriffin information processing theory were involved in the development of the mentioned module. To obtain the face validity percentage and content validity percentage for the module, five experts were appointed to evaluate the module using a questionnaire. Statistical analysis using the Percentage Calculation Method (PCM) was used to determine the face validity percentage and content validity percentage of the module. The findings showed that the face validity percentage and content validity percentage of the ConProRet-A module were high at 94% and 90.33%. This showed that the ConProRet-A module developed can be used in teaching and learning sessions in schools.

Keywords module development, content validity, algebraic conceptual knowledge, algebraic procedural knowledge, retention

INTRODUCTION

A student's forgetfulness towards knowledge learnt is a frequent occurrence. In 1885, Ebbinghaus conducted a research on the brain's ability in remembering information and he created the Ebbinghaus Forgetting Curve [1]. He pointed out that if a student does not review what they have learnt, they will forget 60 to 70 percent of what they have learnt within 24 hours. In a month, they will forget 80 to 90 percent of what they have learnt. One of the main principles of the education system is to help students strengthen knowledge retention, with the expectation that what is learnt will be remembered for a long time and may be retrieved and applied to the construction of new knowledge as needed [2]. In this case, knowledge retention refers to the process of remembering and retrieving information. According to McDermott and Roediger, the knowledge retention process entails three phases: information encoding, information storage and information retrieval. A students' failure in any phase will result in forgetting or incorrect memory formation [3].

Mathematics is a discipline that requires mastery of many concepts, theorems, and formulas in order to solve problems. However, these concepts, theorems, and formulas most of the time bring less meaning to students due to their abstract and symbolic nature. This resulted in a circumstance where students employ surface learning method to learn. Students memorise desirable concepts, theorems, and formulae via surface learning method without truly comprehending them [4]. The surface learning method does not provide long-term mathematical understanding [5]. Students who practice memorisation of mathematical knowledge from rote learning will experience forgetting knowledge learnt rapidly [6]. When knowledge learnt has a significant meaning for students, it is more likely to be retained [7]. Therefore, knowledge retention among students can be improved when knowledge is learnt in a meaningful way rather than mere memorising through rote learning.

Algebra is the key to success in mathematics due to its essential function in all fields of mathematics [8, 9, 10]. Forming a foundation for success in algebra is one option to boost students' mathematical learning and achievement [11]. However, students have largely failed to obtain a thorough comprehension of algebra despite the importance of algebra and the emphasis placed on it [11]. Several studies reveal that many students all around the world struggle to master algebra at different educational levels [12, 13, 14, 15, 16]. O'brien and Ni Riordain suggested that students' struggles at early secondary level may be a contributing element to the difficulties they face at upper secondary level or tertiary level [17]. Students who have low fundamental algebra abilities struggle to solve algebraic problems and even have difficulties simplifying algebraic expressions and equations [18]. Because of these barriers, they seek learning by memory rather than comprehending, and this pattern of learning persists until a higher level of education. As a result, students who adapt to this method of learning can only handle lower-level thinking problems and non-routine problems are out of their conceptual grasp [18]. Hence, the effort to facilitate students master and retain algebraic knowledge from lower secondary level is essential because when students have strong fundamental algebra abilities, they can achieve better in mathematics.

Modular instruction is a form of alternative instructional design that uses created instructional materials tailored to meet the needs of students [19]. Modular instruction consists of a set of learning plans with specified objectives, well planned teaching-learning activities, and assessment using criteria-referenced measurements [20]. Teaching-learning modules have evolved into a recognized teaching approach in the educational system due to their effectiveness in improving students' learning qualities [21]. Well-designed modules enable students to get actively involved in their learning independently, developing at their own pace, and ultimately providing them with a sense of self-satisfaction upon completion of learning [20]. Some researchers in Malaysia have developed mathematics teaching-learning modules and proven their effectiveness in improving students' learning [22, 23, 24, 25, 26, 27] but yet not much modules have been developed to improve students algebraic abilities especially studying on knowledge retention. Therefore, this study aimed to develop a teaching-learning module to facilitate students' mastery and retention of algebraic conceptual and procedural knowledge for Form 1 students.

LITERATURE REVIEW

APOS Theory

The APOS theory defines a student's mathematical knowledge as their proclivity to respond to difficult mathematical situations by reflecting on problems and their solutions in a social context, as well as the construction and reconstruction of actions, processes and objects into schemas to deal with the situation [28]. The APOS theory is a constructivist theory of how mathematical knowledge is mastered [29]. APOS theory stresses the utilization of students' mental structures to develop new and more resilient structures to handle increasingly difficult mathematical knowledge during teaching and learning [30]. Under this theory, the mastering cycle of all mathematical concepts may be expressed as actions, processes, objects and schemas [29]. APOS is an abbreviation for the phases involved in the formation of mathematical knowledge which are action-process-object-scheme. The formation of a mathematical concept begins as an Action, that is, as an externally directed transformation of a previously conceptualized Object. When a student repeats an Action while reflecting on it, the Action may be interiorized as a Process. When they need to do transformations on these Processes, the student encapsulates them into Objects. A Scheme is made up of a logical collection of Actions, Processes, Objects and other Schemes, as well as relationships between them [30]. The implementation of APOS theory in teaching and learning is to encourage students to construct their own knowledge of mathematical concepts through a series of activities [31]. Hence, all the activities in the module are designed in such a way where students are required to master all the knowledge learnt through the steps action-process-object-scheme.

Scaffolding Theory

Wood, Bruner and Ross came up with the term scaffolding in 1976 and the idea can be understood as the assistance given to learners in completing a task that would be impossible for him to do on his own [32]. Dependency, fading and transfer of responsibility are all essential components of scaffolding [33]. In education, scaffolding involves teachers guiding students at the beginning of their learning and progressively reducing their help until the students mastered the learning [34]. Van de Pol, Volman and Beishuizen also outlined several scaffolding methods for supporting a student's learning, which include; (a) feedbacks: providing information regarding students' performance, (b) giving hints: providing clues or suggestions, (c) instruction: how something must be done, (d) explanation: providing more detailed information, (e) modelling: offering behaviour for imitation and (f) questioning: questions that require an active linguistic and cognitive answer [35]. Pfister et al. suggested scaffolding implementation can be accessed through the following criteria; (a) cognitive activation: students must develop an understanding from the actions which they are led to engage, (b) stimulating discourse: interactions between the teacher and students, (c) handling errors productively: teachers prompt students to identify and correct their errors or misconceptions, (d) target orientation: selection of learning materials and appropriate tasks and (e) using manipulatives: selection of examples and manipulatives [33]. Hence, all the activities in the module are designed in such a way where guided assistance are given to students through learning activities and learning materials until they can master knowledge learnt independently.

Atkinson and Shriffin Information Processing Theory

The information processing theory was initially presented by Atkinson and Shriffin as a cognitive theory of learning that addresses the processing, storage and retrieval of knowledge in the mind [36]. The Atkinson and Shriffin memory model, depicted in Figure 1, illustrates the importance of this theory by modelling how information flows in a memory system [37]. According to Atkinson and Shriffin, the memory system is splitted into four parts: input (stimuli), sensory memory, short-term memory and long-term memory. First, external inputs such as sights, sounds, tastes, smells and feelings enter the sensory memory and are converted into information. Attention allows the learner to choose whether or not to respond to the stimuli. When the learner responds to the stimuli, the information moves into short-term memory; if they do not, the information is likely to be forgotten. When working with information in short-term memory, organising and rehearsal can increase the like hood of the information being moved to long-term storage because the learner acquires greater meaning for the information and encodes it into long-term memory. By providing frequent distributed practice, the learner can retrieve and utilize information stored in long-term memory. According to Atkinson and Shriffin again, forgetting can also be caused by the loss of information in short-term memory and long-term memory.

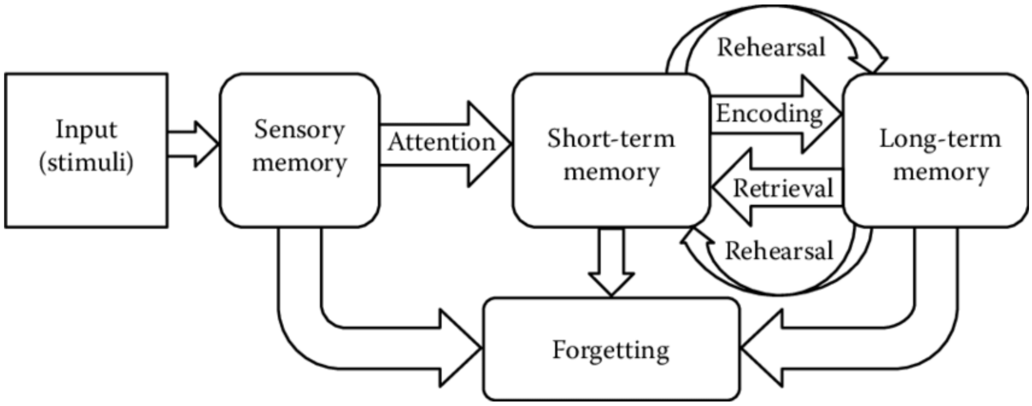

Figure 1 Atkinson and Shriffin memory model (1968)

This study examines the retention of algebraic conceptual and procedural knowledge among Form 1 students by focusing on the cognitive processes of encoding and retrieval in the Atkinson and Shriffin memory model. Encoding and retrieval strategies were reviewed and applied to the development of the ConProRet-A module so that the retention of algebraic conceptual and procedural knowledge could happen more effectively among Form 1 students. The knowledge retention strategies applied were a) elaboration strategy, b) mental image strategy, c) organization of learned information strategy and d) pattern generalization strategy. Elaboration strategy refers to the process of connecting bits of knowledge in order to remember mathematics knowledge learnt. Students need to build connections in order to better grasp the concept or procedure being taught; that is, we learn something new by linking it to something we already know [38]. The more connections between mathematical concepts or procedures that are stored in memory, the more likely it is that the recall will be accurate [39]. The use of visualization to portray abstract things is referred to as mental image strategy. A learner can retain knowledge better when information is encoded together with visuals [40]. Through utilization of visualization during lesson, students' attention can be drawn and the visualization will be the key to effective shaping of memory [39]. The organization of learned information strategy refers to the process of arranging information systematically to enhance the retrieval process. Organization of new knowledge in hierarchical pattern enables learners to distinguish pieces of information learnt and subsequently makes retrieval of information much easier [41]. Pattern generalization strategy refers to the technique of developing memory through pattern generalization by engaging in guided exploration activities. According to Hawkins, students will be able to build longer memories of a pattern after forming generalizations about it [42]. Furthermore, students' identification of patterns generalized leads to a feeling of knowing [43]. Hence, all the activities in the module are designed in such a way where students use visualizations, make connections between information, arrange the information systematically and make pattern generalizations through guided exploration activities.

RESEARCH OBJECTIVES

The study aimed to develop and validate ConProRet-A module. Specifically, the study sought to:

1. develop the ConProRet-A module for use in mastery and retention of algebraic conceptual and procedural knowledge for Form 1 students.
2. validate the developed ConProRet-A module in terms of content validity and face validity.

DEVELOPMENT OF MODULE PROCESS

The ConProRet-A module was developed based on the ASSURE model. The abbreviation ASSURE stands for the six steps involved in the instructional design model, which are: Analyse students, State standards and objectives, select strategies, technology, media and materials, Utilise technology, media and materials, Require students participation and Evaluate and revise as shown in Figure 2 [44]. The ASSURE model is an instructional design used to develop effective instructions with technology integration [45]. The ASSURE model involves step by step approach to produce a technology-integrated instruction which enhances students' learning [46]. Besides, instructions preparation by using the ASSURE model will enable students to get actively involved in their learning [45].

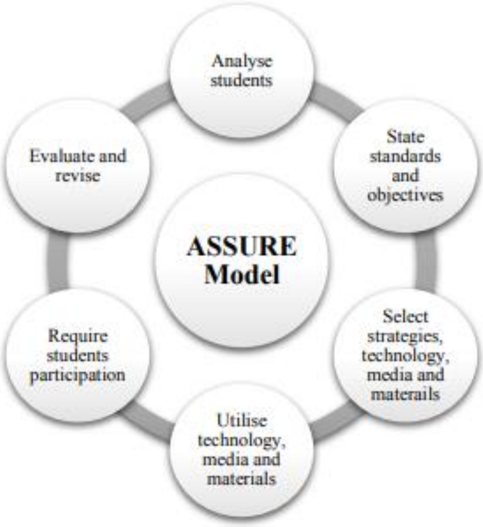

Figure 2 The ASSURE model (1996)

Step 1: Analyse students

This step is the foundation to all the following steps in the ASSURE model where the researcher has to define the problem, identify the cause of the problem and determine suitable solutions. A need analysis had been carried out on 150 Form 1 students and 150 Form 2 students to identify the three hardest topics to be learnt in Form 1 Mathematics [47]. It was found that the difficulty ranking of the 3 hardest topics to be learnt in Form 1 Mathematics were as follow: Linear Equation (42.56%), Algebraic Expressions (31.50%) and Linear Inequality (15.83%). Besides that, results from the need analysis carried out also showed students had difficulties in conceptual and procedural knowledge mastery and also knowledge retention. Based on the analysis that has been done, the ConProRet-A module was developed to facilitate students' algebraic conceptual and procedural knowledge mastery and hence enhance their knowledge retention.

Step 2: State standards and objectives

In the second step, the researcher has to identify the goals for the module. According to Kemp, Morrison and Ross, the four main elements in designing a module are students, objectives, methods and assessment [48]. Hence, the first thing that comes into the frame is the learning objective. This defines the specifications of what learners can do after instructions. Learning objectives have to be written specifically so that they can be measured and determined whether achievable or not [49]. Therefore, the learning objectives to all activities in the ConProRet-A module were as shown in Table 1.

Table 1 Learning Objectives for each activity in ConProRet-A module

Activity	Learning Objectives
Activity 1	Students are able to a) show the solution steps for the addition of two algebraic terms in one unknown correctly b) show an understanding of the concept for the addition of two algebraic terms in one unknown c) apply concepts learnt to solve word problems
Activity 2	Students are able to a) show the solution steps for the subtraction of two algebraic terms in one unknown correctly b) show an understanding of the concept for the subtraction of two algebraic terms in one unknown c) apply concepts learnt to solve word problems
Activity 3	Students are able to a) show the solution steps for the multiplication of an algebraic term in one unknown with integer correctly b) show an understanding of the concept for the multiplication of an algebraic term in one unknown with integer c) apply concepts learnt to solve word problems
Activity 4	Students are able to a) show the solution steps for the division of an algebraic term in one unknown with integer correctly b) show an understanding of the concept for the division of an algebraic term in one unknown with integer c) apply concepts learnt to solve word problems
Activity 5	Students are able to a) show the solution steps for the addition of two algebraic expressions in one unknown correctly b) show an understanding of the concept for the addition of two algebraic expressions in one unknown c) apply concepts learnt to solve word problems
Activity 6	Students are able to a) show the solution steps for the subtraction of two algebraic expressions in one unknown correctly b) show an understanding of the concept for the subtraction of two algebraic expressions in one unknown c) apply concepts learnt to solve word problems
Activity 7	Students are able to a) show the solution steps for the multiplication of an algebraic expression in one unknown with integer correctly b) show an understanding of the concept for the multiplication of an algebraic expression in one unknown with integer c) apply concepts learnt to solve word problems
Activity 8	Students are able to a) show the solution steps for the division of an algebraic expression in one unknown with integer correctly b) show an understanding of the concept for the division of an algebraic expression in one unknown with integer c) apply concepts learnt to solve word problems
Activity 9	Students are able to a) show the solution steps for solving linear equation with one unknown correctly b) show an understanding of the concept for solving linear equation with one unknown c) apply concepts learnt to solve word problems

Step 3: Select strategies, technology, media and materials

In the third step, the researcher has to select instructional methods, media and materials for the module. To achieve educational goals, it is necessary to select suitable methods, media and materials [49]. Suitable methods, media and materials selected can enhance students' learning [49]. Therefore, the researcher has selected a student-centered approach as the primary method for this module. Students will need to do explorations to build algebraic conceptual and procedural knowledge from each activity in ConProRet-A module. The media selected for the module were Geogebra files created by the researcher while the materials selected were the worksheets for each activity in the module. The summary of the method, media and materials selected for each activity in ConProRet-A module were as shown in Table 2.

Table 2. Method, media and material selected for each activity in ConProRet-A module

Activity	Theme	Method	Media	Materials
Activity 1	Addition of two algebraic terms in one unknown	Exploration	Geogebra file: Addition of algebraic terms	Worksheet 1
Activity 2	Subtraction of two algebraic terms in one unknown	Exploration	Geogebra file: Subtraction of algebraic terms	Worksheet 2
Activity 3	Multiplication of algebraic term with number	Exploration	Geogebra file: Multiplication of algebraic term	Worksheet 3
Activity 4	Division of algebraic term with number	Exploration	Geogebra file: Division of algebraic term	Worksheet 4
Activity 5	Addition of two algebraic expressions in one unknown	Exploration	Geogebra file: Addition of algebraic expressions	Worksheet 5
Activity 6	Subtraction of two algebraic expressions in one unknown	Exploration	Geogebra file: Subtraction of algebraic expressions	Worksheet 6
Activity 7	Multiplication of algebraic expression with number	Exploration	Geogebra file: Multiplication of algebraic expression	Worksheet 7
Activity 8	Division of algebraic expression with number	Exploration	Geogebra file: Division of algebraic expression	Worksheet 8
Activity 9	Solving linear equation in one unknown	Exploration	Geogebra file: Balance scale and Solving linear equation	Worksheet 9

The APOS theory, the Scaffolding theory and the Atkinson and Shriffin information processing theory were applied in the development of activities in the ConProRet-A module. The APOS theory was applied to facilitate students construct mathematical concepts through a standard set of steps while the Scaffolding theory was applied to give students guided support throughout the learning process which enables students to master knowledge independently. The Atkinson and Shriffin information processing theory was applied to facilitate students retain knowledge learnt through effective knowledge retention strategies.

Step 4: Utilise technology, media and materials

In this step of the ASSURE model, the researcher has to set up an integrated plan to use method, media and materials identified in the previous step. Thus, in the process of setting up the plan, the researcher has considered several prior preparations that need to be done before carrying out the plan. The preparations were a) prepare sufficient working computers to run the Geogebra software for each student in the experiment group, b) prepare the learning environment and c) prepare the students on what they need to learn and how they will be evaluated throughout the learning using the ConProRet-A module.

Step 5: Require students' participation

The implementation of this step can be verified through the exploration activities that the students need to carry out throughout the learning by using the ConProRet-A module. Thus, the ConProRet-A module was designed in such a way where students need to get actively involved in the learning process in order to master the knowledge.

Step 6: Evaluate and revise

The last step of the ASSURE model was the evaluation process on the effect of learning on students' performance. This could be done through the reinforcement exercise prepared at the end of each activity in the ConProRet-A module.

RESEARCH METHODOLOGY

The validation process of the ConProRet-A module was conducted using a descriptive study approach. According to Russell, the validation of a developed module could be executed through evaluation by a panel of experts appointed [50]. It has been recommended that there should be at least five members in the panel to evaluate the face validity and content validity of module developed [51]. Therefore, five experts with expertise on mathematics content, pedagogy and instructional design were selected through the purposive sampling method to validate the ConProRet-A module in terms of face validity and content validity. The panel of experts evaluated the face validity and content validity of the ConProRet-A module through a module validity evaluation form with statements regarding the face validity and content validity of the ConProRet-A module based on a 10-point Likert scale. The face validity score and content validity score was obtained through the Percentage Calculation Method (PCM). The scores could be calculated by dividing the total expert score (x) with a maximum score and multiply it with 100. When it comes to face validation, an indicator with at least 75% affirmative responses is regarded legitimate [52]. Sidek and Jamaludin suggested that a content validity percentage of 70% and above indicated high content validity for the module developed [19]. The panel of experts was also requested to provide feedbacks and suggestions on the ConProRet-A module developed.

RESULTS AND DISCUSSION

The panel of experts accessed the face validity of the ConProRet-A module by reviewing the module in terms of its understandability, precision of language and consistency of terms used throughout the module. Table 3 shows the face validity analysis for ConProRet-A module. Findings show that the face validity percentage for ConProRet-A module is 94% which is higher than the 75% acceptance value proposed by Tuckman and Waheed [52]. Therefore, the ConProRet-A module has high face validity.

Table 3 Face validity score for ConProRet-A module

Statement	Expert Assessor				
	A	B	C	D	E
The language used is easy to understand.	9	10	9	8	9
The instructions given are clear.	10	10	10	9	9
The usage of terms is consistent.	10	10	10	7	9
The use of grammar is precise.	10	10	10	8	9
The spellings are correct.	10	10	10	10	9
Face validity total score	49	50	49	42	45
Face validity percentage	94%				

The module validity evaluation was then reviewed in terms of its content validity. Therefore, content validity of the ConProRet-A module was reviewed in four aspects through statements regarding the presentation of module, adherence to the curriculum, application of model/theories and suitability of module contents. Table 4 shows the content validity analysis for ConProRet-A module. Findings show that the content validity percentage for ConProRet-A is 90.33% which is higher than the 70% acceptance value proposed by Sidek and Jamaludin [19]. Therefore, the ConProRet-A module has high content validity.

Table 4 Content validity score for ConProRet-A module

Statement	Expert Assessor				
	A	B	C	D	E
The module content is align with Form 1 Mathematics Dokumen Standard Kurikulum dan Pentaksiran (DSKP).	9	10	10	10	9
The module content is suitable on targets' background.	10	10	9	10	9
The module content is suitable with learning context needs.	9	10	9	10	9
The module content can facilitate learning process.	9	9	9	10	9
The module content can help students to master learning content.	9	9	9	10	9
Time allocated to each activity is suitable.	10	10	9	1	9
Learning objectives are achievable.	9	10	9	9	8
The selection of module learning content is appropriate.	10	9	8	10	9
The arrangement of learning content in module is appropriate.	8	8	10	10	8
The learning sequence in module is appropriate to help students master the learning content.	8	8	10	10	8
The module learning materials selected are suitable.	8	9	8	9	9
Questions in the module are suitable to measure learning objectives.	9	10	8	9	8
The module implementation procedure is clear.	10	8	9	10	8
The module activities are suitable to help students master the learning content.	9	9	8	10	8
The module development steps align with the ASSURE model.	10	9	9	10	8
The module activities align with the application of APOS theory.	10	9	9	10	8
The module activities align with the application of Scaffolding theory.	10	9	9	10	8
The module activities align with the application of Atkinson and Shriffin information processing theory.	10	9	9	10	8
Content validity total score	167	165	161	168	152
Content validity percentage	90.33%				

The panel of experts also gave feedback and suggestions on the ConProRet-A module. Overall, the panel of experts gave positive comments and several improvements have been made to the module based on the feedback and suggestions given by the panel of experts. Table 5 shows the feedback and suggestions given by each expert assessor and the actions taken to improve the module.

Table 5 Feedbacks and suggestions by expert assessors

Expert assessor	Feedback and suggestions	Actions taken
A	Give more focus to the 4 types of operations (addition, subtraction, multiplication and division) involving algebraic terms and algebraic expressions by emphasizing the specific meaning of each type of operation involved.	• The recalling back activity of operations on positive and negative integers is removed from the module. • The exploration activities in the module have been enhanced with emphasis on the specific meaning of each type of operation (addition, subtraction, multiplication and division). • The conceptual examples have been improved to guide students understand the concept of operations on algebraic terms and algebraic expressions. • A few terms used in the module were amended as suggested by expert assessor.
B	Overall, the developed module is good because the contents were aligned with the Form 1 Mathematics DSKP. The module content sequence and procedures are systematic and easy to use. The module development step aligns with the instructional design model chosen and all theories are applied correctly. However, a few terms used in the module need to be amended.	
C	The recalling back activity for addition and subtraction of positive and negative integers using real life situations was appropriate, but the recalling back activity for multiplication and division of positive and negative integers was rather confusing. Improvements are needed to help students master conceptual knowledge through the conceptual examples in each activity.	
D	The recalling back activity for multiplication and division of positive and negative integers using real life situations was not suitable for Form 1 students. Overall, the developed module is good.	
E	The recalling back activity for multiplication and division of positive and negative integers using real life situations was not appropriate. Congratulations on the effort to develop a useful learning module for students.	

CONCLUSION

The ConProRet-A module was developed with the goal of boosting students' mastery and retention of algebraic conceptual and procedural knowledge. The module's face and content validity were examined, and their validity percentages were determined to be high. This demonstrated that, in the opinion of experts, the module is ready to be implemented on the target audience. Besides, mathematics instructors may use it as a resource to help them vary their instructional techniques to facilitate students' mastery and retention of algebraic conceptual and procedural knowledge within an active and technology-integrated environment.

REFERENCES

[1] Murre, J. M., & Dros, J. (2015). Replication and analysis of Ebbinghaus' forgetting curve. *PloS one*, *10*(7).

[2] Kooloos, J. G., Bergman, E. M., Scheffers, M. A., Schepens-Franke, A. N., & Vorstenbosch, M. A. (2019). The Effect of Passive and Active Education Methods Applied in Repetition Activities on the Retention of Anatomical Knowledge. *Anatomical sciences education*.

[3] McDermott, K. B., & Roediger, H. L. (2018). Memory (encoding, storage, retrieval). In *General Psychology FA2018* (pp. 117-140). DEF Publishers.

[4] Tan, K. M. (2018). *Creating a Modified Monopoly game for promoting students' higher-order thinking skills and knowledge retention* (Doctoral dissertation, University of Otago).

[5] Murayama, K., Pekrun, R., Lichtenfeld, S., & Vom Hofe, R. (2013). Predicting long-term growth in students' mathematics achievement: The unique contributions of motivation and cognitive strategies. *Child development*, *84*(4), 1475-1490.

[6] McInerney, D. M., Cheng, R. W. Y., Mok, M. M. C., & Lam, A. K. H. (2012). Academic self-concept and learning strategies: Direction of effect on student academic achievement. *Journal of Advanced Academics, 23*(3), 249-269.

[7] Ausubel, D. P. (2012). *The acquisition and retention of knowledge: A cognitive view*. Springer Science & Business Media.

[8] National Mathematics Advisory Panel. (2008). *The final report of the National Mathematics Advisory Panel*. U.S. Department of Education.

[9] RAND Mathematics Study Panel. (2003). *Mathematical proficiency for all students: Toward a strategic research and development program in mathematics education*. RAND.

[10] National Council of Teachers of Mathematics (NCTM). (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

[11] Knuth, E., Stephens, A., Blanton, M., & Gardiner, A. (2016). Build an early foundation for algebra success. *Phi Delta Kappan*, *97*(6), 65-68.

[12] Al Jupri, & Drijvers, P. H. M. (2016). Student difficulties in mathematizing word problems in algebra. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(9), 2481-2502.

[13] Ling, G. C. L., Masitah Shahrill, & Tan, A. (2016). Common misconceptions of algebraic problems: Identifying trends and proposing possible remedial measures. *Advanced Science Letters, 22*(5-6), 1547-1550.

[14] Ijaz Ahmed Tatlah, Muhammad Amin & Muhammad Anwar. (2017). An Investigation of Students' Learning Difficulties in Mathematics at Secondary Level. *Journal of Research & Reflections in Education (JRRE)*, *11*(2).

[15] Sugiarti, L., & Retnawati, H. (2019). Analysis of student difficulties on algebra problem solving in junior high school. In *Journal of Physics: Conference Series* (Vol. 1320, No. 1, p. 012103). IOP Publishing.

[16] Md. Yusoff Daud & Ainun Syakirah Ayub. (2019). Student Error Analysis in Learning Algebraic Expression: A Study in Secondary School Putrajaya. *Creative Education, 10*(12), 2615.

[17] O'brien, A., & Ni Riordain, M. (2017). Examining difficulties in initial algebra: Pre-requisite and algebra content areas for Irish post-primary students. In *10th Congress of European Research in Mathematics Education* (pp. 1-8). European Society for Research in Mathematics Education.

[18] Najihah Mustaffa, Zaleha Ismail, Mohd Nihra Haruzuan Mohamad Said & Zaidatun Tasir. (2015). A Review on the Developing of Algebraic Thinking. *Advanced Science Letters, 23*(10), 3381-3386.

[19] Sidek Mohd Noah & Jamaludin Ahmad. (2005). *Pembinaan Modul: Bagaimana membina modul latihan dan modul akademik.* Penerbitan Universiti Putra Malaysia.

[20] Nardo, M. T. B., (2017). Modular Instruction Enhances Learner Autonomy. *American Journal of Educational Research, 5*(10), 1024-1034.

[21] Gonzales, E. (2006). *A Modular Approach to Writing in the Discipline*. Anahaw Enterprise.

[22] Siregar, N. C., Roslinda Rosli & Siti Mistima Maat. (2020). The Effects of a Discovery Learning Module on Geometry for Improving Students' Mathematical Reasoning Skills, Communication and Self-Confidence. *International Journal of Learning, Teaching and Educational Research, 19*(3), 214-228.

[23] Noor Azimah Abdul Ghani. (2019). Pembangunan Set Lengkap ASK (Algebra Story Kit) Membantu PdP Dalam Matematik. *Journal on Technical and Vocational Education (JTVE), 4*(3), 57-68.

[24] Foo, J. Y., Mohd Faizal Nizam Lee Abdullah & Lee T. T. (2017). The development of form two mathematics i-Think module (Mi-T2). In *AIP Conference Proceedings, 1847*(1), 030018.

[25] Siti Nabila Khalid, Muzirah Musa, Fainida Rahmat, Nurul Akmal Mohamed & Nor Azian Aini Mat. (2019). Pembangunan dan Penilaian Modul Pengajaran STEM dalam Bidang Statistik dan Kebarangkalian dalam KSSM Matematik Tingkatan Dua. *Journal of Quality Measurement and Analysis, 15*(2), 25-34.

[26] Rohani Abd Wahab, Abdul Halim Abdullah, Mahani Mokhtar, Noor Azean Atan & Mohd Salleh Abu. (2017). Evaluation by experts and designated users on the learning strategy using sketchup make for elevating visual spatial skills and geometry thinking. *Bolema, Rio Claro (SP), 31*(58), 819-840.

[27] Khor, M. K. & Ruzlan Md-Ali. (2016). Penggunaan Geogebra dalam Pembelajaran Matematik melalui Pembelajaran Modular. In *Proceedings of the ICECRS*, *1*(1), 147-154.

[28] Dubinsky, E. (1991). Reflective Abstraction in Advanced Mathematical Thinking. In D. Tall, *Advanced Mathematical Thinking.* Kluwer Academic Publishers.

[29] Dra Hanifah. (2016). *Buku model APOS Inovasi pada pembelajaran matematika.* Unit Penerbitan FKIP Universitas Bengkulu.

[30] Arnon, I., Cottrill, J., Dubinsky, E., Oktaç, A., Roa Fuentes, S., Trigueros, M., & Weller, K. (2014). *APOS theory. A framework for research and curriculum development in mathematics education.* Springer.

[31] Suwanto, F. R., Aprisal, A., Putra, W. D. P., & Sari, R. H. Y. (2018). APOS Theory towards Algebraic Thinking Skill. In *International Conference on Mathematics and Mathematics Education* (Vol. 1, pp. 52-58).

[32] Bature, I. J., & Jibrin, A. G. (2015). The Perception of Preservice Mathematics Teachers on the Role of Scaffolding in Achieving Quality Mathematics Classroom Instruction. *International Journal of Education in Mathematics, Science and Technology*, *3*(4), 275-287.

[33] Pfister, M., Opitz, E. M., & Pauli, C. (2015). Scaffolding for mathematics teaching in inclusive primary classrooms: A video study. *ZDM*, *47*(7), 1079-1092.

[34] Nurul Farhana Jumaat & Zaidatun Tasir. (2014). Instructional Scaffolding in Online Learning Environment: A Meta-Analysis. In *2014 International Conference on Teaching and Learning in Computing and Engineering* (pp. 74-77). IEEE.

[35] Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: A decade of research. *Educational psychology review*, *22*(3), 271-296.

[36] Brown, J. L. (2015). Using information processing theory to teach social stratification to pre-service teachers. *Journal of Education and Learning*, *4*(4), 19-24.

[37] Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. *Psychology of learning and motivation*, *2*(4), 89-195.

[38] Restak, R. (2006). *The Naked Brain*. Three Rivers Press.

[39] Laughbaum, E. D. (2011). The neuroscience of connections, generalizations, visualizations and meaning. In *Mathematics education with digital technology* (pp. 3-11). Bloomsbury Publishing.

[40] Byrnes, J. P. (2001). *Minds, brains, and learning: Understanding the psychological and educational relevance of neuroscientific research*. Guilford Press.

[41] Wegner, C., & Solty, L. (2009). Learning Strategies of Teachers. *Teachers in Practice and Process-Heterogenity calls for Dialogue*, 49-60.

[42] Hawkins, J. (2004). *On Intelligence*. Times Books.

[43] Burton, R. A. (2008). *On Being Certain: Believing You Are Right Even When You're Not*. St Martin's Press.

[44] Heinich, R., Molenda, M., & Smaldino, S. E. (1996). *Instructional media and technologies for learning.* Prentice-Hall.

[45] Sezer, B., Yilmaz, F. G. K., & Yilmaz, R. (2013). Integrating technology into classroom: The learner-centered instructional design. *International Journal on New Trends in Education and Their Implications, 4*(4), 134-144.

[46] Smaldino, S. E., Lowther, D. L., & Russell, J. D. (2012). *Instructional technology and media for learning*. Pearson Prentice Hall.

[47] Teh, G. L., Raja Lailatul Zuraida Raja Maamor Shah & Nor'ashiqin Mohd Idrus. (2020). Analisis keperluan bagi pembangunan modul untuk pengekalan pengetahuan konseptual dan prosedural Matematik Tingkatan 1. *Journal of Science and Mathematics Letters, 8*(2), 86-99.

[48] Kemp, J. E., Morrison, G. R., & Ross, S. M. (1998). *Designing effective instruction* (2nd ed.). Prentice-Hall.

[49] Yusup, H. (2001). *Reka bentuk dan sistem instruksi.* Utusan Publication and Distributors Sdn Bhd.

[50] Russell, J. D. (1974). *Modular Instruction: A Guide to the Design, Selection, Utilization and Evaluation of Modular Materials.* Burgess Publishing Company.

[51] Mensan, T., Kamisah Osman, & Nazatul Aini Abdul Majid. (2020). Development and Validation of Unplugged Activity of Computational Thinking in Science Module to Integrate Computational Thinking in Primary Science Education. *Science Education International, 31*(2), 142-149.

[52] Tuckman, B. W., & Waheed, M. A. (1981). Evaluating an individualized science program for community college students. *Journal of research in science teaching*, *18*(6), 489-495.