

Motivating Mathematics Learning: Changes in Teachers' Practices and Beliefs During a

Nine-Month Collaboration

A Critical Analysis

Inquiry Exam

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Overview of Study

Turner, Warzon, and Christensen designed this study in an attempt to investigate whether teachers' beliefs and practices affected students' motivation to learn and understand mathematics. The authors completed interviews before implementation of teaching strategies to assess teachers' beliefs about how mathematics should be taught as well as to glean information about the manner in which they teach the mathematics to their students. Although the researchers initially recruited six teachers, they chose to include the collaboration of three of the teachers. The three teachers included were all female, with 6, 7, and 20 years of experience teaching mathematics to grades 6, 5, and 8, respectively, and were all certified as elementary education teachers.

The authors framed their study with aspects of motivational theory, namely student competence, belongingness, autonomy, and meaningfulness of the mathematics. The authors spoke in great detail about each of the four areas of motivational theory in order to situate their study within each of the lenses. The authors used a case study format to frame their research and collected data via interviews, class observations, and monthly professional development meetings during which new strategies were provided to the collaborating teachers for review and implementation.

Turner, Warzon, and Christensen concluded that the intervention provided the collaborating teachers with methods and strategies to increase student motivation, but the amount of motivation gained was dependent on teacher efficacy, acceptance of the rationales and strategies, and teachers' perceived student abilities.

Critical Analysis

In this section I will evaluate the individual facets that contribute to the study as a whole. Since this is a case study, there are many factors that affect the significance of the study's results. I will evaluate this study following the guidelines of components, quality, and protocol as set forth by Yin (2009). After a careful evaluation of each area I will provide additional comments on the study as a whole.

Components

Question. Turner, Warzon, and Christensen began their paper with a brief background followed by a literature review on motivation and instruction, which ultimately led to the discussion of their theoretical framework. Intertwined among this writing were the goals of the research: “to understand how and why teachers’ beliefs and practices related to motivation and mathematics developed and changed over time, given participation in the collaboration” (p. 719) and “to investigate if and why opportunities to enact the four principles of motivation might prompt teachers to change their model of mathematics instruction” (p.723). However, the research question developed for this study was “Which factors help explain different change patterns among three experienced elementary teachers who participated in the collaborative?” (p. 724).

I was left confused as to the reason the researchers created this question rather than following the goals they had previously set forth. It is my opinion, that the goals would have created more answerable opportunities to coincide with the data collected. The research question assumes the teachers will experience change, whereas the stated goals do not appear to allow for assumptions to be garnered.

Propositions. Yin (2009) defines propositions as “direct[ing] attention to something that should be examined within the scope of the study” (p. 28). According to this definition, the authors’ propositions are the effects of implementing motivation strategies to improve student competence, belongingness, autonomy, and the meaningfulness of the mathematics being learned. By stating these propositions and providing the relevance thereof in the literature review, the authors are guided to look for any changes that emerge in the teachers’ pedagogy and how those changes affect student motivation. The propositions provide an area for the researchers to “look for relevant evidence” (Yin, 2009, p. 28).

Unit of analysis. The authors chose to include the collaboration of three female teachers as their three case studies and the units of analysis were the strategies implemented to promote student motivation. I believe this study could have been made richer by student views of the new strategies to gain insight into their increase in motivation (or lack thereof). Another unit of analysis that could have provided more reliability to the study would have been to include student assessments, both pre- and post- motivation strategy implementation. Although the inclusion of grades would have created a mixed methods study rather than a solely qualitative study, it is my opinion that the grades would have made the findings “more real.”

Logic behind propositions. It is my opinion that the authors used a chronological time-series analysis to collect and evaluate their data. I substantiate this opinion by referring to the manner in which the data was reported – in monthly stages as the strategies were implemented – and because as the study progressed different types of variables were assessed (Yin, 2009), namely the four principles of motivation as defined by the authors. This would have certainly been easier to decipher if the authors had been more transparent in their design framework and methodology. Turner, Warzon, and Christensen do not explicitly define their framework at any

point in the article; they never define the three teachers as “cases” nor do they refer to the instructional strategies as variables they are observing.

Criteria for findings interpretation. Turner, Warzon, and Christensen include a great deal of information about each of the three teachers at each implementation stage. However, the actual number of interviews conducted is left to the reader to surmise; there are very few quotations from the teachers; very little information is provided on coding techniques; coder-reliability is mentioned on page 729, but there is no mention of percent agreement; classroom observations were not coded; and the first author completed all of the data collection. I found the transparency of the authors to be virtually non-existent when they spoke of their evaluation techniques, which provides hesitation, on my part, to take any significant information from this study.

Quality

Construct validity. Construct validity is created when multiple sources of data are collected, a chain of evidence is established, and member checking is conducted (Yin, 2009). Turner, Warzon, and Christensen clearly collect multiple sources of data – pre- and post-interviews, classroom observations, classroom observation follow-up interviews, and professional development conversations. The problem I find with the data collection, however, is that it is collected by the primary researcher who also is teaching the implementation strategies. In my opinion, this creates reflexivity – interviewee answers in a manner thought to be warranted by the interviewer (Yin, 2009), or teaches as instructed in the professional development sessions while being observed.

Interviews can be a valuable source of information and can be focused on the propositions to be studied. However, interviewees can also become focused on a topic other than

the planned topic. An example of this was when the interviewer planned to focus on the competence principle and Marcie “spent about three fourths of the interview discussing her grouping strategies” (p. 736). This variance from the topic could also be due to the familiarity of the interviewee with the interviewer; the interviewee may have sensed the interview as being that of a more informal interview whereas if one of the other authors had conducted the interview the formality, and therefore the topic at hand, may have been preserved.

Classroom observations can be sources of excellent information since they take place in real time and in context (Yin, 2009). However, they can be narrowed to the selectivity of the observer, whereas if all of the authors (or more than one at the least) were present during the observations, they would then be able to compare their field notes to hone in on more refined aspects of the teachers’ implementations of the strategies.

There were also conversations referred to as the result of the professional development meetings, however, they were conducted by the first author which could create an atmosphere of the teachers saying what they believe the researcher wants to hear. Although outside readings, videos, and speakers were used to help the collaborative teachers understand the strategies and techniques to be implemented in their classrooms, they were clarified by the first author, thus presenting a possible area of reflexivity bias.

Triangulation results when multiple data sources are analyzed and result in similar findings thereby strengthening the study (Patton, 2002). The authors did include a form of triangulation through their use of collecting data from several sources such as the pre- and post-interviews, classroom observations, and professional development forums.

Member checking is a procedure in which key informants (the teacher collaborators) are afforded the opportunity to read the final report before submission (Yin, 2009). Member

checking provides credibility to the findings “...as a way of corroborating the essential facts and evidence presented in a case report” (Yin, 2009, p. 182). The authors do not refer to the act of member checking in their article, which leads me to believe it was not a part of their process.

Internal validity. The authors attempt to provide interval validity (without explicitly stating so) by using pattern matching; pattern matching “involves an attempt to link two patterns where one is a theoretical pattern and the other is an observed ... one” (Trochim, 2006). This is developed through the authors’ theoretical perspective and literature review in which they describe in detail the effects of student competence, belongingness, autonomy, and meaningfulness of the mathematics as they relate to motivation. As a result of the professional development meetings where the collaborative teachers are introduced to the strategies to promote motivation they are observed and then interviewed on the implementation of such strategies. It is my opinion that this process sets out to find evidence to support the use of the strategies and therefore may be biased, mainly due to the fact that the same person is the professional development instructor and observer.

External validity. Isaac and Michael (1995) define external validity as “the generalizability or representativeness of the...findings” (p. 69). The external validity of this type of study is extremely important because if found valid, it could provide a wealth of information to colleges and universities offering teacher education programs. Unfortunately, this study does not meet the guidelines of external validity as it only monitors the teachings of three teachers in one school setting; the data is not generalizable to other teachers of mathematics. The authors are aware of and claim this lack of generalizability as a limitation of their study.

Reliability. Yin (2009) defines the goal of reliability as “the ability...to minimize the errors and biases in a study” (p.45). A study is reliable if it can be replicated by other

researchers and the findings are similar to the original study (Yin, 2009). Although the authors appear to be transparent in the explanation of their setting, participants, procedure, data collection, and data analysis, I do feel there are many shortcomings in their process.

The setting is described as a school corporation. This is the first time I can recall reading the description of a school as being a corporation; this leaves me to wonder if it is a private school as the description does not state it to be either public or private. The demographics of the student population of the school are noted, but it is not clear if the three collaborative teachers taught students meeting those criteria or the demographics of their classes were different. The teachers chosen were said to be “experienced” (p. 726), but the authors do not provide a definition of what they term *experienced* to represent. The intervention was said to comprise four areas of motivation theory, however, only Table 3 was presented as an example and it only gives examples of the competence strategies. I feel more information, or online links to, the remaining information provided to the collaborating teachers would have created more transparency in the study. As mentioned previously, the multiple roles of the primary researcher hinders the reliability of the data collection process and presents a possible area of bias.

“Two to three coders coded each meeting transcript independently and then met to resolve discrepancies” (p. 729); however, there is not any mention of inter-rater reliability. Another area of weakness in the data analysis, in my opinion, is that the authors speak about coding according to motivation principles and through open coding schemes, but no tables or lists of coding examples are provided to allow the reader to understand and agree/disagree with the manner of coding.

Protocol

Turner, Warzon, and Christensen chose to collect data before, during, and after implementation of the four motivation constructs. The data was collected through interviews (before and after implementation of constructs), monthly collaborative meetings, classroom observations, and interviews following observations. Yin (2009) believes it is important for the interviewer to enter the interview process with an open mind, capable of asking good questions, adaptive, and flexible. Yin (2009) defines good questions as those that elicit responses that immediately lead into a series of new questions that ultimately creates “some significant inquiry about how or why the world works as it does” (p. 70). When an interviewer enters into the interview process with an open mind and is adaptive and flexible they are less likely to interpret the results with bias (e.g., hearing what they *want* to hear), are able to make use of information provided that is not necessarily in response to the question posed (e.g., Marcie’s observation interview on page 736), and can redirect an interview when it heads in the wrong direction (Yin, 2009). Patton (2002) states it is the responsibility of the researchers to create questions that are easily understood by the interviewee (i.e., the meaning of the question is clear and difficult to misinterpret) and advises against “why” questions as they “presume cause-effect relationships, an ordered world, and rationality” (p. 363).

The interview questions asked at the completion of the study are the same questions asked before the start of the study and are asked by the same interviewer. It is my opinion that by asking the same questions by the same interviewer, consistency in this aspect of the data collection is preserved. Using this format the researchers were able to analyze the data and more accurately compare teacher responses in an attempt to identify areas of teacher growth and change in beliefs. The questions are open-ended and very well written according to Yin and

Patton's guidelines above. The questions delve into the teachers' knowledge base and sense of reflection. After viewing the questions shown in the Appendix (pre- and post- study questions and excerpts of observations interviews) only two questions in each set are "why" questions; this is a strength in the protocol development.

The classroom interviews are a solid addition to the data collection protocol and were important for helping the teachers to recall and reflect on particular incidents. I feel that the classroom observations would have been more reliable if there was more than one researcher in the classroom during the observation to gain real-time interpretations; having more than one observer allows for more information to be collected due to the additional eyes and ears available to receive the information.

The collaborative meetings were video-taped and recorded. I believe this is an important protocol because it allowed the main researcher to reflect on her teaching of the strategies and techniques. By viewing the tapes the researchers are also able to link teachers' knowledge, questions, and interpretations about the strategy and technique implementations; this could be an excellent source of information to link to the observation interviews.

The observation interviews were extremely important as they allowed the researchers to create reflection on behalf of the teachers in order to interpret their feelings both during and after strategy and technique implementation. The questions included in the Appendix show a solid mix of questions that were unique to each teacher and elicited good data. I feel that the interviews would have been stronger, though, if another researcher was present during the interview to record body language and nuances since there was no mention of the interviews being videotaped.

Summary

The previous seven pages have provided evidence of strengths and weaknesses in the present study. Although the weaknesses seem to be numerous the authors do deserve to be complimented on the depth of the background and literature review provided to substantiate the necessity of a study such as this. Although the authors do not speak to motivational theory separate from the four constructs they aim to study, they do provide a great deal of information about each of the individual constructs. They also claim the four constructs “cut across prominent theories of motivation” (p. 720), but it is not clear how they classify *prominent* or if the term is borrowed from their readings. Furthermore, they provide a great deal of information focused on teachers’ beliefs about motivation. However, I did notice that the authors interjected many opinion statements throughout the literature review without citations to substantiate them (e.g., “Many teachers, especially in mathematics, believe that students disengage because they think that they aren’t ‘good at math’” p. 720).

The authors substantiate the strategies and techniques used to create motivation as having “good potential for increasing students’ motivated behaviors” (p. 724), but fail to qualify their definition of good (i.e., expected outcomes). As stated earlier in this critique, the ability to view all of the suggested methods would have been useful for validating the findings and making the design more replicable.

I do believe a study on this topic is warranted and necessary for current and future teacher education programs, but the weaknesses noted would need to be cured to create a study that is reliable and valid. A case study is not an easy to undertake, in my opinion, and I give these researchers a lot of credit for the findings. My suggestion would be for them to re-do this study as a mixed methods study, improve their areas of weakness, use diverse faculty and schools, and

include student assessments as proof of the positive effect of the implementation of the four constructs.

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