IMVI *ISSN (p) 2303-4882, ISSN 1840-4383*
Open Mathematical Education Notes
Vol. 8(2018), 35-46
www.imvibl.org / JOURNALS / IMVI OMEN
DOI: 10.7251/OMEN1802035V

ESPOUSED VS ENACTED MODEL OF MATHEMATICS ASSESSMENT IN CASE OF ORAL AND NON-ORAL ASSESSMENT CULTURES

Milica Videnovic
Faculty of Education, Simon Fraser University
8888 University Drive, Burnaby, B.C., Canada. V5A 1S6
E-mail: mvidenov@sfu.ca

Peter Liljedahl
Faculty of Education, Simon Fraser University
8888 University Drive, Burnaby, B.C., Canada. V5A 1S6
E-mail: liljedahl@sfu.ca

Abstract. In previous research [19, 20], seven mathematics professors shared their views on positive and negative aspects of oral and written assessments in mathematics and types of knowledge and understanding in mathematics that can be assessed on written and oral exams. These participants are coming from Bosnia, Poland, Romania, Ukraine, Canada, the United States, and Germany. In this study, these participants share their experiences with teaching and studying mathematics in oral and non-oral assessment cultures. The results show that in non-oral assessment cultures mathematics professors face many constraints within their assessment practice and teaching of mathematics.

Keywords: mathematics, oral assessment, oral examination, beliefs, culture

Introduction

The research presented in this paper is an extension of the work presented in [19, 20]. In these two papers, seven mathematics professors shared their personal experiences with written and oral assessments in mathematics classroom. The results showed that having non-evidential beliefs could affect views on oral assessments in mathematics, and that written exams alone are not sufficient to assess students' conceptual knowledge and relational understanding in mathematics. The pseudo names of participants are the same as those used in the previous two studies: Melissa, Elisabeth, Van, Nora, Dave, James, and Jane.[1]

[1] More details about structure of oral examination in mathematics, participants' education and teaching backgrounds, and methodology of the study can be found in [19].

Even though there exists research that indicates that oral assessments have a positive impact on students' learning of mathematics [1, 6, 9, 10, 13, 14, 16], almost all of the research on oral assessments in mathematics focuses on both its positive and negative aspects. Most of the research on oral assessments focuses mainly on liberal arts subjects rather than mathematics. The main topic that has been discussed in oral assessments literature is related to advantages and disadvantages of oral in comparison to written assessments, particularly focusing on understanding assessment from learner's and teacher's perspectives (indicating almost complete absence of research that studies oral assessments in mathematics classroom). There is no literature that specifically points out that oral assessments either have only positive or only negative effect on students' learning. These views are divided.

In terms of disadvantages of oral assessments in comparison to written ones, the question of anxiety comes up. When it comes to oral assessments and anxiety, there is a perception that an oral assessment may make students more anxious than other forms of assessments for two reasons: oral assessment anxiety may be primarily related to its unfamiliarity and oral assessment anxiety is associated with the conception that oral task requires deeper understanding and the need to explain to others. Hounsell, Falchikov, Hounsell, Klampfleitner, Huxham, Thompson and Blair [7] note that, "it is not clear whether oral assessments are scarier or just more novel" (p. 34). Also, Huxham, Campbell and Westwood [8] note that oral assessment anxiety may be primarily related to its unfamiliarity. In the study on students' experiences with oral presentations, Joughin [11] notes that greater anxiety about oral compared to written assessments is associated with a richer conception of the oral task as requiring deeper understanding and the need to explain to others.

In terms of advantages of oral assessments over written ones, based on students' experiences and comments, the literature shows that oral assessments in mathematics: provide immediate feedback and immediate grade; prevent plagiarism and provide fairness and accuracy; help develop better oral communication skills; promote deep comprehension of the learned material; encourage students to deeply and actively engage with the course material; help students gain ownership of the learned material; help students learn to express technical material clearly and concisely; allow for probing knowledge through dialogue; provide long-lasting mathematical knowledge; are authentic; help prepare students for their professional careers; help develop better presentation skills; help students build the confidence; are reactive to students' needs; encourage students to put more effort and time in preparing for it [1, 6, 9, 10, 13, 14, 16].

In this study, we looked in the relationship between mathematics professors' views on the nature of mathematics assessment and their mathematics assessment practice in case of oral and written dimensions. Although there are numerous papers written about the inconsistency between teachers' beliefs and teachers' practice, we found no research studies on teachers' beliefs and teachers' practice from an oral assessment perspective. Most of this research showed that there is a difference between teachers' beliefs and their actual classroom practice [18, 21]. In addition, there is a large amount of research that indicates the disjunction between teachers' intentions of practice and their actual practice [4, 12, 15, 17]. On the contrary to many of these previous research in which socio-cultural and socio-mathematical norms are usually only discussed in the contexts of students, in this paper, our focus is placed on mathematics professors. In this study, seven professors share their experiences on teaching and studying mathematics in oral and non-oral assessment cultures.[2]

Theoretical Framework

Ernest [5] suggests that the teaching practice of mathematics depends fundamentally on the

[2] Non-oral assessment culture is defined as a culture in which oral assessment in mathematics is not part of the system of education while oral assessment culture is the one where oral assessment is an important part of assessment practice in mathematics.

teacher's system of beliefs, and in particular, on the teacher's views of the nature of mathematics and mental models, which represent the teacher's views of teaching and learning mathematics.

Ernest [5] points out two main causes for the mismatch between beliefs and practices. Firstly, there is the powerful influence of the social context, as the results from the expectations of others including students, parents, peers (fellow teachers) and superiors, and the institutionalized curriculum (the adopted text or curricular scheme), the system of assessment, and the overall national system of schooling. These can be viewed as a set of constraints that can affect the enactment of the models of teaching and learning mathematics, which Ernest [5] calls 'enacted' models of learning and teaching mathematics, and the use of mathematics texts or materials. In addition, teachers in the same school are often observed to adopt similar classroom practices despite having different beliefs about mathematics and its teaching [5]. Secondly, there is the teacher's level of consciousness of his or her own beliefs, and the extent to which the teacher reflects on his or her practice of teaching mathematics.

When it comes to 'espoused' model of teaching mathematics, this model represents the teacher's conception of the type and range of teaching roles, actions and classroom activities associated with the teaching of mathematics. Similarly, when it comes to 'espoused' model of learning mathematics, this model represents the teacher's view of the process of learning mathematics, what behaviors and mental activities are involved on the part of the learner, and what constitute appropriate and prototypical learning activities [5]. Furthermore, Ernest [5] points out two key constructs for these models:

- Learning as active construction, as opposed to the passive reception of knowledge
- The development of autonomy and child interests in mathematics, versus a view of the learner as submissive and compliant

Ernest [5] provides a diagram that describes the relationships between teachers' views of the nature of mathematics and their models of its teaching and learning (see Figure 1).

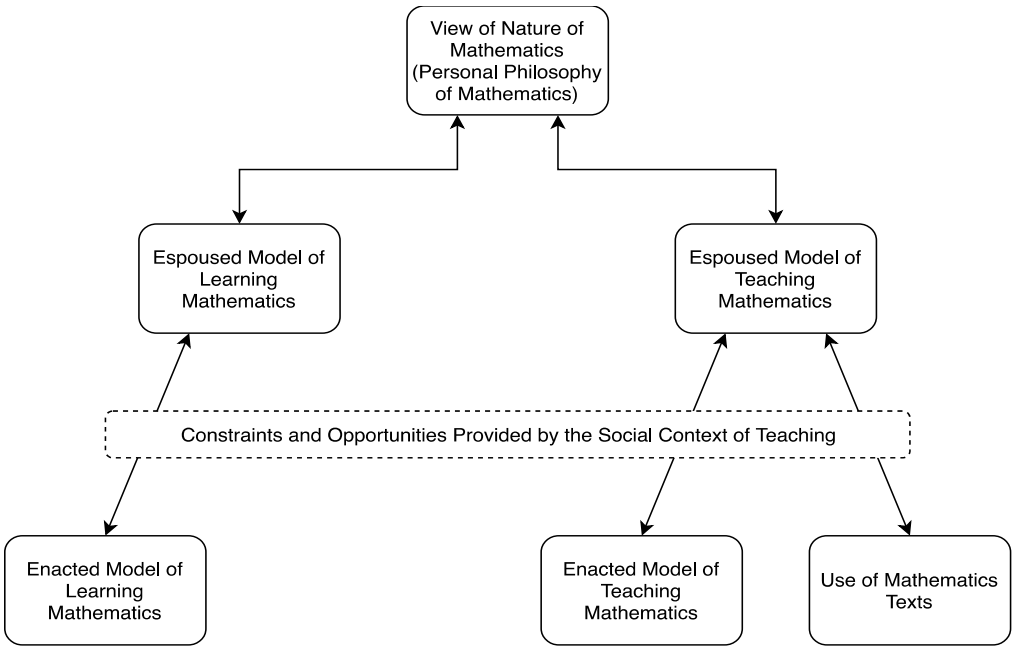

Figure 1: Relationships between beliefs, and their impact on practice [5]

This diagram shows how teachers' views of the nature of mathematics provide a basis for the teachers' mental models of the teaching and learning of mathematics. According to Ernest [5],

teacher's mental or espoused models of learning and teaching mathematics are subject to the constraints and contingencies of the school context, and they are transformed into classroom practices. These are: the enacted (as opposed to espoused) models of learning and teaching mathematics, and the use of mathematics texts or materials. As we are interested in the relationship between mathematics professors' views on the nature of mathematics assessment and their mathematics assessment practices, we modified Ernest's diagram by adding Espoused and Enacted Models of Mathematics Assessment (see Figure 2).

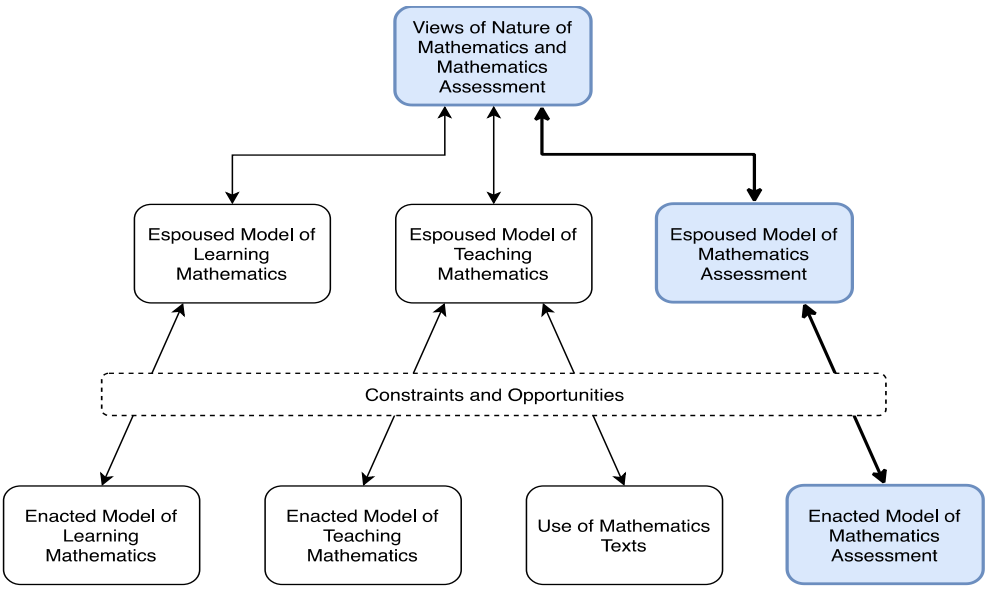

Figure 2: Relationships between beliefs, and their impact on practice (modified version)

The modified diagram shows how mathematics professors' views of the nature of mathematics and mathematics assessment provide a basis for the professors' mental model of mathematics assessment. This professor's mental or espoused model of mathematics assessment is subject to the constraints and opportunities of the university context, and it is transformed into classroom practices, which is the enacted model of mathematics assessment.

As the social context can have a great impact on the teacher's autonomy within his/her own classroom, we decided to tie social-cultural norms to Ernest's framework for discussing the impact of the socio-cultural norms on constraints and opportunities that exist within different cultures. Cobb and Yackel [22] define social norms as general classroom norms that regulate the social interactions in the classroom, and they can be applied to any subject matter area. As social norms are expressions of the normative expectancies in the classroom, social norms can be thought of as taken-as-shared beliefs that constitute a basis for communication and make possible the smooth flow of classroom interactions [3]. Within the classroom setting, social norms define both the teachers' and students' roles. Social norms are not specifically focused on a particular content area, and they include: (a) explaining and justifying solution strategies; (b) making sense of another student's strategies; (c) questioning another students' solution strategies when misunderstandings occur; and (d) agreeing/disagreeing with other students [2].

Results

All seven participants have had a chance to study and/or teach in both cultures, and their views of their experiences studying/teaching in both cultures are presented in Table 1.

Table 1: Constraints and opportunities

Culture	**Constraints and Opportunities**		**Participant(s)**
Canada / US	Constraint	Issue of Time	Melissa
		Students (more private; less open; some have family, jobs; sense of entitlement)	Melissa; Elisabeth; Jane
		Institutional/Mathematics Department beliefs (tradition; not flexible; set up rules)	Elisabeth; Van; Nora; Dave; Jane; Melissa
		School Cost	Melissa; Elisabeth; Nora
		Professors' evaluations	Nora; Jane
		Mathematics Curriculum and Mathematics Textbooks	Nora; Jane
Germany	Opportunity	Flexibility (teaching and assessment)	Dave; James; Jane
Cross Cultural	Constraints or Opportunities	Issue of getting feedback	Jane
		Education vs. Mathematics Department	Dave
		Position of Teaching Assistants	Melissa; Elisabeth; Van
		Declaring major of study	James; Jane
		Bologna system	Dave; James; Jane

Constraints

The participants' views show clear division between studying or teaching in oral assessment cultures and non-oral assessment cultures in terms of constraints and opportunities within each of these two cultures. The results show that participants who are coming from oral assessment cultures and currently are teaching mathematics in non-oral assessment cultures have to face many constraints that are not necessary aligned with their own personal beliefs. These constraints are: issue of time, students, institutional and departmental beliefs, school cost, professors' evaluations, mathematics curriculum, and mathematics textbooks. The following comments exemplify each of these constraints:

- *issue of time*

  "Part of the one aspect of the equation is time to perform much more in-depth examination… oral examinations on average take more time…I would say written examinations were shorter than some of the written examinations here. When I came here, it felt like in written examinations here speed was much more an issue than in Poland. In Poland, I never felt that I was sort of rushed to" *(Melissa).*

- *students*

  "Here in Canada these days we have large percentage of students who work or they have family. When I was a student, it was unthinkable that you'd have a family while undergraduate student" *(Melissa)*.
  "They're a little bit more private here" *(Elisabeth).*
  "I haven't had any German students complain about grades yet…In US, students like to complain about their grades…. Yeah, I feel like there's kind of some sense of entitlement especially in the U.S. from students" *(Jane).*

- *institutional and departmental beliefs*

  "The tradition here is mostly written or computer based quiz" *(Elisabeth).*
  "Our department is not that flexible" (*Nora).*
  "I was given the curriculum, I was told to teach them this, I tried to and then I assessed whether or not they have learned it by doing exams that were similar to the exams that people have given in the past years" (*Dave).*
  "So, in the U.S. system in my experience specifically with large state schools and this might be different if you're in a small liberal arts college, but there are so many different rules and regulations and, you know, for example when you have a course you've got – even if it's a more advanced course and you're the only one who's teaching it, you're still required to put out a syllabus that has very specific we will be covering these things on these days" (*Jane).*

- *school cost*

  "People seldom worked to support themselves because they usually had their parents supporting them or they had government grant and tuition was free which again contributed to less need for work" (*Melissa).*
  "So after graduating from university, we were sent to work because we did not pay tuition. We needed to do some return of service" (*Elisabeth).*
  "Basically, in Ukraine, we were all paid scholarships" *(Nora).*

- *professors' evaluations*

  "There is unfortunately a situation when some of the classes are taught by sessional instructors and sessional instructors depend on evaluation from the students. How do you get good evaluations? If students get good grades. How do you get good grades? The easy way is to give easy midterms" (*Nora).*
  "In the U.S. every single course you have at the end of the course an anonymous written evaluation, the department collects them all up and then you get this, you know, you see all of them and numbers and like you have this printout and that's not how it is in Germany… for most classes you do not get evaluations" (*Jane).*

As Jane commented, in addition to the given flexibility in oral assessment culture to teach and assess mathematics in correspondence with participants' personal beliefs, these participants are also not expected to be regularly evaluated by their students during their teaching in Germany. The responsibility for the student's learning is solely placed on the student himself/herself. James' response exemplifies his teaching experience in Germany:

> "I mean I don't really have the idea that after a lecture everybody understood what I did on that lecture. But, it's rather that if they would take the time to think about what I said while reading what I wrote and while doing the homework, they will put the puzzle together themselves."

On the other hand, the participants who are teaching in non-oral assessment culture are expected by their institutions to more frequently evaluate their students. The professor and the student are both equally responsible for the student's learning. Dave's response exemplifies his personal views on learning and teaching mathematics:

> "I suppose my answer to that is that if they haven't learned it, it's not necessarily their fault. I'm also meant to be teaching them something. And if nobody has learned it, it probably means that I'm not teaching it very well. And then that's the reflection on me. So yeah my assessment is assessing me as well and so then I need to think about how I could be doing this better."

- *mathematics curriculum*

  "Our curriculum in Ukraine was, maybe because I was Math major, but we had to do way more of conceptual courses... Our courses here, in Canada, are watered down because there is no separation between calculus for math majors and calculus for engineers" (*Nora).*

- *mathematics textbooks*

  "Math majors in Germany advance at the undergraduate level – they advance much more quickly. So, like this course I'm preparing for now, I mean it is a first semester course and like one of the standard German textbooks for it starts out with proof by induction like that's the very first step of the course which in the U.S. that might be something that you take as part of the proof methods course in your second year. And so, it's kind of just like they throw the kids in, in Germany, and it's – you have to work really hard, you're not eased in at all" (*Jane).*

Opportunities

On the other hand, the participants who are coming from non-oral assessment cultures (Canada and United States) and currently are teaching mathematics in oral assessment culture (Germany) are given the opportunity to teach and assess mathematics within the alignment of their own personal beliefs. The following comments exemplify this:

"Everybody is doing pretty much what they want… I can pretty much decide" (*Dave).*

"It is really a decision of myself. So, I can say, okay, I mean for fifty students I don't really want to go through the procedure of oral exams, I just choose to have written exams or I could say, well, for these thirty people now I really want to get to know them so I do oral exams" (*James).*

"In Germany an instructor has a lot more freedom…I decide exactly what it is contained in the course. So, it's – and that part is very – is very different. So, if I were teaching the similar kind of course in the U.S., I would not have as much freedom of, you know, what I was covering in the course" (*Jane).*

The data clearly shows that the participants' practices of teaching and assessing mathematics certainly depend on the social context, in other words, socio-cultural norms, of their current teaching situation. Therefore, in the following section, socio-cultural norms are discussed in terms of institutional expectations that exist within each culture, oral assessment and non-oral assessment.

Socio-Cultural norms:

Within the oral assessment culture, students are expected:

- to attend university of no or minimum cost
- to declare their undergraduate major of the study right upon their university admission
- to take written and oral exams in their mathematics courses
- to receive up to two grades in their mathematics courses: one from written exam and one from oral exam
- less likely to have jobs
- not to be shown any grading rubric for oral exams in mathematics
- to explain their mathematics solutions, mathematical reasoning and their ways of thinking on oral exams

Within the oral assessment culture, mathematics professors are expected:

- less frequently to be evaluated
- to experience great autonomy in terms of having complete freedom to choose what to teach

and how to assess in their mathematics courses

Within the non-oral assessment culture, students are expected:

- to pay full cost of university tuition and fees
- to declare their undergraduate major of the study after two years of attending university
- to take only written exams in their mathematics courses
- to receive up to six grades in their mathematics courses: homework weekly written assignments, online assignments, weekly quizzes, two written midterm exams, and written final exam
- more likely to have jobs
- to have some sort of sense of entitlement
- to be shown, if asked, the grading rubric for any form of assessment taken in mathematics
- less likely required and able to explain their mathematical reasoning and their ways of thinking on written exams

Within the non-oral assessment culture, mathematics professors are expected:

- more frequently to be evaluated
- to experience many constraints within their teaching institution and mathematics department, such as: the institutionalized curriculum (the adopted text or curricular scheme), the system of assessment, and the overall national system of schooling

Cross Cultural Constraints and Opportunities

Besides these provided constraints and opportunities within both cultures, there were some participants' comments that could represent some additional constraints or opportunities that exist within these two cultures as well. These comments addressed the issue of getting feedback, education vs. mathematics department, position of teaching assistants, declaring major of study, and Bologna system. The following comments support this:

- *issue of getting feedback*

  "There are no quizzes and there are no midterms (*university in Germany where she teaches*). It's also sometimes, you know, that means it can be a little bit harder to get kind of feedback with as far as like you're getting a feel for what the students are understanding or not understanding" *(Jane).*

- *education vs. mathematics department*

  "In Canada, mathematics education is housed in the education department, while in Europe, it's housed in mathematics department" (*Dave).*

- *position of teaching assistants*

  "In Poland, the exam was conducted both by course instructors and teaching assistants during tutorials" (*Melissa).*
  "When I was a student for example, if the professor and the TAs would examine, so sometimes students will stay and not step in until maybe the TA is available to get the students" (*Elisabeth).*
  "So, being a teaching assistant there was a profession" (*Van).*

- *declaring major of study*
  "In the Bachelor System in Germany you already start out with a major" (*James).*

"I did end up changing my major I actually started mechanical engineering. But, certainly I knew plenty of people in the U.S. who had no idea what they wanted to do, you know, didn't have a major for a while or changed their majors a number of times… Whereas, in Germany you kind of come in and if you're a Math major like you start out your Math major and you will take Math classes" (*Jane).*

- *Bologna system*

"I have a feeling that there are more written exams now than they were used to be. That about 10 years ago now, Europe decided to try and standardize university courses a bit more… So there might previously have been more oral exams than there are now. I also got the impression that there used to be just few less assessments. That somebody might go through their academic career and be assessed less often. But now there's a requirement that every module must have assessment" (*Dave).*
"Oh, yes, very much. It's much more written exams… well, I think the general feeling is that it's not good. Well, for the one thing it introduced this enormous number of written exams, which I don't think really helps and does not help in assessment" *(James).*
"I mainly just thought it was the difference in, you know, how you organize the degrees… there is this kind of thought that master's students are still undergraduates that a bachelor degree isn't really a complete degree, so there's still at least the mindset and this is not so much assessment, but there's still at least a mindset that if you don't have a master's degree, then you don't really have a degree" (*Jane).*

Due to constraints and opportunities within the oral and non-oral assessments cultures, some participants had to change their assessment practices in mathematics courses that do not correspond with their personal beliefs and past experiences with mathematics assessment while some participants did not have to. As a result of data, new diagram is created, which illustrates the relationship between participants' views of the nature of mathematics and mathematics assessment, and their impact on mathematics assessment practice within oral and non-oral assessment cultures (see Figure 3).

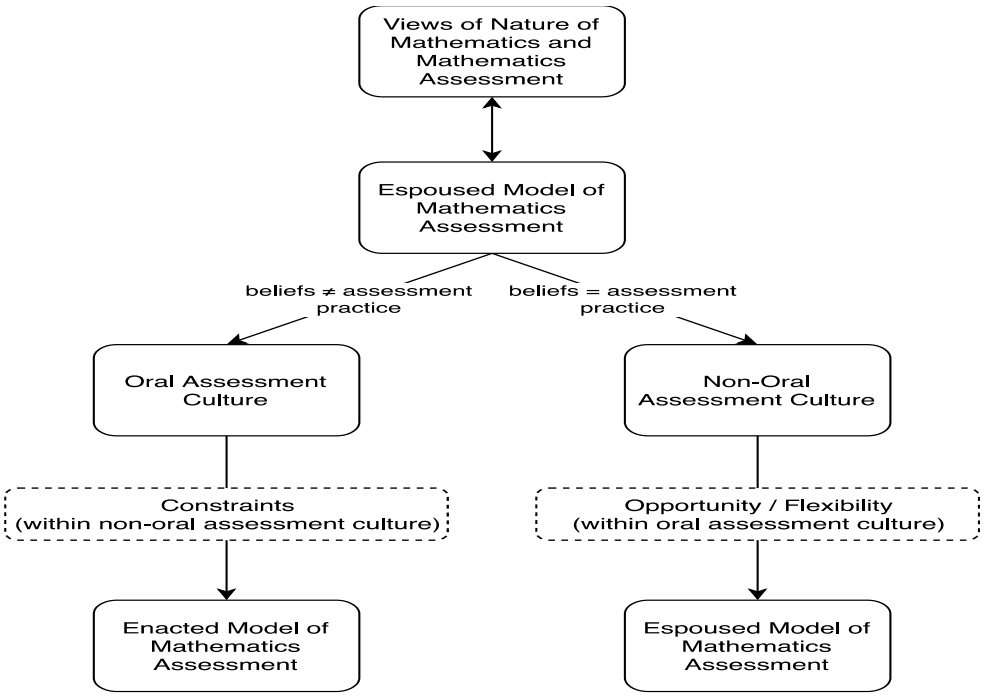

Figure 3: Participants' views of nature of mathematics and mathematics assessment, and their impact on mathematics assessment practice within oral and non-oral assessment cultures

The data shows how participants' views of the nature of mathematics and mathematics assessment provide a basis for their espoused model of mathematics assessment, which is mostly based on participants' prior schooling and teaching experience, school culture, and study program within the assessment culture. This espoused model of mathematics assessment is subject to constraints and opportunities of the university context within oral and non-oral assessment cultures, and it is transformed into participants' classroom practices, which represents the enacted model of mathematics assessment. Therefore, Van, Melissa, Nora, and Elisabeth, who had been previously exposed to oral examination in mathematics before moving to Canada, in other words, who came from oral assessment culture to non-oral assessment culture, are currently facing many constraints within their assessment practice and teaching of mathematics. Their espoused model of mathematics assessment as being subject to the constraints of the university context within non-oral assessment culture is transformed into their assessment practice, which represents the enacted model of mathematics assessment. Thus, these participants' current assessment practices in mathematics are not consistent with their personal beliefs of mathematics assessment. On the other hand, Dave and Jane, who came from non-oral assessment culture to oral assessment culture, are currently experiencing in Germany many opportunities within their assessment practice and teaching of mathematics. Their espoused model of mathematics assessment as being subject to the opportunities of the university context within oral assessment culture is transformed into their assessment practice, in the way that their current assessment practices in mathematics are consistent with their personal beliefs of mathematics assessment. Thus, these participants are able to keep their espoused model of mathematics assessment in their current teaching of mathematics.

Discussion and Conclusion

Ernest [5] points out that the system of assessment can be viewed as one of many sets of constraints that can affect the enactment of the models of teaching and learning mathematics. Based on the participants' responses, the model of mathematics assessment is to be viewed as a separate entity that does not fall under learning or teaching model particularly. The reason to it is that the model of mathematics assessment can fall under either, learning model or both, learning and teaching models, depending on the culture that we are looking into.

In non-oral assessment cultures, the model of mathematics assessment is part of the models of teaching and learning mathematics. The importance is placed on both, assessing teachers' teaching and assessing students' learning. Based on socio-cultural norms in non-oral assessment cultures, mathematics professors are expected more frequently to be evaluated/assessed by their teaching institution and to experience many constraints within their teaching institution and mathematics department, such as: the institutionalized curriculum (the adopted text or curricular scheme), the overall national system of schooling, etc. The responsibility for the student's learning is shared equally between the teacher and the student.

In oral assessment cultures, on the other hand, the model of mathematics assessment is part of the model of learning mathematics, with a great emphasis on assessing students' learning. Based on socio-cultural norms in oral assessment cultures, mathematics professors are expected less frequently to be evaluated/assessed by their teaching institution and to experience greater autonomy in terms of having complete freedom to choose what to teach and how. The greater responsibility for the student's learning is placed on the student himself/herself.

Therefore, when participants were asked to share their personal views on mathematics assessment, the only participants who mentioned in their interviews that the responsibility should be shared equally between the teacher and the student were Dave and Jane, both educated in non-oral assessment cultures. The other five participants focused solely on students' responsibilities for their learning and grades.

Moreover, this paper can serve as a guide to anyone who is about to experience the transition in their teaching of mathematics, moving from oral assessment culture to non-oral assessment culture and vice versa.

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