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Student-Centered Assessment Repertoire for Modular Instruction

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Abstract

A 3-cycle action research on modular instruction employing the Community of Inquiry framework overarching the Plan-Do-Study-Act (PDSA) model, revealed the need for assessments in addition to the usual paper-and-pencil tests. This qualitative study explored the experience on various assessments of an intact BSE math calculus class to complement the nature of a modular instruction. The teacher-researcher administered peer, self, reflective, and democratized assessments. Data were collected through students' unstructured interview and survey and teacher-researcher observation and reflection. The study revealed that peer and self-assessments were appropriate in determining students' acquired competency in terms of knowledge and skills validated during group studies. Reflective assessment which enhances metacognition, proved to be a potent evaluation tool in determining the ability of learners to make deeper connections between the lessons and lived experiences. Democratized assessment allowed the students to showcase their understanding of a particular lesson as they desire. Calculus agency which is the ability to use calculus correctly, was demonstrated through included literary works, visual arts, and audio-visual presentations. Students felt empowered when given the opportunity to decide on how they can prove their understanding of any concept in calculus. The assessments administered throughout the semester complemented the usual paper-and-pencil tests and underscored the relevance of student-centered assessments in a fully modular class.

Keywords

Student-Centered Assessment, Democratized Assessment, Peer Assessment, Self-Assessment, Calculus Agency

1. Introduction

The global health pandemic brought about by COVID-19 in early 2020 served as

the impetus for a radical change in education. Suspension of in-person classes was inevitable with the purpose of curbing the spread of the virus then which resulted in tremendous struggles for almost all teachers and students who are used to physical classes with lectures and discussions. Academic institutions, including higher education institutions adopted the flexible learning arrangement which is a form of remote learning where classes were conducted on an online platform and students and teacher simultaneously met virtually. With the many restrictions as a result of in-person classes suspension, instruction delivery and assessment became a struggle for teachers and students alike. During this time, a fully modular instruction (MI) class, seemed to be the most viable mode of instruction. The modular approach achieved through self-contained learning modules proved to be an effective mode of instruction delivery in the absence of a face-to-face class and its merits went beyond the pandemic and were practiced even in hybrid classes at present. The MI provides positive learning experience and significantly improves calculus agency (Domingo, 2023a), which is the ability to use calculus correctly and meaningfully.

1.1. Modular Approach and Assessment

A modular approach involves the delivery of instruction through self-contained learning modules. The approach is considered to be an information block, including a logically complete unit of learning material, program of actions determined by a specific purpose, and a guidance for didactic objectives to be achieved (Rakova et al., 2018). The teacher-researcher developed 15 self-contained, self-learning modules, each of which contained an introduction, objectives, instruction to users, pretest, lesson presentation, activity, posttest, and self-assessment which includes a reflection part. With the self-contained learning modules, a fully modular instruction was in place which provided students with opportunities for self-regulated learning and collaboration (Domingo, 2023a).

1.2. Assessments and Evaluation

It is common knowledge that student learning is the core of assessments, which drives the efforts to gather data on student learning outcomes and provide assurance that learning is indeed taking place as designed (Simms & George, 2014). Assessment is a key process in assuring quality education. Wiliam and Thompson (2017) believed that educational assessments have three functions: supporting learning, certifying the achievements or potential of individual learners, and evaluating the quality of educational institutions or programs. Over the years, from being a mere tool to record student achievement, classroom assessment has shifted to an activity to support learning (Yin et al., 2022). A concern over the need to develop assessments that have strong alignment with curricular ambitions and values and which have applicability to classroom contexts and processes was expressed by Bennett (2018) as cited by Brown (2022). The teacher-researcher firmly believes that since instruction is modular, assessments should deviate from

the usual pen-and-paper exam normally administered in a lecture or discussion class. A study of Karal and Cebi (2012) concluded that assessment and evaluation process in modular instruction involves not only online exams but includes forum, assignments, wiki, and dictionaries which show students' process performance. They emphasized that students' answers in modular assessment and evaluation process should be considered qualitatively and quantitatively.

1.3. Self-Assessment

Panadero et al. (2016) defined self-assessment (SA) as a "wide variety of mechanisms and techniques through which students describe, and possibly assign merit or worth to evaluate the qualities of their own learning processes and products". This definition sits well with a modular instruction in calculus where students are tasked to study on their own with the aid of self-contained learning modules. Students' empowerment is observed in the assessment process since ownership of learning and use of self-regulatory strategies are practiced (Nicol & MacFarlane-Dick, 2006). It is believed that students' self-assessment plays an important role in academic success and a potent educational learning process (Dochy et al., 1999).

1.4. Reflective Assessment

Reflective assessment (RA) is viewed as an innovative alternative assessment to develop students' learning objectives through critical reflection of the learning process and deeper interaction with the topic at hand (Nurlatifah et al. 2023). RA is shown to facilitate low-achieving students' enactment of collective reflection, monitoring and regulation, and these metacognitive processes supported low-achieving students to achieve higher levels of cognitive, emotional, and epistemic engagement (Yang et al., 2022).

1.5. Democratized Assessment

A number of assessment strategies based on democratic principles are proposed by Shohamy (2001). These are based on democratic principles so that society can be guarded and protected from unfair practices. In this study, democratized assessment refers to any kind of output from the student to demonstrate their understanding of a particular concept in differential calculus. This includes literary works (poem, essay, song lyrics); visual arts (drawing, painting, photography); and demonstration teaching.

2. Methodology

2.1. Research Design and Participants

A 3-cycle action research (AR) design was employed to explore the experience of student participants on various forms of assessment which would complement a fully modular instruction calculus class. The Community of Inquiry (CoI) framework by Garrison et al. (2000) was observed throughout the study, overarching the Plan-Do-Study-Act (PDSA) model by Sagun & Prudente (2021). The CoI

framework represents a process of creating a deep and meaningful learning experience through the integration of three core elements: teaching presence, cognitive presence, and social presence. Akyol and Garrison (2008) defined social presence in terms of affective expression, open communication and group cohesion as students actively get involved in discussions. The two defined cognitive presence through the phases—triggering event, exploration, integration, and resolution while teaching presence was defined in terms of design, facilitation and direct instruction. The integration of the core elements was particularly emphasized during module development, and implementation of the modular approach. This paper presents the experiences of student participants on the various forms of assessments, besides the usual pen-and-paper tests, administered throughout the implementation phase. The teacher-researcher argues that since the usual lecture and discussions held during in person classes are absent in a modular class, the normal pen-and-paper tests administered for in person classes would not be sufficient, thus, the various modes of assessments were adopted. The intact class is composed of 22 3rd year BSE mathematics students during the academic year 2023-2024.

2.2. Data Collection and Analysis

Students' experience on the various forms of assessments was determined through unstructured interview, survey, reflective journal and the teacher-researcher observation and reflections. Descriptive analysis is used for the surveys while Braun and Clarke's six-step process of thematic analysis is conducted to elicit answers from interview, observation and reflection. Data collected were encoded in Microsoft Excel, read several times for familiarization, coded (opportunities or challenges), and emerging themes are captured.

2.3. The Modular Approach

One common practice of students of calculus under the modular approach is to conduct group studies to discuss various concerns about a particular topic module which encourages collaboration among the learners. During group studies, students also enhance their communication skills and critical thinking skills. Also, each of the self-contained learning modules ends with a reflective assessment part where students are asked to make connections between the module topic and their realities. There was also a question-and-answer portion during in person classes.

Various practices which students engage in when having a modular approach both during in person classes and asynchronous mode warrant different forms of assessments. These assessments served as the subject of this paper.

2.4. Peer Assessment

Domingo (2023b) found out that a common practice of students under modular instruction is conducting group studies. In the modular instruction calculus class, students were grouped with 4 to 5 members. They were instructed to meet one hour a week, a day before the in-person class, to discuss the module assigned to

them for that week. Each one was asked to share the most challenging part of the topic where a common difficulty among groupmates. This common difficulty will be reported to class for classroom discussion facilitated by the teacher-researcher. The group study is a regular activity for the modular class where a Likert scale survey questionnaire on peer assessment was distributed and students were required to rate their groupmates.

2.5. Self-Assessment

Each self-contained modules include an activity and a pretest and posttest which the students need to accomplish. Complete solutions are presented in the modules which allow the students to do a self-check. A table of scores is also included which features remarks and actions to be taken by the student based on the score. Student have to compare their scores with the scores in the table and execute the necessary action based on the score. A student has to reach the passing score to proceed to the next step or the next module. A low score would require the students to accomplish the module anew until they reach the passing score. At the end of each module is a self-assessment part which assesses the student's understanding of the immediate past lesson. It is a Likert scale questionnaire with ratings of 1 - 5, 5 being the highest. A student needs to reflect on their understanding of the immediate past lesson and rate themselves accordingly.

2.6. Democratized Assessment

During the entire semester, teachers are expected to administer four long exams (prelims, midterms, prefinals, and final). Usually, these are pen-and-paper tests which cover everything studied during the period. In the case of the teacher-researcher calculus class, two major exams (prelims and prefinals) are administered as democratized assessment. The students are given the authority and privilege to express their learning through various forms of their preference and liking. This could be but not limited to visual arts, literary arts, and performance.

2.7. Reflective Assessment

At the end of each module, a self-reflection is required. The last question on the assessment part compels the student to reflect on the topic presented in the module and their context. They should be able to discuss a connection between the module topic and their own lived experience. Critical thinking is enhanced here and students are able to fully understand the abstract concepts presented in the module by relating them to anything meaningful to them. Contextualized learning then, is strongly encouraged.

3. Results and Discussions

The nature of a modular approach necessitates assessment besides the usual pen-and-paper tests. A study of Karal and Cebi (2012) argued that in modular assessment, students' answers should be considered qualitatively and quantitatively which can be

minimally explored through the pen-and-paper test. Alternative teaching strategies like modular form of instruction, in this instance, should be followed by appropriate assessment strategy. This has long been argued by Boe (1994) who believed that co-operative group work, for example, should be followed by cooperative assessment strategies. Peer assessments were administered since group studies were held in the calculus class regularly. The modules which are self-contained include activities which are all self-check making self-assessment an appropriate form of assessment. Since the modular instruction encourages self-regulated learning and enhances metacognition, reflective and democratized assessments are also appropriate.

The student participants of this study expressed appreciation on the various forms of assessments administered during the entire semester. The regular conduct of group studies allowed them to manage peer assessment (**Figure 1**) with their group mates. The students argued that they are in a position to describe the progress and agency of their groupmates over the course of the semester. Since the Community of Inquiry Framework was adopted in the modular approach particularly in the implementation phase, social presence is very evident. As the group members share their experience studying using the modules, they are able to communicate and express their ideas and experiences and each engages in collaborative learning. A sort of an intellectual discourse is always practiced and this gives the students validation of their own learning. Once they hear their group mates having the same understanding of the lesson or shared difficulty, these instances validate their own learning journey and make them more confident with their calculus acquisition. This makes them wait with anticipation the next group study and discussion. This is supported by the study of Yan et al. (2023) where collaborative study groups are shown to provide crucial learning opportunities for the members.

PEER-ASSESSMENT CHECKLIST ON DIFFERENTIAL CALCULUS

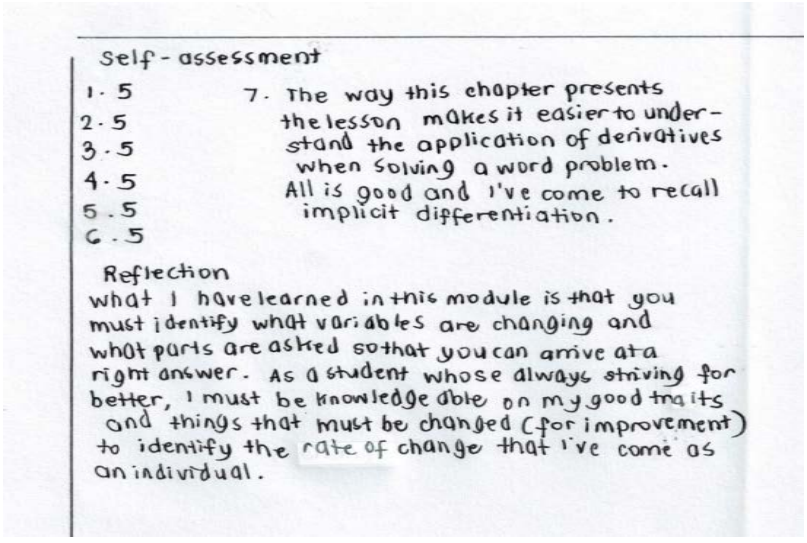
Rate your peer using the scale 1-3 (1- needs improvement, 2-satisfactory, 3- outstanding) by affixing 1 under the column which best describe them.

	Can't say	1	2	3
	have no idea	needs improvement	satisfactorily	outstandingly
Recognize type of functions i.e linear, quadratic, trigonometric, exponential, ogarithmic, hyperbolic				1
calculate the value of a function for a given value				1
determine if the limit of a function exists (or not)				1
evaluate limits				1
determine if a function is continuous (or not)				1
determine if a function is differentiable				1
differentiate constants				1
differentiate a function with positive power				1
differentiate a function with negative powers				1
differentiate a function with fractional exponents		1		
differentiate a function using sum/difference rule				1
differentiate a function using product rule				1
differentiate a function using quotient rule				1
differentiate a function using the chain rule				1
differentiate trigonometric functions and their inverses		1		
differentiate exponential functions		1		
differentiate logarithmic functions		1		
differentiate hyperbolic functions and their inverses		1		
perform implicit differentiation		1		
evaluate higher order derivatives			1	
apply differentiation rules on rate of change problems i.e. speed, acceleration	1			

Figure 1. Answered peer assessment questionnaire on differential calculus agency.

The self-assessment part at the end of each module is a rich source of data to validate student's scores on the usual pen-and-paper exam (midterms and finals for the semester). In this part, a student can exhibit their understanding (or the lack of it) on the immediate past lesson. Their answers can be used as a basis to explain their midterm (or final examination) score. The particular self-assessment below (**Figure 2**) shows that the student graded themselves highly by assigning 5 in all questions pertaining to the immediate past lesson. It was also articulated that the particular chapter made it easier for the student to understand the application of the derivates to word problems. This comment can be used to validate or invalidate the student's score in word problems. The self-assessment questionnaire clearly allows the students to be aware of their own understanding. This is supported by the study of Yan and Carless (2021) who posited that self-assessment involves both introspective and interpersonal processes. The former requires a high level of self-awareness and self-regulation while the latter rely on relational and communication skills.

There are researchers who believe that reflection is an activity where an individual actively engages in exploring their own experiences (Rogers, 2001). According to Gelter (2003) and Ryan (2011), through expressing their thoughts and experiences in a focused and structured manner, students are able to understand themselves better. The student's reflection on the self-assessment part at the end of each module, provided the students with an opportunity to reflect on their experience as they go through the immediate past lesson of the module. They see this as an avenue where they can articulate the connections they made with the lesson and their own lived experiences.


Self-assessment

1. 5
2. 5
3. 5
4. 5
5. 5
6. 5

7. The way this chapter presents the lesson makes it easier to understand the application of derivatives when solving a word problem. All is good and I've come to recall implicit differentiation.

Reflection

what I have learned in this module is that you must identify what variables are changing and what parts are asked so that you can arrive at a right answer. As a student whose always striving for better, I must be knowledge able on my good traits and things that must be changed (for improvement) to identify the rate of change that I've come as an individual.

Figure 2. Answered self-assessment questionnaire on student understanding of the immediate past lesson.

When students are given authority to manifest their understanding of particular concepts in differential calculus, they have numerous and surprising ways to do so.

This what makes democratized assessment exciting and something to look forward to. In an attempt to demonstrate her understanding of limits and continuity, a female student submitted an abstract painting (Figure 3) with a brief description about geometric patterns, convergence, and divergence. This shows the student's ability to connect her understanding of the concepts of limits and continuity to visual objects and by inference, to ordinary situations as a lived experience.

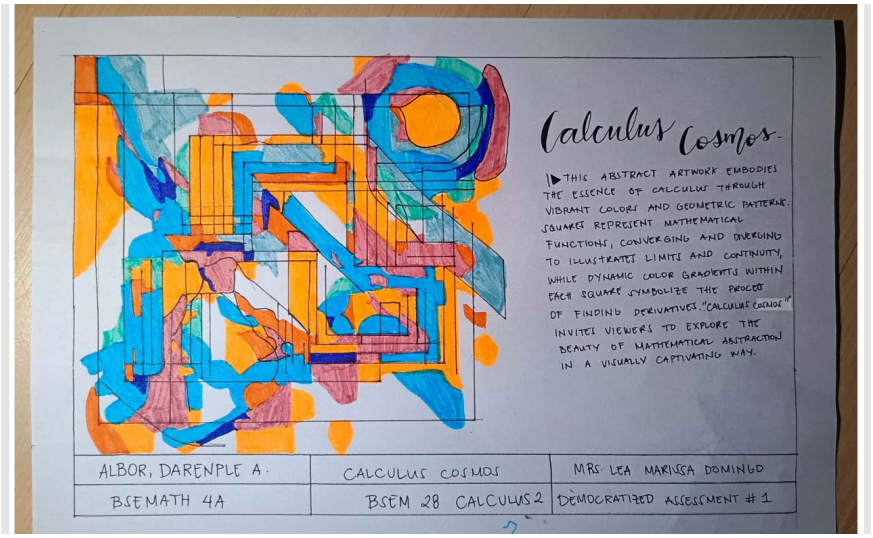


Figure 3. A student's abstract painting to illustrate limits and continuity.

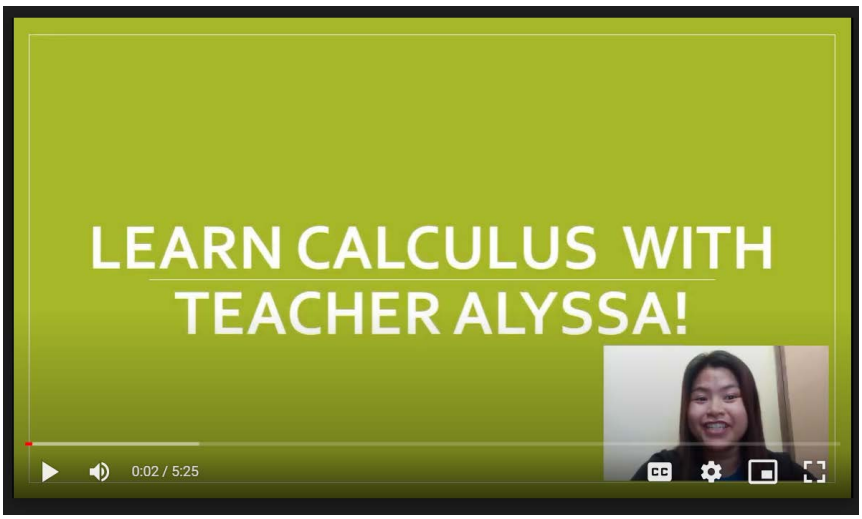


Figure 4. A snapshot of a student's recorded demonstration teaching.

The participants in the action research study are BSE students majoring in mathematics. Since they are pre-service teachers, it is understandable that when given freedom to demonstrate their understanding of a concept, they would express that understanding through demonstration teaching (demo teaching). Alyssa recorded around 5 minutes of her teaching demonstration video (Figure 4) which is her way of showing her calculus agency. This technique is supported by the study of Zulkifli

et al. (2022), which asserts that demonstration approach encourages students' involvement in learning during the learning process and stimulates students' learning activities so that the learning process becomes enjoyable.

Teacher-Researcher Reflection. A richer classroom environment is cultivated when assessments are administered to complement the instructional strategy implemented in class and students perceive them as adding value to what they already know. This is supported by the study of Gaytan and McEwen (2007) as they posited that using effective assessment techniques is an essential part of effective teaching and learning and adding value to them (Chan & Yeung, 2021). Self-regulated and self-directed learning encouraged by a modular approach requires student-centered assessments, which would showcase the students' knowledge and skills acquisition. Allowing the students to have authority on how they can demonstrate their learning motivates them to be more creative, critical, and inspired to reveal their understanding and their learning. A more positive culture is developed when students are asked to participate on assessments decision making.

4. Conclusion and Implication

The global heath pandemic provided a window of opportunity for learners and educators alike as teaching-learning is no longer limited to face-to-face interactions and hybrid classroom models abound. Various instruction delivery modes are available including a fully modular instruction class in differential calculus, where the traditional pen-and-paper exams do not complement the various instructional activities in class. Different forms of assessments which highlight student-centeredness encouraged in collaborative and self-regulated learning activities better match the learning outcomes defined at the outset. Democratized assessment allowed the students to exhibit their knowledge acquisition in ways that give more meaning to them and should therefore be encouraged.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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