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CONTEXTUALIZED LEARNING MODULES IN BRIDGING STUDENTS' LEARNING GAPS IN CALCULUS WITH ANALYTIC GEOMETRY THROUGH INDEPENDENT LEARNING

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Abstract

The transition of the educational system in the Philippines vastly affects basic and higher education. A mismatch of pre-requisite Mathematics learning competencies from the basic education level occurred when the student reached higher education. This descriptive-developmental method of the study utilized the developed contextualized learning modules for the bridging course on the identified learning gaps in Calculus with Analytic Geometry for the Bachelor of Secondary Education (BSEd) major in Mathematics. Real-world concepts and situations featuring the Province of Sorsogon, Philippines were integrated into the learning modules while promoting independent learning. The content, format, presentations and organizations, accuracy, and up-to datedness of information of the learning modules passed the evaluation of 13 experts (Mathematics Professors) from the different Higher Education Institutions (HEIs) in the Bicol Region, Philippines. Also, the 18 student participants were very much satisfied with the utilization of the learning modules that bridged their learning gaps in the conic section through independent learning.

Keywords: conic sections, bridging course, learning gaps, independent learning, contextualized learning modules

Abstrak

Transisi sistem pendidikan di Filipina sangat mempengaruhi pendidikan dasar dan tinggi. Ketidaksesuaian kompetensi pembelajaran Matematika prasyarat dari tingkat pendidikan dasar terjadi pada saat siswa mencapai perguruan tinggi. Metode pengembangan deskriptif dari studi ini memanfaatkan modul pembelajaran kontekstual yang dikembangkan untuk menjembatani suatu topik pada kesenjangan pembelajaran yang diidentifikasi dalam Kalkulus dengan topik Geometri Analitik untuk Sarjana Pendidikan Menengah (S.Pd.) jurusan Matematika. Konsep dan situasi dunia nyata yang menampilkan Provinsi Sorsogon, Filipina diintegrasikan ke dalam modul pembelajaran sambil mempromosikan pembelajaran mandiri. Isi, format, presentasi dan organisasi, keakuratan, dan kemutakhiran informasi modul pembelajaran telah melewati proses evaluasi dari 13 ahli (Profesor Matematika) yang berasal dari berbagai Institusi Pendidikan Tinggi (IPT) di Wilayah Bicol, Filipina. Selain itu, 18 peserta didik peserta sangat puas dengan pemanfaatan modul pembelajaran yang menjembatani kesenjangan pembelajaran pada bagian berbentuk kerucut melalui pembelajaran mandiri.

Kata kunci: irisan kerucut, matrikulasi, kesenjangan pembelajaran, pembelajaran mandiri, modul pembelajaran kontekstual

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Mathematics is considered the universal language, but student math achievement is exceptionally low (Morita-Mullaney, Renn, & Chiu, 2020; Wong & Chan, 2019; Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015). The complexity of mathematics and its utility is not as obvious as it is (Andrews & Hatch, 1999) as an abstract discipline with various applications in different areas (Jankvist, 2015). Relating mathematics concept to its context in the real – world is now the demand (Gainsburg, 2008; Jurdak, 2006) which allows learning transfer through contextual teaching and learning approach (Boaler, 1993; Mahendra, 2016; Mulyono & Lestari, 2016; Nabila & Widjajanti, 2020).

The process of matching the content and instructional strategies relevant to students is called contextualization (Department of education [DepEd], 2016). It is the use of relevant and meaningful things, situations, and experiences to students in the presentation and discussion of the learning content. Contextualization can help enable the transformation and construction of a larger motivational environment for students (Haris & Putri, 2011; Weinberg, Besile, & Albright, 2011). When mathematics is real and accessible, students overcome their fear which leads to an appreciation of its utility (Wang, Sun, & Wickersham, 2017). Realistic mathematical approaches increase the learning independence of students (Hasibuan, Saragih, & Amry, 2019).

Context is directly related to everyday life (Supiyati, Hanum, & Jailani, 2019). Mathematizing culture and environment where it is assumed to motivate students to recognize mathematics as part of everyday life aim to enhance the student's ability, deepen their understanding of all forms of mathematics, and to make meaningful mathematical connections (Alangui, 2017; Muhtadi, Sukirwan, Warsito, & Prahmana, 2017; Rosita, 2016). Albeit, contextualization consumes much time for preparation with the unavailability of the local materials and difficulty in pedagogy. Not all topics are applicable and students' differences pose a challenge to contextualization, however, contextualization still increases the learning engagement wherein students have better retention of concepts and conceptual understanding.

Scaffolding is an integral part of contextualization (Howe, 2013). The first step in scaffolding is contextual support followed by a series of actions and interactions to balance the routine of the scaffolding procedure (Amerian & Mehri, 2014). Scaffolding is important to students with learning difficulties because it increases their mathematical understanding (Sutiarso, Coesamin, & Nurhanurawati, 2017; Gravemeijer, 2011). An increase in students' engagement characterizes high-quality teaching and learning (Ashwin & McVitty, 2015). Instructional support is the most dominant factor determining student engagement (Alrajeh & Shindel, 2020) and learning becomes more efficient and relevant to them (Baker, Hope, & Karandjeff, 2009). Students also develop new skills, knowledge, abilities, and attitudes (Rivet & Krajcik, 2008).

The learning module contains summaries of material, training, and covers how students build knowledge (Hamdunah, Yunita, Zulkardi, & Muhafzan, 2016). It is an instructional material used to ease, encourage, improve, and promote teaching and learning activities to improve and facilitate effective processes of instruction (Matarazzo, Durik, & Delaney, 2010; Fradd, Lee, Sutman, & Saxton, 2001). Learning module offers new approaches and learning opportunities that enhance student's knowledge and helps them overcome deficiencies (Gordon & Nicholas, 2013). Teachers should be aware of the prerequisite topics so that intervention could be done to address students' least mastered competencies (Herrera & Dio, 2016). Learning modules develop mathematical skills (Setyani, Putri, Ferdianto, & Fauji, 2020), and improve students' abilities and affect their learning motivation (Saifiyah, Ferdianto, & Setiyani, 2017). Nevertheless, contextualized learning modules are effective to bridge learning gaps independently as they supplement and complement the teacher's verbal explanations in making a learning experience. Contextualized learning modules can also clarify, vitalize, emphasize the instruction, and enhance learning in the process of transmitting knowledge, ideas, skills, and attitude (Oladejo, Olosunde, Ojebisi, & Isola, 2011). The integration of contextualization in the learning modules allows greater transfer of mathematics ideas related to their environment (Boaler, 1993; Anwar, Budayasa, Amin, & Haan, 2012). As students take ownership of their learning, they are engaging in independent learning (Field, Duffy, & Huggins, 2015; Livingston, 2012) which has a large effect on student learning (Chingos & Whiteburst, 2012; Olayinka, 2016). Contextualized learning modules are user – friendly where students can learn on their own (Lai & Hwang, 2016) and are widely accepted by the present educational systems to have a positive effect on learning (Hendriana, Prahmana, & Hidayat, 2019). This connotes that contextualized learning modules eventually promote independent learning.

The full implementation of the Philippine new K to 12 Basic Education program in 2016 is a move to meet the world's demand for quality education at the basic education level. The education transition from 2016 to 2021, presents significant challenges in the reform of the Philippine educational landscape (Commission on Higher education [CHED], 2020) such as student learning gap when they reach the higher education level. Learning gaps occur when there is a mismatch of learning competencies between the basic education and higher education levels. In this light, this paper aimed to developed contextualized learning modules for a bridging course in Calculus with Analytic Geometry that promotes independent learning among the Bachelor of Secondary Education (BSEd) major in Mathematics students who are non-STEM (Science, Technology, Engineering & Mathematics) strand graduates during the Senior High School.

METHOD

This descriptive – developmental study describes a phenomenon and its characteristics (Nassaji, 2015) and assesses the changes with a phenomenon over an extended period (Jaikumar, 2018) brought by the developed contextualized learning module in bridging student's learning gaps. ADDIE model (Analyze, Design, Develop, Implement, Evaluate) is the main approach used in evaluating the characteristics of the developed learning module (Cullata, 2020). The ADDIE approach is a product developmental concept applied for constructing performance-based learning adopting the Input – Process – Output (IPO) paradigm (Branch, 2009).

Analyze phase

The Philippine CMO No. 105, s. 2017 mandated Higher Education Institutions (HEIs) not to discriminate against college enrollees (CHED, 2017). Furthermore, the Philippine CMO No. 75, s. 2017 is the Policies, Standards, and Guidelines (PSG) for Bachelor of Secondary Education (BSEd) including specialization in Mathematics (CHED, 2017). BSEd- Math accommodated STEM (*Science, Technology, Engineering, and Mathematics*) graduate students and Non – STEM (*all other senior high* *track/ strand*) (DepEd, 2014). Initially, STEM graduates are expected to enroll in science and mathematics-related courses including BSEd – Math. The learning gap occurred to BSEd – Math students who are non-STEM graduates of Senior High School. Curriculum mapping was conducted to Calculus with Analytic Geometry to all SHS strands, and conic sections were the identified learning gap as a prerequisite to the subject. The identified learning gap was also validated by tertiary mathematics professors teaching Calculus subjects.

Design phase

The learning modules on the identified student learning gaps about conic sections were designed by contextualizing mathematical concepts to reality by bringing Sorsogon's best in the materials. Contextualization is present in various parts of the module that promotes independent learning (Hasibuan, Saragih, & Amry, 2019; Yilmaz, 2020) where content and strategies are matched to relevant and meaningful things, situations, and experiences. Besides, the module uses clear and simple language, presentation, and illustration to cater to all students. It is designed to be used as supplementary material in the Calculus with Analytic Geometry bridging course to second-year Non-STEM graduates BSEd – Mathematics students.

Develop phase

The collated relevant materials which are locally available to conic section concepts were used in the development of the module through its integration in the following parts of the module: introduction, lesson proper, examples, formative and summative assessment. Contextualization of modules featured things familiar to learners such as tourist attractions, products, and situations to the locale of students in the Province of Sorsogon, Philippines. Language experts and design experts were consulted to improve the material's language and medium of delivery as well as the presentations of figures and illustrations. Recommendations of mathematics experts who are teaching the subjects were also incorporated in the development of the contextualized learning modules.

Implement phase

The researcher conducted the bridging course to the purposively selected 18 BSEd – Mathematics major student-participants of the Sorsogon State College at the beginning of the second semester, SY 2019-2020. These student-participants are the non-STEM graduate of Senior High School who was subjected to the bridging class. The bridging class was conducted for 18 hours which were distributed evenly for 3 weeks. The general orientation of the purpose, mechanisms, and schedules was conducted first during the first hour of the class before the distribution of the learning modules. Students were tasked to solely read and understand the content of modules, answer the assessments, and explain their solutions and answers. The learning modules were implemented in series from module 1 to module 4 which cover circle, parabola, ellipse, and hyperbola, respectively.

Evaluate phase

This phase assesses the quality of instructional products and processes (Branch, 2009; McGriff, 2000; Kurt, 2018) which is continuous in conjunction with the first four phases of the ADDIE model (Branch, 2009). The developed learning modules were sent to 13 experts (Mathematics Professors – teaching Calculus) from seven HEIs in Bicol Region (Region V) who served as evaluators using the adopted Evaluation Rating Sheet for Print Resources from Guidelines and Process for LRMDS (*Learning Resources Management and Development System*) Assessment and Evaluation (DepEd, 2009).

Jurors evaluated the modules using 5 – point Likert scale for content, format, and presentation, and organization, and 4 – point Likert scale for accuracy and up – to – datedness of information (DepEd, 2009). Experts' validation made modules meet the valid criteria (Hasibuan, Saragih, & Amry, 2019). Indicator's accumulated points were interpreted based on set standards of the instrument – at least 21 of 28 (contents); 54 of 72 (format); 15 of 20 (presentation and organization); and 18 of 24 (accuracy and up – to – datedness of information) (DepEd, 2018). Contextualization feature indicators were adopted from its definition stipulated in DepEd Order No. 35 (2016), and independent learning feature indicators were also adopted from Mckendry and Boyd (2012) in the expert evaluation.

After conducting the bridging course, the students evaluated the acceptability of the learning modules using the instrument of Tan-Espinar and Ballado (2017) with a 4 – point Likert scale. The students' comments were also analyzed to support their written evaluation. On the other hand, students' evaluation measured the acceptability of clarity, usefulness, suitability, adequacy, timeliness, and language, style, format, illustration, and presentation. Frequency count and weighted mean were used in the analysis and quantification of the data through Microsoft Excel and interpreted using the interval used from the study of Owusu-Manu, Torku, Pärn, Addy, and Edwards (2017). All numerical results are supported by the content analysis of the comments and suggestions of the experts and students who utilized the learning module.

RESULTS AND DISCUSSIONS

Learning Gap of Non – STEM students to Calculus with Analytic Geometry

Philippines CMO No. 75, s. 2017, the adapted course description of Calculus with Analytic Geometry is: *The course equips the students with knowledge and skills needed to be able to determine limits of the functions, to differentiate and integrate algebraic, exponential, logarithmic, and trigonometric functions in one variable. It also includes exposure to more challenging problems covering the continuity and areas of the region.* Explicitly, it includes more challenging problems about areas of the region. This topic is one of the major practical applications of the integration of calculus itself. College Algebra, Trigonometry, and Geometry are prerequisite subjects of Calculus with Analytic Geometry, but conic sections (*circle, parabola, ellipse, and hyperbola)* are not included in any of these subjects and even in Calculus with Analytic Geometry. The course description of Calculus with Analytic Geometry focuses more on limits and continuity, differential, and integral calculus.

Conic sections are topics in Pre – Calculus subject in SHS - STEM, other SHS strands/ tracks do not offer this subject (Ascano, Martin, Olofernes, and Tolentino, 2016). This entails that this topic is a learning gap for all non – STEM graduates studying BSEd – Mathematics. Book authors proved that conic sections are in the topic area of the region bounded by the curve. Anton, Bivens, and Davis (2012) used the concepts of conic sections in their published book to determine the area of the region bounded by equations. *Find the area of the region that is enclosed between the curves* $y = x^2$ *and* $y = x + 6$ *(Example 2, p.415). Find the area of the region enclosed by* $x = y^2$ *and* $x = y + 2$ *(Example 4, p. 417). Show that the area of the ellipse in the accompanying figure is* πab *(Exercise Set 6.1, no. 50, p. 420).* These examples show that the concepts of conic sections are prerequisites for the area of the region bounded by equations/curves. The first two examples are parabolas that open upward($y = x^2$) and rightward($x = y^2$). The latter example is to prove the formula of ellipse $\left(\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1\right)$ using integral calculus.

Larson and Edwards (2019) also used conic sections to illustrate the concept of areas of the region bounded by equations/curves in their Calculus book. *Find the area of the region bounded by the graphs of* $f(x) = 2 - x^2$ *and* $g(x) = x$ *(Example 2, p. 446). Find the area of the region between the graphs of* $f(x) = 3x^3 - x^2 - 10x$ *and* $g(x) = -x^2 + 2x$ *(Example 4, p. 447). Find the area of the region bounded by the graphs of* $x = 3 - y^2$ *and* $x = y + 1$ *(Example 5, p.448).* These examples used parabolas to illustrate areas of the region bounded by equations/curves. The first function in Example 2 is a parabola that opens downward, and so with the second equation in Example 4. Hence, the first equation in Example 5 is a parabola that opens leftward.

Furthermore, Stewart (2016) also used conic sections to illustrate the area of regions. More of his examples are also used in parabolas which require basic integration. In Chapter 7 of Stewart's book (Techniques of Integration) Exercises 7.3 (pp. 491 – 492, no. 34), one of the exercises stated *Find the area of the region bounded by the hyperbola* $9x^2 - 4y^2 = 36$ *and* $x = 3$. He also added that in determining the area of circle and ellipse, an integral of the form $\int \sqrt{a^2 - x^2}\, dx$ where $a > 0$ will be used. This requires a technique of integration, specifically trigonometric substitution.

Contextualized Learning Modules for Bridging Course in Calculus with Analytic Geometry

In various parts of the modules, different things relevant to the students were used to illustrate and transfer the concepts of conic sections and eventually evaluate their context. The use of local material's contexts in the introduction is a platform to ensure the learning transfer of everyday mathematics to abstract mathematics (Boaler, 1993).

The circle is traced in the image of coconut (*locally called "niyog" in the entire Philippines, and "lubi" in the local dialect of Sorsogon"*), which is put in the Cartesian plane labeled the parts and is used to introduced circle conic sections in the module. From real objects, the students learned the abstract concepts of the circle, then eventually apply back to situational problems. One of these real and contextualized objects is *"timitim"* (see Figure 1) which is one of the local delicacies of Gubat, Sorsogon (Villareal, 2018; Sorsogon 101, 2019).

Figure 1. *Sorsogon "Timitim"*

The word "timitim" is derived "patikim – tikim" or to taste. Its main ingredient is "kamoteng kahoy" or cassava. Since it is locally made in Sorsogon, students easily recognized it and grasp the context of the circle based on the given scenario. Contextualization is also integrated into assessments, like the circles on the ceiling of Sts. Peter and Paul Cathedral in Sorsogon City, Sorsogon. Contextualization is an avenue for students to appreciate, and an authentic transfer of mathematics concepts.

Figure 2. Sorsogon *"Parola"*

Parabola is presented by its trace in the image of Fatima Church in Sorsogon City, Sorsogon. Similarly, after abstraction, students applied it back into realistic situations, such as the arch (somewhat parabolic) of the doorway of Lighthouse or "*Parola*" (see Figure 2) at Sorsogon City Boulevard or locally called "Rompeolas". Parabola concepts are also applied to other different situational problems such as radio signal satellite dish, the cable of suspension bridges, sound reflector, bridge arch, and television dish antenna.

Meanwhile, an ellipse is introduced using the orbit of the moon around the earth, orbits of planets around the sun, the elliptical image of the earth, and castle nut scientifically called *"canarium ovatum"* and locally called *"pili"* (*entire Philippines*) (Yve, 2015). Pili (see Figure 3) uses its trace to introduce the concept of the ellipse, and its determined parts are used further in abstraction. Furthermore, the concept of an ellipse is also applied to pili sculpture (at Sorsogon City Boulevard) and its platform, situational planet's orbit, semi-elliptical dome and tunnel, Colosseum at Rome, and Sputnik I's (artificial satellite) orbit.

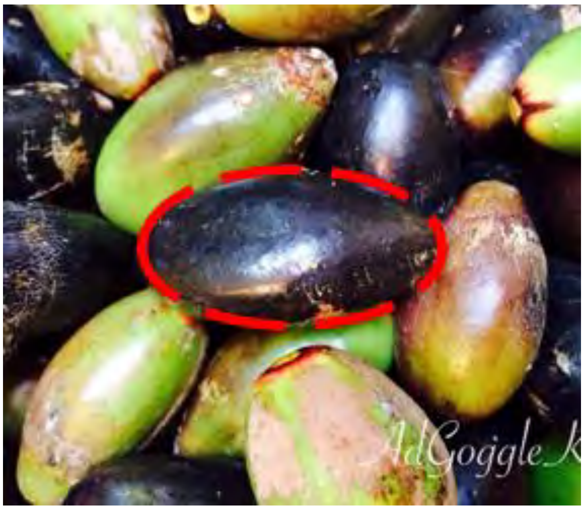

Figure 3. *"Pili"* Fruit

Different sceneries such as an image in the middle of Bulusan Lake at the foot of Mt. Bulusan, Bulusan, Sorsogon, the mountains around the lake, and its reflection to the water traces the image of the hyperbola and the hyperbola image at the ceiling of Sts. Peter and Paul Cathedral were used as a platform for the abstraction of the hyperbola concept and used also in scenarios for real-world application of the concept. Added to these scenarios are a hyperbolic mirror for panoramic photography, explosion scenario, hyperbolic shaped pillar, long-range navigation (LORAN), and the aerial view of crossroads at Sorsogon City (see Figure 4).

The mind naturally seeks meaning in a context related to a person's current environment that makes sense and is useful (Ampa, Basri, & Andriani, 2013). The contextualization feature relates to the environment in the transfer of mathematics ideas (conic section) to students. Beginning at context is meaningful and fun, it also sharpens students' minds and focuses (Muslimin, Putri, Zulkardi, & Aisyah, 2020). Activities are put into perspective and linked concepts into practical real-world contexts (Dewi & Primayana, 2019; Lasa, Abaurrea, & Iribas, 2020). In this way, content becomes meaningful and relevant to them (Baker, Hope, & Karandjeff, 2009). Through this, learning engagement and conceptual understanding increase, and students have better retention of concepts (Reyes, Insorio, Ingreso, & Hilario, 2019).

Figure 4. Sorsogon City Crossroads

Realistic mathematical approaches increase the learning independence of students (Hasibuan, Saragih, & Amry, 2019). Realistic mathematics' principle is the transition from informal knowledge to formal knowledge through contextual problems (Yilmaz, 2020). Also, Independent learning or independent study is a process, method, and philosophy of education in which a student acquires knowledge by his or her efforts, and develops the ability for inquiry and critical evaluation (Field, Duffy, & Huggins, 2015). Here, learners have ownership and control of their learning (Livingston, 2012). Using the modules, students independently learn the lessons.

The modules use precise and simple language (Jamison, 2000), concrete illustrations, the relation of each mathematics concepts to explain the context of conic sections. Moreover, color coding is also used as a cueing instrument to highlight which gives ease to readers in the algorithm, such as in similar terms, and related mathematical concepts (Maile & Cooper, 2018). Furthermore, related ideas/ concepts/ mathematical terms are summarized into table/s which enable the readers to see and grasp the relatedness of each concept to one another. The relatedness of information gives users a general outlook on how to execute the step by step solutions. Solutions of examples are readily prepared with complete and comprehensive explanations to guide the readers. Fully packaged learning solutions can be for independent learning where students work step – by – step (Utemov, Khusainova, Sergeeva, & Shestak, 2018). Final answers to problems of formative assessments are readily available at the back so that students can self–assess and monitor their progress (Biehler, Fischer, Hochmuth, & Wassong, 2010). These make the modules to be student-friendly wherein students learn on their own (Dewi & Primayana, 2019). The integration of independent learning guides the students to address the gap and deficiencies independently (Biehler, Fischer, Hochmuth, & Wassong, 2010). Students discover facts by themselves and become responsible for their learning (Oginni & Owolabi, 2012).

Jurors' Evaluation of the Learning Modules

Evaluation is one of the major determinants of the quality of developed learning modules. It also determines the value of worthiness, appropriateness, goodness, validity, and legality of modules (Kizlik, 2014). The summary of jurors' evaluation of the learning modules is presented in Table 1. All learning modules accumulated passing points from each criterion.

Table 1. Jurors' summary of points of learning modules evaluations

Criteria	Points to pass (*DepEd, 2009*)	Mean Scores of Jurors' Evaluation			
		M1	M2	M3	M4
Content	at least 21 of 28	26	25	24	24
Format	at least 54 of 72	66	63	62	62
Presentation and organization	at least 15 of 20	18	17	18	17
Accuracy and up –to –datedness of information	at least 18 of 24	22	22	22	22

Legend: MI, M2, M3, M4 – Modules developed

This infers that content is suitable for students' level of development. The scope, range, and depth of content and topics are appropriate to their learning needs. The level of difficulty of modules is appropriate for their age and stage of learning, and the level of detail is appropriate for the achievement of the specified learning outcomes. The result tells that the learning modules contributed and supported the achievement of the specific objectives (Rosita, 2016). It also reinforces, enriches, and/or leads mastery of competencies. The module develops higher cognitive skills of students such as critical thinking, creativity, inquiry, problem solving, and others (Dewi & Primayana, 2019).

As to the format of the modules, findings show that the modules' prints, design and layout, paper and binding, and size and weight of resources contributed to visual representations for easy grasp and understanding of the concepts. Presentations are engaging, interesting, and understandable. The flow of ideas is logical, smooth, clear, and evident. Vocabulary level is appropriate to the experiences and understanding of the students. New, technical, or complex terms are strategically, clearly, and consistently explained. The sentence length used was suitable for the target (Jamison, 2000). All of these factors help the students in meaning-making (DepEd, 2016).

Most of the jurors identified very minor errors such as conceptual, factual, grammatical, and computational, use of obsolete information, and other errors (i.e. illustrations, diagrams, pictures, maps, graphs, and tables). There is no conceptual error that may lead to the development of misconceptions or misunderstanding of the content nor factual errors which means that the content was accurate and up-to-date, and without outdated information. Metcalfe (2017) emphasizes that committing minor errors should not be exaggerated, rather it should be handled sensitively, and teachers and learners should be open to mistakes, and actively use them in becoming prepared for the test that counts. The identified minor errors can still be used as a way to facilitate new learning, to enhance memory for the generation of correct responses, to facilitate active learning, and to direct the attention of the learner while letting the teacher be aware of the focus of discussion.

Table 2 presents the summary of the jurors' evaluation along with the presence of the features – contextualization and independent learning. It is depicted that the jurors are satisfied that contextualization and independent learning features are present in the learning modules.

Table 2. Presence of the features of learning modules

Features	Mean Scores of Modules				
	Module 1	Module 2	Module 3	Module 4	Overall
Contextualization	3.68 (VS)	3.58(VS)	3.57(VS)	3.46(VS)	3.57(VS)
Independent learning	3.41(S)	3.25 (S)	3.48(S)	3.30(S)	3.36(S)

Legend: S– Satisfactory, VS – Very Satisfactory

The presence of contextualization implies that they can relate the subject matter conic sections to practical, applicable, and meaningful situations that are relevant to students (Dewi & Primayana, 2019; Lasa, Abaurrea, & Iribas, 2020). These situations are supported by facts and theories that embed the cultural, historical, ideological fabric, and/or personal experiences of students (Ampa, Basri, & Andriani, 2013; Baker, Hope, & Karandjeff, 2009). Contextualization allows the transfer of mathematics ideas (conic section) to students (Boaler, 1993; Anwar, Budayasa, Amin, & Haan, 2012). It also motivates students to recognize mathematics as part of everyday life to enhances student's ability; and deepens their understanding of all forms of mathematics to make meaningful mathematical connections (Alangui, 2017; Reyes, Insorio, Ingreso, & Hilario, 2019; Muhtadi, Sukirwan, Warsito, & Prahmana, 2017). Realistic mathematics which is supported by classroom activities constructs an understanding of meaningful mathematical ideas (Anwar, Budayasa, Amin, & Haan, 2012).

Sorsogon local information leverages students' knowledge by bringing the students' concepts from their home and community to classroom situations, allows the students to have fun, makes the lessons relevant and meaningful, resulting to lessons being effectively and efficiently delivered (Ulandari, Amry, & Saragih, 2019; Supiyati, Hanum, & Jailani, 2019; Rivet & Krajcik, 2008). The modules assist the students to learn independently and think actively with minimal guidance and tested their mathematical resiliency (Asih, Insnarto, & Sukestiyarno, 2019). Mathematical problem-solving abilities and student learning independence increase using realistic mathematical approaches (Hasibuan, Saragih, & Amry, 2019). Students overcome their fear and appreciate the utility of mathematics if it is real and accessible (Wang, Sun, & Wickersham, 2017). Instructional support can make students' learning more engaging (Alrajeh & Shindel, 2020).

Students' Acceptability of the Learning Modules

To validate the response of the experts, the students also evaluated the acceptability of the contextualized learning modules. Table 3 presents the evaluation of the students along with the acceptability of the developed contextualized learning modules in conic sections. The table reveals that all learning modules are very much acceptable (VMA) to students along with the different indicators (Hasibuan, Saragih, & Amry, 2019).

Table 3. Summary of student acceptability of developed contextualized learning modules

Criteria	Mean Scores for Acceptability				Overall
	Module 1	Module 2	Module 3	Module 4	
Clarity	3.94(VA)	3.93(VA)	3.90(VA)	3.86(VA)	3.91(VA)
Usefulness	3.89(VA)	3.87(VA)	3.85(VA)	3.85(VA)	3.87(VA)
Suitability	3.76(VA)	3.76(VA)	3.76(VA)	3.78(VA)	3.77(VA)
Adequacy	3.84(VA)	3.84(VA)	3.85(VA)	3.85(VA)	3.85(VA)
Timeliness	3.98(VA)	3.98(VA)	3.98(VA)	3.96(VA)	3.98(VA)
Language, Style, and Format	3.83(VA)	3.81(VA)	3.79(VA)	3.80(VA)	3.81(VA)
Illustrations	3.92(VA)	3.81(VA)	3.81(VA)	3.82(VA)	3.84(VA)
Presentations	3.94(VA)	3.93(VA)	3.96(VA)	3.93(VA)	3.94(VA)
Overall	3.88(VA)	3.86(VA)	3.85(VA)	3.84(VA)	3.87(VA)

Legend: VA- Very Much Acceptable

This implies that the language and information used in the modules are presented in such a manner that it can deliver the concept of the conic section logically and independently. The consistent and purposeful use of vocabulary building greatly assisted the students (Riccomini, Smith, Hughes, & Fries, 2015). This connotes that the modules are useful to comprehensively prepare them to think logically and critically and to develop their analytical thinking and mathematical skills (Kurniati, Kusumah, Sabandar, & Herman, 2015). The use of meaningful and relevant information actively involved them in various learning activities (Alangui, 2017; Reyes, Insorio, Ingreso, & Hilario, 2019). The learning modules are suitable to address the previously identified learning gap (Rochsun & Agustin, 2020). Activities cater to unique differences, attitudes, and capabilities, with suitable prescribed topics that are relevant, interesting, and self-motivating (Singh, 2014). Sufficient and salient information is provided in the delivery of the concept. Adequate activities provided enhance their knowledge, critical thinking, skills, and attitudes. Situational problems motivate them and provide a mechanism to organize ideas. These also allow them to be reflective and to develop metacognition (Belecina & Ocampo, 2018).

The modules and their features are appropriate to be used as an urgent, tactical, transformative solution to the 21st-century educational challenges and issues (NEDA, 2017). "*The learning module is useful for the students because it can be considered as an alternative tool, and through its activities, students can exercise their mind, ability, and skills.",* as affirmed by one of the students. Each learning module is designed and programmed from simple to complex concepts to let the learners determine the interrelationship of the concepts, and so that it will guide them to easily understand the concepts (van de Pol, Volman, Oort, & Beishueizen, 2015). One of the students emphasizes, "*[The Learning module] Provide examples that are easy to understand especially to those students who do not encounter some of the mathematical terms.* Another student also stresses, *well-prepared module, and for this, it can help the student to understand the topic easily."* Furthermore, one student believes that "*the module presents real-life situations that boost students to think critically."*

Print legibility influences the readability as it gives ease to the learner to distinguish letters and words while reading (Maile & Cooper, 2018). Indeed, the language, style, and format used in the modules aided the comprehension, understanding, and learning of the concepts in the developed material (Karimah, Hidayah & Utami, 2020; Widodo, Prahmana, Purnami, & Turmudi, 2018). The clear, simple, and relevant illustrations and presentations piqued their interest and made learning effective and enjoyable, and provided concrete visual clues (Maile & Cooper, 2018).

"*The module is helpful for those students especially the student who takes Mathematics as their major that [who] did not take STEM while they are [were]in senior high school. With the help of the module, the lesson gets more exciting and it serves [s] as the bridge in a learning gap between other strand and STEM students",* one of the students affirms. This comment concluded that the developed contextualized learning modules help them bridge the learning to the subject Calculus with Analytic Geometry. These learning modules serve as supplementary materials to learn the concept independently and excite them to learn. These are affirmed by their acceptability and jurors' (experts') evaluations (Setiyani, Putri, Ferdianto, & Fauji, 2020).

CONCLUSION

The developed learning modules on conic sections for the conduct of the bridging course BSEd Mathematics students who were non-STEM graduates in Senior High School were in accordance with the identified learning gap of the students to Calculus with Analytic Geometry subject. The learning modules were positively evaluated and validated by jurors' (experts' – who are Mathematics Professors). Furthermore, students' evaluations revealed that the developed contextualized learning modules on conic sections are very much acceptable. Consequently, for further development of quality supplementary materials that promote independent learning and holistic development of critical thinking, it is highly recommended to contextualize or even localize the concepts. Contextualized learning modules can be used in the conduct of different academic remediation such as bridging courses, remote learning in times of unwanted circumstances such as pandemic (e. g. COVID-19), and among others. It is also highly recommended to test the effectiveness of the use of contextualized learning modules to the student learning outcomes.

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