IMVI *ISSN (p) 2303-4882, ISSN 1840-4383*
Open Mathematical Education Notes
Vol. 10(2020), 9-13
www.imvibl.org / JOURNALS / IMVI OMEN
DOI: 10.7251/OMEN2001009V

SHORT GUIDE ON HOW TO IMPLEMENT ORAL ASSESSMENT IN POST-SECONDARY MATHEMATICS COURSES: COVID TIMES AND BEYOND

Milica Videnovic
Simon Fraser University
Burnaby, British Columbia, Canada
E-mail: mvidenov@sfu.ca

Since the COVID-19 pandemic started, many universities around the world have changed their teaching and assessment practices. Most universities had to switch to remote teaching since mid-March this year. Different technologies, such as *Blue Jeans* and *Zoom*, have been implemented to support teaching online classes. Talking to some of my colleagues, mathematics professors and instructors, in Canada, I realized that the greatest challenge is how to administer remote unsupervised exams, as most of mathematics professors and instructors in Canada had never given mathematics exams online. They were concerned that students might cheat using their class notes, Internet, and other sources of technologies during the exams. For instance, Italy seems to have solved that problem when the government decided to replace all written exams with oral exams since June this year. Despite the current pandemic situation, many countries, such as Hungary, Germany, Romania, Poland, and the Czech Republic, maintain an oral assessment in most academic subjects as an important part of their assessment practice.

Oral examination in mathematics courses at undergraduate level is not common form of mathematics assessment either in Canada or in the United States although there are many research studies that indicate that oral exams have a positive impact on students' learning of mathematics [1, 2, 4, 5, 8, 9, 10]. My previous research [12] showed that mathematics professors who were interviewed believed that written exams can mostly assess procedural knowledge and instrumental understanding while oral exams can better assess conceptual knowledge and relational understanding in mathematics. *Relational understanding* – as knowing both what to do and why, and *instrumental understanding* – as the ability to execute mathematical rules and procedures [11]. Similarly, *conceptual knowledge* – a knowledge rich in relationships, which can be thought of as a connected web of knowledge, a network in which the linking relationships are as prominent as the discrete pieces of information, and *procedural knowledge* – a knowledge that consists of rules or procedures for solving mathematical problems [3].

Furthermore, the literature on oral assessment addresses many positive aspects of oral assessment in mathematics classroom and only a few negative ones. These positive and negative aspects of oral assessment are presented in my previous study [13]. In this paper, the term *assessment* is used to represent a broader range of evaluation activities, but also, as most assessments in undergraduate mathematics are exams, in this paper, the terms *assessment* and *exam* are used interchangeably.

What is the oral assessment?

According to Joughin [6], oral assessment is defined as assessment in which a student's response to the assessment task is verbal, in the sense of being expressed or conveyed by speech instead of writing. It can be in the form of *presentation* on a prepared topic - individual or in groups, *interrogation* - covering everything from short-form question-and-answer to a doctoral oral exam, and *application* - where candidates apply their knowledge live in a simulated situation [7].

Joughin [6] identifies a comprehensive categorization system for oral assessment based on these six different dimensions:

- The dimension of *primary content type,* whether the aim of the assessment is to assess knowledge and understanding, applied problem solving ability, interpersonal competence or personal qualities.

- The dimension of *interaction,* whether the action is presentation, in which no questioning or discussion occurs, or highly interactive dialogue, or combined.

- The dimension of *authenticity,* whether the assessment is contextualized or decontextualized. Oral assessment is completely contextualized when it is conducted in contexts of professional practice. An example of it would be the medical examination of patients in hospital settings. Oppositely, oral assessment is considered to be decontextualized when the assessment focuses on academic learning. An example of it would be the oral defense of a doctoral thesis, conducted in a classroom or public auditorium or on Zoom.

- The dimension of *structure,* whether the structure of the assessment is either closed and formal, with little interaction between student and assessor, or open, with less structure and the opportunity for dialogue between student and assessor. In this closed structure format, the list of fixed pre-set questions is applied to all students. On the other hand, the open structure approach consists of a loose flow of dialogue, questions and answers, where the assessor shapes the questions in accordance to the student's answers.

- The dimension of *examiners*, whether the oral assessment may include components of self-assessment, peer-assessment, or authority-based assessment (the most common). In other words, the examiner dimension concerns who judges the worth of the student's responses.

- The dimension of *orality,* whether the oral assessment is purely oral by word-of-mouth, or combined with other media such as a written paper or a physical work such as an architectural design.

Implementing oral assessment in post-secondary mathematics courses

During all my schooling experiences in Serbia, from elementary to undergraduate levels, the

interrogatory type of oral examination in mathematics had been an important part of assessment practice. Therefore, as someone who experienced oral assessment in mathematics classroom, I would like to propose some tips on how to implement oral assessment in post-secondary mathematics courses. These tips are based on Joughin's six dimensions of oral assessment and my personal experiences with oral assessment. So, for those mathematics professors and instructors who are willing to implement oral assessment in their mathematics teaching and assessment practices, the following didactical recommendations are suggested:

- define the aim of mathematics assessment (for example, the aim is to assess *conceptual* or *procedural knowledge*, *relational* or *instrumental understanding*; problem-solving ability);
- define the interaction of mathematics assessment (for example, presentation - where no questioning or discussion is allowed; interrogation - as interactive dialogue; or combined);
- define the context of mathematics assessment (for example, assessment conducted in the classroom; or outside the classroom - assessment conducted online using *Zoom*);
- define the structure of mathematics assessment (for example, closed - little interaction between student and examiner; or open - opportunity for dialogue between student and examiner);
- define the examiner (for example, self-assessment; peer-assessment; or authority-based assessment – examiner is a professor or teaching instructor);
- define the orality (for example, assessment is purely oral by word-of-mouth; or combined with other media such as a written paper or using school board);
- create rubric and criteria for grading mathematics assessment (for example, grading rubric can be based on the number of times an examiner provided extra help or guidance to the student during the exam; or based on clear and concise student's explanation to the given mathematical problem);
- examiner should take the notes during the exam (notes can be used for marking and in providing feedback to the student);
- if more than one examiner is involved, one of them can record student's responses while the other does the questioning;
- exam can be audio or video recorded, for instance, using *Zoom* (to keep it as a record in case a student wants to review his/her grade);
- mathematics professors and instructors who already experienced oral assessment in their previous teaching can provide some professional training to their teaching colleagues and teaching assistants;
- before it is used for formal purpose, oral assessment can replace a weekly quiz or written homework assignment;
- at the beginning, students may be given an opportunity to choose between oral or written mathematics exam;

- students should be provided with some examples of mathematics oral examination (either live -for instance, using *Zoom*; or provided with a video recording);

- students should be given an opportunity to practice mathematics oral exam with their professor or instructor, teaching assistant, or class peers (for example, students can practice oral exam, either in person or online, during the tutorial hours with their teaching assistant or during the office hours with their professor or instructor).

One way for students to get familiar with mathematics oral assessment is to have their professor or instructor implement the oral form of assessment into their daily mathematics teaching. For instance, at the end of each class, professor or instructor may put students into random groups (4 or 5 students per group), and ask each group to summarize the day's lesson, stating the meaning and the importance of the lesson. One way to create random groups is by having the professor or instructor allocate a number to each student (e.g., 1, 2, 3, 4, 1, 2, 3, 4, 1, etc.) around the class. When all students have a number, all the students with the number 1 get into a group; all the students with the number 2 get into another group, etc. Then, after some time, professor or instructor can randomly select one group to present their answers. Other students can also participate by helping fill-in the gap if the group may have missed out something in their presentation. This exercise is a good example of how students can practice presenting mathematics orally before the oral exam is given.

When it comes to choosing the most appropriate questions for the oral exam, questions should be asked or worded using words 'why' and 'explain' to trigger a discussion. For instance, when a student is given a problem such as $|x - 6| > 5$, instead of asking a student to solve for x (this can be asked on the written exam), student should be asked to explain the meaning of $|x - 6| > 5$ (for example, student can describe an absolute value as a measure of distance).

Another example would be to ask a student the meaning of the derivative in a calculus class. Student could explain differentiation in calculus mathematics geometrically as well as by definition. Furthermore, in a geometry class, a student could be asked to prove the Pythagorean Theorem. Even though there are many approaches to prove the Pythagorean Theorem, the most common ways would be by splitting up squares or using similar triangles.

I hope that these tips on how to implement oral assessment in post-secondary mathematics classroom can serve as a guide to some mathematics professors and instructors who might be thinking of implementing the oral method of assessment in their teaching of mathematics.

References

[1] Boedigheimer, R., Ghrist, M., Peterson, D., and Kallemyn, B. (2015). Individual oral exams in mathematics courses: 10 years of experience at the air force academy. *PRIMUS*, **25**(2): 99-120.

[2] Fan, L., and Yeo, S. M. (2007). Integrating oral presentation into mathematics teaching and learning: an exploratory study with Singapore secondary students. *The Montana Mathematics Enthusiast, Monograph,* **3**: 81-98.

[3] Hiebert, J., and Lefevre, P. (1986). Conceptual and procedural knowledge in mathematics: An introductory analysis. In J. Hiebert (Ed.), Conceptual and procedural knowledge: The case of mathematics (pp. 1-27). Hillsdale, NJ: Erlbaum.

[4] Iannone, P., and Simpson, A. (2012). Oral assessment in mathematics: implementation and outcomes. *Teaching Mathematics and Its Applications*, **31**(4): 179–190.

[5] Iannone, P., and Simpson, A. (2015). Students' views of oral performance assessment in mathematics: straddling the 'assessment of' and 'assessment for' learning divide. *Assessment and Evaluation in Higher Education*, **40**(7): 971-987.

[6] Joughin, G. (1998). Dimensions of oral assessment. *Assessment and Evaluation in Higher Education*, **23**(4): 367-378.

[7] Joughin, G. (2010). *A short guide to oral assessment*. Leeds: Leeds Met Press.

[8] Nelson, M. (2011). Oral assessments: improving retention, grades and understanding. *PRIMUS*, **21**(1): 47–61.

[9] Nor, H. N. H. M., and Shahrill, M. (2014). Incorporating the use of poster and oral presentations as an alternative assessment in the teaching of secondary mathematics. In *Proceedings of the 2nd International Conference on Social Sciences Research* (pp. 369-378). Kota Kinabalu, Sabah, Malaysia.

[10] Odafe, V. U. (2006). Oral examinations in college mathematics. *PRIMUS*, **15**(3): 243–256.

[11] Skemp, R. (1976). Instrumental understanding and relational understanding. *Mathematics Teaching*, *77*, 20-26.

[12] Videnovic, M. (2017). Oral vs. written exams: what are we assessing in mathematics? *Open Mathematical Education Notes*, **7**(1): 1-7.

[13] Videnovic, M., and Liljedahl, P. (2018). Espoused vs. enacted model of mathematics assessment in case of oral and non-oral assessment cultures. *Open Mathematical Education Notes*, **8**(2): 35-46.