Analyzing the Perceptions of the Common Core Mathematical Practices Held by Inservice and Pre-service Teachers

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Introduction

The recent implementation of Common Core State Standards has influenced the k-12 mathematics classroom both in the terms of content taught and expectations for influencing students individual approach to leanring mathematics. This latter objective can be seen in the eight Standards for Mathematical Practice (see chart to the right). The Standards for Mathematical Practice "describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important processes and proficiencies with longstanding importance in mathematics education."(CCSS, 2010) Research suggests that teachers view theses practice as a positive influence upon their students, but it less clear if teachers are fully prepared to effectively implement these practices in their classrooms (Davis er. Al., 2013.).

The purpose of the study described here was to continue to build an understanding of the ways in which teachers understand and implement the Practice Standards. This is an area of interest as the effective implementation of any curriculum related reform is heavy influenced by the teachers who interpret and implement the reform in their classroom. Our investigatiopn focus on comparing pre-service teachers' opinions with practicing teachers' opinions regarding these mathematical practices. We were interested to see if pre-service teachers' knowledge of the practices that they acquired in their core mathematical education classes at university level transferred to their instruction as a practicing teacher. Our research was focused on examining this shift of the Mathematical Practices from learning to application.

Methods

The resarchers in this project consisted of nine pre-service teacher and one university professor. Data was colelcted in two phases. The first phase consisted of 128 pre-service elementary and middle grades techers responding to questions related to ranking the Mathemtical Priactices in terms of most and least important. These pre-serice teachers were also asked to provide an argument to support their choices., The second phase of data collection consiseted of interviews with six inservice teachers. These interviews focused on how the mathematical practices were perceived by practicing teachers. Data analysis for the first phase of data collection focuswed on quantitative measurement of the rankings and qualitative exmaination of the pre-service student reasoning. Data analysis for the second phase of data collection consisted of transcrbing the interviews and, with a group of five researchers, apllying a constant comaritive approach to coding the data and documentinbg the emergence of the themes.

Interview Results

To determine inservice teachers' perceptions of the Common Core Mathematical Practices, we interviewed six inservice teachers who teach mathematics as part of their teaching assignemnt. These teachers have one to two years in the field and teach mathematics to students ranging from 1st -10th grade. Five of the six participiants teach in Pennsylvania and the other one teaches in North Carolina. All inservice teachers were familiar with and used the Mathematical Practices to varying degrees. The five inservice teachers in Pennsylvania are required to use the Mathematical Practices by their district as part of their mathematics curriculum.

The Matheamtical Practices that were identified by inservice teachers as most important in their mathematics classrooms include construct viable arguments and critique the reasoning of others, modeling with mathematics, look for and make use of mathematics, make sense of problems and perservere in solving them, and attend to precision. The practices that were identified by inservice teachers as least important in their mathematics classrooms were attend to precision and reason abstractly quantitatively. We determined that there were no patterns in our results. The inservice teachers each identified different practices as most and least important based on their teaching philosophy, their beliefs, their values, and their students. Inservice teachers described impacts of the Mathematical Practices on their teaching practices as creating a focus on vocabulary, deeper understanding, collaboration among teachers, connections across curricular areas, and an overall increase in thoughtful teaching.

References

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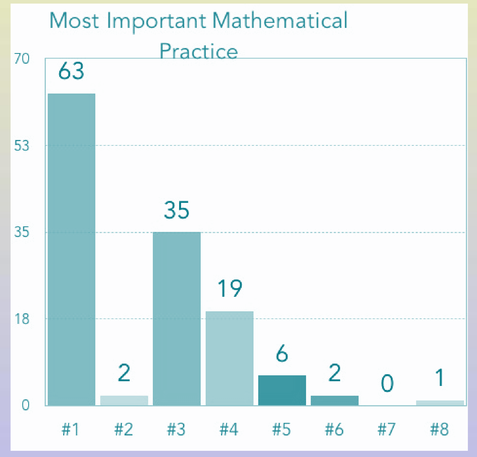
Results From Pre-Service Teachers

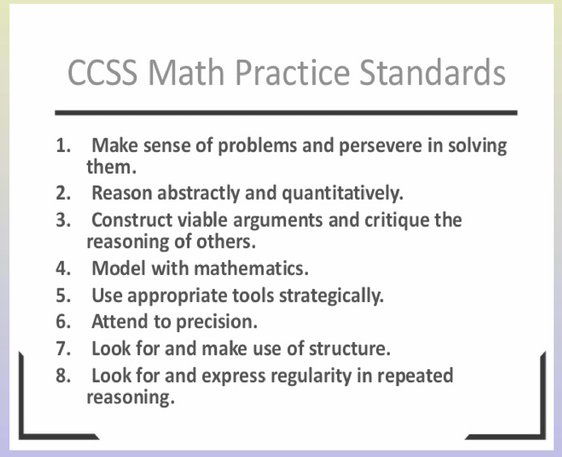
The results from the responses of the 128 pre-service elemntary and middle grades teachers suggest a clear pattern in the ways in which this group perceives the relative importance of the eight Mathematical Practices. Overwhelmingly the pre-service teachers chose "make sense of problems and persevere in solving them" as the most important standard. There are two common reasons given as to why this was chosen as the most important mathematical practice. The first reason suggested by this group of pre-service teaches is that, if a student is unable to make sense of a problem, they cannot begin to master any of the other practices. This suggests a hierarchy in which the Mathematical Practices should be introduced. The second reason given is that perseverance is key to the success of a student, because when a student encounters a problem that they find difficult they need to be able to keep trying and not give up.

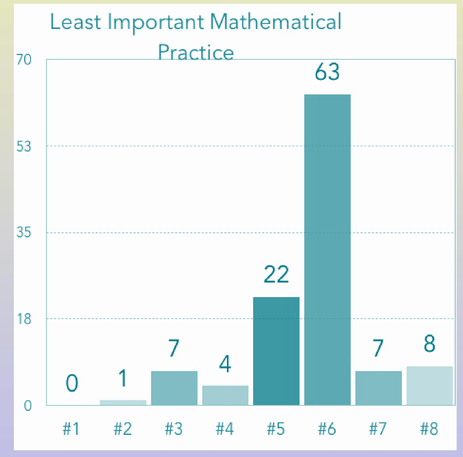
The Mathematical Practice that was next likely to be chosen as the most important standard was "construct viable arguments and crtizue the reasoning of others." When asked to support their choice pre-serivce teachers suggested that both constructing arguments and critiquing others' reasoning requires higher order or critical thinking, which allows students to develop and demonstrate a deeper understanding of the concepts.

The Mathematical Practice that the pre-serice teachers in this study perceived to be the least improtnat pratice was "attend to precision". Preservice teacher suggested three common answers as to why this is the lesst important choice. The first reason given is that the answer is not as important as the process. The second reason is that attending to precision puts too much pressure on students to solve the problem the right way. The last reason is that if students can explain what they did in their own words than they understand and the terminology should not matter.

The Mathematical Praictice that was next as likely to chosen as the least important was "using tools strategically". Pre-service techers suggetsed three common answers given for this choice. The first reason is that tools are not necessary to solve a problem. The second reason is that using tools is general knowledge and students are already aware of how to use them. The last reason is that schools have a variety of tools and some schools may lack tools so not all of the students are being exposed to the same tools.







Discussion and Conclusion

The initial question posed to pre-service teachers, ranking the least and most important Mathematical Practice s, was in itself purposely flawed. The eight Practice Standards are not meant to be taught in isolation or in a specific order. However, by asking pre-service teachers to rank the Mathematical Practice s and support their reasoning, we hoped to force the participants to have and support a view on the ways in which the Mathematical Practices are to be applied in the k-12 classroom. The results above provided clear patters in how this group of pre-service teachers view the important (and lack of) of four of the Mathematical Practices What we also believe that the data suggests is a reason as to why the pre-service teachers may have made these decisions.

Given the explanations provided by the pre-serivice teachers in the study, it may be that their knowledge of the eight Mathematical Practices does not extend siginifantly beyond what can be gleamed by the words within title of each of the practices. For example, when disucssing the Mathematical Practice "use appropriate tols strategically" pre-service teachers argued that many schools do not have the funds or access to specific technology or that tools are not necessary to solve a problem. The term tool in this Standard extends beyond tools such as a calculator.

In terms of the Mathematical Practice that the majority of the pre-service teachers chose as most important, "make sense of problems and persevere in solving them," it is possible familiarity helped to drive their choice. The language used in this Mathematical Practice may require less interpretation and be more likely to fit into pre-conceived expectations for leaners of mathematics. The fact that no pre-service teacher chose this as the least important is in itself an indication as to the way this Mathematical Practice differs from the others in terms of the pre-service teachers perceptions.

The data collected from in-service differed from that of pre-service in that there was greater variations in the ways the participants discussed the most and least important Standard. In-service teachers discussed curriculum resources and professional development informing their choices. In this way the in-service teachers appear to have a more nuanced understanding of the Mathematical Practices.

In closing, our data suggest that pre-service teachers would be well served with a more in-depth exposure to the Standards for Mathematical Practice. Opportunities to see multiple Mathematical Practice applied in a classroom scenario would help to add a much deeper understanding of these Practices. These experiences would also help these pre-service positively incorporate varied messages delivered by curriculums and professional development during their transition to an in-service teaching position.