

Review of the dissertation thesis written by

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Development of knowledge and skills in initial mathematics teacher education and early years of teaching career in Ghanaian Basic Schools

The thesis will be considered from the point of view of the requirements placed on the dissertation theses on mathematics education at the Faculty of Education, Charles University.

Selected topic

The main objective of this dissertation is to contribute to the improvement of Ghana's education system through the improvement of mathematics teaching. Thus, I consider the chosen topic very important. The current state of the Ghanaian education system is described in chapter Two in details. The depth and comprehensiveness of the elaboration of the topic, and the fact that four articles have already been published in the professional journals in the last year, gives the assumptions that the author has a good potential to influence the decisive spheres of education policy in Ghana. By analysing and comparing the content of curriculum documents for the pre-primary and early-primary (Grades 1-3) levels, including objectives and recommended teaching strategies, in addition to studying other important aspects that influence the quality of teaching, such as teachers' attitudes towards mathematics, their self-efficacy, beliefs and, of course, the level of mathematical knowledge, the author adds depth, authenticity and timeliness to the results of the research. To compare the mathematics content in the curriculum documents for pre-service and early-primary teacher education, the learning objectives, and to assess the mathematical proficiency of practicing teachers, the author used a fairly new (from 2020) comprehensive document, the Global Proficiency Framework for Mathematics (GPF), which ensured objectivity in the comparison. To map teachers' attitudes towards mathematics, self-efficacy and their mathematics pedagogical content knowledge, the author worked with two groups - pre-service student teachers and in-service teachers both of lower grades (grades 1-3).

I must add that this topic is a great inspiration for research in the Czech education environment, especially in view of the ongoing revisions of the RVP ZV, where the GPF document used in this thesis is also used as a key source for the area of Mathematics and its applications.

The aim of the thesis and the theoretical framework

The aim of the research is to investigate the mathematical preparation of primary school teachers in Ghana, their level of mathematical knowledge and teaching skills. The research involves both, as mentioned above, two groups of respondents - students completing their preparation for the teaching profession and teachers beginning their teaching career. By pointing out the identified gaps in the training process and describing possible improvements in teacher quality, the author seeks to enhance the quality of mathematics teaching and consequently improve mathematics education outcomes in Ghana.

Five research questions are directed towards this goal. On four of them, the author and her supervisor have published articles in peer-reviewed journals. The answer to each research question is elaborated separately in Sections 4.1-4.5 and the important findings are summarized in the concluding Chapter 5.

The research questions are as follows:

RQ1: What alignments exist between the early-grade mathematics curriculum implemented by Colleges of Education in Ghana and the National Kindergarten Mathematics Curriculum?

RQ2: How do Ghana's national kindergarten and Colleges of Education early-grade mathematics curricula align with the knowledge and skills outlined by the Global Proficiency Framework?

RQ3: What are pre-service and early career teachers' attitudes toward mathematics in Ghana?

RQ4: How do pre-service and in-service teachers' attitudes towards mathematics relate to their mathematics teaching efficacy beliefs?

RQ5: What content and pedagogical content knowledge do early career teachers and pre-service early-grade teachers possess at the end of their College Education?

The theoretical framework is well elaborated the second chapter – literature review. Here, the author demonstrates a very extensive knowledge of the literature, which helps to define the key concepts dealt with in the text, such as teacher knowledge, subject matter knowledge, mathematical knowledge for teaching, pedagogical content knowledge, attitudes towards mathematics, teachers beliefs, self-efficacy, mathematics anxiety and confidence, enjoyment and motivation, ... Also, this theoretical background provides arguments for the choice of research design and methodology, and also supports the research findings by putting them in context with other published research in the discussion.

Methodology and results of the thesis

The methodology was chosen appropriately to achieve the objectives and answer the five RQs. A mixed research method was used - qualitative and quantitative research which complement each other. The use of breadth of quantitative data and depth of qualitative data allows the researcher to gain a deeper understanding of the research problem. A table summarizing for each research question what type of data was collected, what instrument was used, and what key concepts the research question addressed is provided on page 28.

The research participants are presented in sufficient detail in section 3.2, with only a somewhat brief description of their selection - with reference to the literature: Ewing and Manuel's (2005) and Cohen and Morrison's (2000) classification of teachers. Also, the selection and number of participants from all the participants who took part in the survey of teachers' attitudes towards mathematics is not clear. A semi-structured interview was conducted with these 20, (or was it 40?) participants after completing the questionnaire as part of an exploration of their level of pedagogical content knowledge for teaching mathematics in addressing RQ5. It is further written (p. 31), "In total, twenty mathematics teachers from forty schools across two regions, representing all ..." and also that "Questionnaires were distributed to all twenty pre-service early-grade teachers and twenty early-grade teachers in the early years ..." This information is not consistent.

Furthermore, the processes of collecting qualitative and quantitative data and how to process them are clearly described. Quantitative data were collected through standardised surveys and assessments, which are modified ATMI and MTEB questionnaires. The first questionnaire is aimed at identifying and measuring respondents' attitudes towards mathematics. This questionnaire was also used for our research at KMDM. The second questionnaire is aimed to measure mathematics teaching self-efficacy and teaching outcome expectancy. The qualitative data were collected through semi-structured interviews that were audio-recorded, transcribed into written form and analyzed using Atlas.ti software.²² The codes chosen corresponded to each theme.

The findings related to the five RQ are adequately presented. However, I have a few comments on this.

In comparing mathematical knowledge, the author lists concepts, phenomena in which the Ghana's curriculum documents exceed the GPF and in which they fall short (RQ 2). For example, it is the concept of fraction that is present in the Ghana's document in Grades 1 and 2 but not in the GPF. Please provide some illustration of how students are introduced to the concept of fraction in Year 1 in Ghana and a reflection on what stage of fraction recognition this is.

In the Discussion, paragraph 4.2.3, it is stated that the national curriculum and the GPF are closely related except that the GPF, unlike the B.Ed. early grade curriculum, omits theories of early-grade numeracy development. I believe that the reference to cognitive theories that should be known by the teacher, not the students, may be a general difference between the two documents. The GPF does not refer to related theories, unlike the national mathematics curriculum. However, it is later stated that the national curriculum goes beyond the GPF in many ways and that this is "a positive outcome, as it implies that the curriculum is designed to ensure that learners develop a solid foundation in mathematics skills and concepts." I believe that the implication expressed may not be correct. Introducing challenging concepts in the lower grades does not necessarily lead to a more solid foundation in mathematics, and the opposite may be true. I agree with the idea that it leads to the need to better prepare teachers.

I disagree with the statement (paragraph 4.2.4) that the fact that national curriculum documents are closely aligned with the GPF "ensures that learners and teachers are well-prepared for national and global assessments, reflecting a commitment to educational excellence". I believe that this is a good assumption, not a guarantee, as the author ultimately communicates with a suggestion for further exploration. The answer to RQ 5 is indicative of what the reality is.

Exploring the relationship of prospective and practicing teachers to the subject they teach is very important, as is also noted in the related literature review chapter.

RQ 3 refers to the relationship between pre-service and in-service teachers towards mathematics. How I could understand, that on page 59 it is written „The slightly higher enjoyment reported by pre-service teachers may stem ...“ , however in figure 1 on page 58 the graph shows, that the enjoyment of both groups is equal. The name of this figure does not correspond to its content and the graph does not .

RQ 4 concerns the relationship between the relationship to mathematics and teaching efficacy of two groups, in-service and pre-service teachers. Formulation of Hypothesis 2 (*There will be no statistically significant difference in the attitudes toward mathematics when comparing pre-service and in-service teachers*, p. 62.) and paragraph 4.4.3, however, refers only to the relationship of teachers to mathematics. Does this hypothesis and text not belong rather to RQ 3?

RQ 5 is interested in the level of Pedagogical Content Knowledge for teaching mathematics of both considered groups RQ 4 concerns the relationship between the relationship to mathematics and teaching efficacy of two groups, in-service and pre-service teachers. However, the formulation of Hypothesis 2 (*There will be no statistically significant difference in the attitudes toward mathematics when comparing pre-service and in-service teachers*, p. 62.) and paragraph 4.4.3 only concern teachers' attitudes toward mathematics. Does this hypothesis and the text not belong rather to RQ 3?

RQ 5 is interested in the level of Pedagogical Content Knowledge for teaching mathematics of both considered groups using a teacher-made achievement test. Since I have no idea what the test looks like and how it is scored, Table 20 (p. 73), Figure 4 are incomprehensible to me. The second part of the investigation in RQ 5 took place through interviews with a random sample of 10 in-service teachers and an unspecified number of pre-service teachers. What is lacking here is a characterization of these teachers and a consideration of the extent to which the selection of teachers for interviews may have

influenced the results. I am grateful for the formulation of the result in section 4.5.6 Conclusion, which points to the need for support for in-service teacher training, although this generalisation only applies to the small group of teachers included in the research. The above-mentioned connection with related international research and the rich experience from our environment give justification to this generalisation.

Chapter 5 summarises the results, implications and limitations of the research and recommendations for practice. The author is aware of a limitation of the study caused by its small sample size, but at the same time points out the consistency of the results with existing international research. Another limitation mentioned by the author is the lack of observation of practice and thus the possibility of comparing the research results with reality.

The recommendations for practice that are made at the end of the thesis capture well the identified gaps in teacher preparation.

Questions

I would like to ask the author to provide some illustrations of how students are introduced to the concept of fraction in Year 1 in Ghana and a reflection on what stage of learning about fraction this is.

Please describe the pedagogical approach of Scaffolding in more details. I find its mention in the documents interesting.

Are some of the research findings surprising?

How will it continue to exert its influence on the necessary changes in Ghana?

Importance of the thesis and concluding remarks

The thesis is well-structured and quite easy to follow. I consider it unnecessary to repeat some paragraphs, namely the formulation of hypotheses and RQs in several places - in the methodology in chapter 3 and in chapter 4 Results, findings, ...

I don't feel competent enough to evaluate the level of English, but I consider the language is at a sufficient level for the reader to follow the text with understanding. Minor typographical shortcomings can be found in the text, such as different table formats as well as some inconsistencies, e.g. program x programme, Ghanaian x Ghana's, B.Ed. Early-Grade x B.Ed. early-grade, different font used for writing hypothesis, ... On p. 53 there is a reference to Table 3, but it does not correspond in content. Table 7 is probably meant. The table on p. 79 is not named.

The topic of the thesis is from my point of view very important and inspiring even for the Czech environment as I mentioned above

I see the main strength of the thesis in its extensive insight into related foreign research, which is used both for the choice of research tools and for comparison or confirmation of the results obtained. Furthermore, I consider the strengths to be the grasp of the problem from several different perspectives, which gives the author a very comprehensive understanding of the situation and a guarantee that the thesis will not remain only in a drawer after the defense.

I recommend Marlene Kafui Amusuglo's thesis to be presented in front of the Ph.D. committee and I support the awarding of the PhD degree.

Prague, 14. 3. 2025

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