COMMOGNITIVE CONFLICTS IN A VIRTUAL LEARNING ENVIRONMENT: EXPLORING THE AFFORDANCES OF MOBILE LEARNING FOR DISCOURSE ANALYSIS

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ABSTRACT

This paper explores the affordances of mobile learning in developing frameworks for discourse analysis. Specifically, this paper examines the commognitive analysis of classroom discourses in virtual learning environments (VLEs) and how it resolves the challenges of discourse analysis in face-to-face (F2F) settings. With the ongoing social turn of mathematics education research comes the widespread adoption of discourse analysis in educational research. The shift towards virtual learning technologies necessitated by the recent COVID-19 crisis has led to the development of various tools and processes that enable the teaching-learning process to occur in the virtual environment. While the initial drive to adapt these tools has since subsided, the advantages of utilizing them remain apparent. As the teaching-learning process moves into virtual environments, so should research methodologies. As part of a broader study that attempts to develop a framework for characterizing commognitive conflicts and the corresponding teacher actions, this paper presents insights from the initial phases in the framework development process where a virtual learning environment was used to examine the integrity of the discourse analytic framework. This paper will discuss how the framework development benefited from using a virtual learning environment—how it mitigated the challenges of discursive approaches and the unique insights it offers for refining the framework compared to applying the framework directly in face-to-face classroom settings. Results from this work suggest that essential components of the mobile learning experience, such as VLEs, are advantageous to the development of discursive research approaches, such as in the case of developing a framework for identifying commognitive conflicts.

1. INTRODUCTION

Recent decades have seen the focus of mathematics education research (MER) shifting towards the social aspect of the teaching-learning process. For one, there has been a proliferation of theories concerning mathematics education that has grown from socially oriented fields of studies such as anthropology, sociology, and psychology. This is what Lerman (2000) refers to as the 'social turn' in mathematics education research. This might be driven by the impetus of interests in the 'learning' half of the teaching-learning process early in the 21st century. This 'learnification of education' (Biesta, 2009), while not problematic per se, has led to an imbalance that has muddled up the purpose and direction of mathematics education. In response, researchers have begun employing methodological approaches that center on the interaction between the students and the teacher rather than on the performance of the 'learner' alone. One evidence of this is the growing trend in the use of discourse analysis as an approach to mathematics education research. However, the use of discursive approach in research is not without challenges.

Attempting to capture various components of social interaction during classroom instruction is filled with many challenges. For one, faithfully capturing classroom interaction requires the use of multiple devices such as video-cameras and audio-recorders which adds to the cost of doing research. To clearly capture both the teacher's and the students' contributions, there is a need to use multiple audio-recorders placed strategically inside the classrooms. There is also the need to capture non-verbal actions, hence, the rise of videorecording as a method of data collection. Another concern is the comfort that participants while being involved in a

recorded interaction. Known to most as the Hawthorne effect, this concern poses a risk on the integrity of the data gathered. Then, even with a faithful copy of the social interactions in the classroom, there lies the daunting task of discourse analysis. As teachers know too well, the classroom is seldom a one-to-one correspondence with a student at a time. Rather, classroom interactions fall under the category of multichannel communication. Hence, there is the challenge of keeping track of who-said-what on top of the task of analyzing what is being said.

In this regard, this paper presents how employing a discourse analysis framework to characterize a virtual learning session led to benefits in comparison with directly using conducting analysis of classroom instruction in a face-to-face setting. Results from studies that attempted to capture instances of commognitive conflicts during mathematics instruction will be used to illustrate the affordances provided by the VLEs in the development of discourse analytic tools as compared to F2F settings.

1.1 MER in Virtual Learning

During the COVID-19 crisis, educational institutions were pushed to adopt new modes of instructional delivery. This has led to the development of various tools and practices that enabled mass adoption and the continuation of education. One such practice is the employment of mobile learning through virtual learning environments using teleconferencing programs like zoom and google meet. While the initial drive for utilizing these tools for instructional purposes have since subsided, the advantages of having them even as optional cannot be understated. On top of that, many education providers such as universities has had to invest a great deal both in the development of resource materials and the training of their educators. To leave all that behind would clearly be a waste. It is for these reasons that distance education, in its various forms, is becoming a staple in many educational institutions. Universities that once shrugged even at the idea of virtual learning now offers it as an option especially for graduate studies and professional development. The Department of Education in the Philippines has since institutionalized the use of alternative delivery modes in the even that face-to-face instruction becomes less viable due to inclement weather conditions amongst other reasons. Rising above the pandemic has led the educational landscape forward with no going back.

As the educational landscape embraces this new normal, it would only be sound for educational research to do the same. With much of mathematics instruction happening virtually, so must mathematics education research look upon the affordances of virtual learning for informing our process of knowledge production. The call herein is not merely to conduct research on mobile learning in virtual learning environments. In fact, most of the critical decisions for education in the pandemic were made possible only through the works of researchers who have previously conducted educational research on innovative platforms. Rather, what is being suggested here is to look upon how mobile learning and particularly VLEs can inform our research practices—including the development and refining of theoretical frameworks and research methods. Novel tools for education are in of themselves novel tools for educational research.

The next section describes an endeavor driven by this insight. It involves the development of an operative characterization of the construct of commognitive conflict as it occurs during mathematics instruction. The conceptualization of the construct is then appraised through a characterization of interaction during mathematics instruction in mobile learning in comparison to that of an f2f setting.

1.2 Sfard's Theory of Commognition

Sfard's commognitive theory of mathematical thinking is one of the paradigms in mathematics education that utilizes a discursive approach to research. As a 'home-grown' theory—that is, developed from within mathematics education research—commognition attempts to fuse the dualistic view of behavior and thought by focusing on the human act of communicating. As such, the term 'commognition' is a portmanteau of the words communication and cognition (Sfard, 2008) suggesting that these communicating and thinking may be explored as visages of the same phenomenon. Thus, in the tradition following this theory, analysis is centered on the discourses between actors within a context which may involve a lone actor interacting with themselves.

Studies in mathematics education within this tradition aims to characterize changes in the mathematical discourse. This demands a high level of fidelity in capturing the interactions during classroom interactions. A researcher who wishes to follow this tradition is enjoined to adhere to a few principles in the analysis of data

(Sfard, 2018). The principle of wholeness means that the entire discourse must be taken in whole as the unit of analysis instead of its constituent structures. There is also the principle of operationality which demands a definition of codes based on perceptually accessible qualities and the principle of alternating perspective where a researcher must be conscious of how their own discourse contributes to the analysis of the discourses of the participants. All these research principles present a unique set of challenges to the commognitive researcher.

1.3 Commognitive Conflicts

Sfard (2008) defines commognitive conflict as a 'situation that arises when communication occurs across incommensurable discourses' (p.296). Since communication can be both *interpersonal* (between two or more individuals) or *intrapersonal* (within an individual), so could commognitive conflicts. To illustrate, a student whose only experience with multiplication is within the discourse of whole numbers subscribes to the narrative that multiplying makes numbers bigger. However, when the teacher introduces the concept of fractions within the discourse of integers, this narrative may fail to hold. Hence, the student may experience commognitive conflict when dealing with fractions. A student may then correct compute ½ x ¾ = 3/8 but still believes that 3/8 is bigger than either ½ or ¾ since 'multiplying makes bigger'. This points to an intrapersonal commognitive conflict. The significance of commognitive conflicts in pedagogy lies in the notion that learning occurs through discursive change resulting from the resolution of commognitive conflicts through various teacher discursive moves.
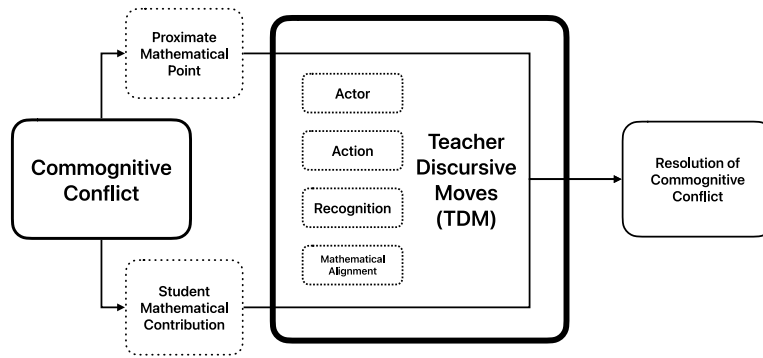

Figure 1. Resolution of Commognitive Conflicts through Teacher Discursive Moves

To aid in identifying commognitive conflicts, this study borrows the notions of *student mathematics* and *mathematical point* from Van Zoest and colleagues' (2022) Teacher Response Coding (TRC) Scheme. The difficulty of identifying commognitive conflicts during classroom instruction stems from the act of extracting two ideas from a student's mathematical contribution. What appears clear in theory is more elusive during commognitive analysis of a classroom instruction. The multimodal nature of communicative actions makes identifying commognitive conflicts a challenge during instruction. Factor in the multichannel communication that goes inside a face-to-face classroom setting and the challenge grows exponentially. Hence, this study turns to different platforms for assessing the viability of this conceptualization of commognitive conflicts.

2. COMMOGNITIVE CONFLICTS IN CLASSROOM DISCOURSES

This section examines the affordances of utilizing mobile learning for refining a framework for identifying commognitive conflicts during classroom discourse. It does through a comparison between commognitive analyses of classroom discourses from an F2F setting and from a mobile learning setting. The section begins with a brief overview of the methodology used for both the studies. Finally, the affordances of employing the conceptual framework against a session of virtual learning is discussed including the difficulties that the platform help mitigate and other unique insights from this endeavor.

2.1 Methodology

Results from the commognitive analyses of classroom discourses from two sessions will be discussed—one in an f2f setting and another in a mobile learning setting. Both these studies utilize commognitive analysis to identify commognitive conflicts in a classroom discourse. Another similarity is in the number of participants for each study which helps highlight the difference in commognitive analysis between the two studies.

The f2f classroom discourse is from a case study focusing on a remediation class in a public secondary school in the Philippines. The class consists of one teacher and six students in Grade 7. There were three sessions of classroom observations with around 40 minutes to 60 minutes of class time. Observations for each session were audio recorded and transcribed. The mobile learning classroom discourse study follows a qualitative interpretive approach to identify commognitive conflicts in a virtual learning class session. The topic is part of a mathematics class in a Problem Solving and Investigations in Mathematics course. There are 6 participants in total including 1 mathematics instructor and 5 students. The class was conducted using zoom which provided the recording of the sessions. Each recording was transcribed and commognitive analysis was conducted aimed at identifying commognitive conflicts.

2.2 Identifying Commognitive Conflicts in an F2F Classroom Discourse

As a pilot test for the framework on identifying commognitive conflicts on classroom discourse, a case study was conducted on a remediation mathematics class in a face-to-face setting. A remediation class was selected for the pilot since there are fewer students (six, in this instance) in the group compared to actual classroom teaching (usually 40-50 students, in a typical Filipino class). The small number allows for the researcher to capture more clearly the discourse between the teacher and the students and consequently, in theory at least, would have helped focus on evaluating the capacity of framework to capture commognitive conflicts within the discourse. However, even with the small number of participants, challenges to commognitive analysis remains evident in f2f classroom settings. One clear challenge is the multichannel flow of discourse in a face-to-face classroom, that is, the conversational turns tangent to different individuals throughout the discussion. This leads to a difficulty in tracking the commognitive conflicts in individuals as well as how the teacher responds to each one of them. While this paper recognizes that there are practical benefits to acknowledging this challenge in actual classroom instruction, the purpose of the pilot study which is to evaluate how effectively the framework capture instances of commognitive conflicts gets buried under the work of tracing the flow of responses. On top of that, there is the issue of positioning the devices for capturing the discourse of both the teacher and the students. There are instances where relevant conversational turns are overshadowed by noise from students closer to the devices. Clearly this issue can be resolved by additional devices, however, resources may not be as easily accessible in a pilot testing than with a full study. Furthermore, additional devices are needed to capture the visual elements such as responses written in the board along with other non-verbal cues which affects the flow of meaning in the discourse. Then there is the issue of participants' comfort to being surveilled. More commonly known as the *Hawthorne effect*, students—and even teachers—act differently when they become conscious of being recorded. This potentially muddies the integrity of the pilot testing which hinders the effective evaluation of the framework's effectiveness.

Acknowledging these barriers to the assessment of the framework for identifying commognitive conflicts, the researcher decided to turn to other platforms to pilot the use of the framework. The next section discusses the potential of mobile learning as an avenue to refine frameworks for discourse analysis.

2.3 Affordances of Mobile Learning for Commognitive Analysis

The use of a virtual learning platform to assess the viability of the conceptualization of commognitive conflicts showed promising potential. There are three direct advantages gathered from this endeavor. For one, the video-conferencing platform of choice, Zoom, already has a recording function built in. The process of capturing the class interactions is already embedded in the virtual learning environment. With this, researchers planning to employ discursive approaches to their work can do so without needing to invest in auxiliary devices for video or audio recording. Another benefit is related to the integrated recording of class interaction. Since the participants are already aware of that their participation is being recorded, this reduces

the effect caused by the discomfort of being observed. While it can be argued that knowledge of being recorded in virtual learning may discourage participation, those who participate do so willingly with less discomfort if not none at all. This means that the quality of data from the participation of those who do participate could be better than that of those who are being recorded in face-to-face settings.

There are also benefit for the analysis beyond the fidelity of the data gathered. In particular, the limitation of videoconferencing tools such as zoom along with tacit etiquettes of having only one person speak at a time makes it easier to analysis the interactions during classroom instruction. This makes it easier for the analysis to track the switch in conversational turns between participants during the interaction. One practice during virtual learning is the presentation of the content during instruction. This way, the content being discussed is recorded alongside the discussion and the interaction between the students and the instructor. This allows the analysis to keep the context in mind when analyzing the communicative actions.

3. CONCLUSION

This paper shows the potential of utilizing mobile learning platforms as a tool to inform the development of operational definitions and frameworks for discourse analysis. Leveraging the recording functions embedded in virtual learning environments for data gathering can increase cost efficiency in educational research and improve the fidelity of the data gathered. This also makes the experience less intrusive for the participants. At the current pace of advancements in educational technology, novel platforms such as mobile learning are not going away. It is high time to capitalize on how these technologies can help inform our practices in mathematics education research.

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