Primary ITT trainees' competence and confidence in mathematics teaching in the UK: a review of literature

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Abstract
Recently, teacher recruitment and retention has been the focus of the government and a step taken to support recruitment was the abolishing of the skills tests. Initial teacher training providers became responsible for assessing trainees' mathematics rather than having it externally assessed. The purpose of this literature review is to synthesise the findings of recent studies conducted in the UK about the trainees' competence in mathematics and confidence in teaching it. Six electronic databases were searched, utilising a systematic approach, which identified only six relevant articles. This is significant as it demonstrates that, despite the evidence about the urgent need for intervention, there is limited research that explore how to address the issue of improving prospective primary school teachers' mathematics competence and confidence, especially in England. This systematic review contributes to the field by bringing attention to the important findings of these studies. Findings suggest that while some primary ITT trainees' competence and confidence about teaching mathematics is low, holding advanced level mathematics qualifications does not guarantee knowledge required to teach primary mathematics effectively. Some trainees have positive attitudes towards mathematics and, more importantly when this is not the case, both trainees' attitude towards learning and teaching mathematics can be improved.

Key words
Primary, ITT, trainee, mathematics, competence, confidence.

Introduction
The government launched the current national curriculum (NC) in 2014 for primary mathematics after the reports that, compared to other countries such as Finland, Singapore, Canada, New Zealand, and Japan, England was not achieving well in the international tests (OECD, 2009; OECD, 2012; Gove, 2011; Edwards, 2013).

To find out how those countries' teaching differed to our teaching and how we could develop our practice, Office for Standards in Education (Ofsted), had visited Finland and published a report titled *Finnish pupils' success in mathematics* (Ofsted, 2010). The report finding was that one of the important factors in Finland's success was the teachers' high-level knowledge in primary mathematics. Similarly, in another influential report carried out by McKinsey and Company (Barber and Mourshed, 2007), it had been highlighted that the teachers' secure subject knowledge was a common factor in mathematically high achieving countries such as China, Singapore, and South Korea. An international comparative study in mathematics teacher training carried out Burghes (2011a) had found that, at the primary level, Japan significantly outperformed all the 10 participating countries while England performed the lowest scores in questions about mathematical concepts. The report recommended increasing the entry to ITT to GCSE grade B in mathematics as the result showed that the trainees who held GCSE grade C level brought the scores down significantly. In terms of provision for ITT, the report recommended developing the trainees' competence and confidence at a level significantly above at which they would teach (Burghes, 2011b). Additionally, in 2008, the Independent Review of

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Mathematics Teaching in Early Years Settings and Primary Schools (Williams, 2008) had recognised these concerns, and recommended significant changes in both pre-service and in-service education for teachers in order to address them.

Parallel to these developments, in the 2012 PISA (Programme for International Student Assessment) results, the mean performance of the UK in mathematics was unchanged from 2006 and 2009 (Table 1), performing within the 'not statistically significant' from the OECD (Organisation for Economic Co-operation and Development) average (OECD, 2006; OECD, 2009; OECD, 2012) whereas Shanghai-China, Singapore, Hong Kong-China and Korea scored the highest points and well above the average.

	2006	*2009*	*2012*
OECD average	**498**	**496**	**494**
United Kingdom	495	492	494
Shanghai- China	--	600	613
Singapore	--	562	573
Hong Kong-China	547	555	561
Korea	547	546	554

Figure 1. PISA Performance Comparison.

As a result of all these events, the NC was heavily influenced by the practice of south Asian countries (Gove, 2011; NCETM, 2014), and two years later, the government started to roll out south Asian teaching methods at primary schools (Gibb, 2016).

As Morgan (2014) points out, this curriculum has higher standards compared to the old one, but our student teachers have lower levels of mathematical knowledge on entry to university compared to the student teachers in the successful countries in mathematics teaching (Ofsted, 2010; Barber and Mourshed, 2007; Sahlberg, 2015; Burghes, 2011b). Therefore, it is vital that during initial teacher training (ITT), the student teachers gain the necessary knowledge and understanding about the difference between the procedural and conceptual teaching coupled with the conceptual teaching methodologies and techniques for teaching, learning, assessment, and planning. More importantly, the trainees should feel confident in teaching this new high-level mathematics to all primary age pupils. Most recently, with a new focus on teacher recruitment and retention (DfE, 2019a), the government scrapped the skills test requirement for ITT entry (DfE, 2019b), requiring the providers to ensure that prospective teachers meet the high standards of mathematics and English subject knowledge required to be a teacher (Gibb, 2019). This means ITT providers must ensure that trainees gain an appropriate level of subject knowledge to be able to teach at high standards in both core subjects. There have been many changes to ITT (Whitty, 2014; Ellis, 2010; Furlong, 2013) in the UK during the last 40 years (Murray and Passy, 2014) and while this policy change was welcomed by some (Hollis, 2019; DfE, 2019b; Speck 2019), ensuring that the ITT trainees have the necessary subject knowledge and confidence in teaching these subjects is bound to be challenging and research about the current situation and provision is vital. Therefore, the purpose of this review is to synthesise the findings of research ITT providers have conducted in the last ten years, and through that, identify the ways in which they implemented changes in practice to improve the trainees' mathematics subject knowledge competence and confidence in teaching it.

Methodology

In conducting this literature review, a systematic search approach was adopted in order to develop a synthesis of existing evidence for the research question as well as ensuring the internal validity (Booth, Sutton and Papaioannou, 2016). The search was executed in consultation with an experienced librarian. Keeping a good record of the details of the screening with exclusion reasons (Siddaway, 2018; Harlen and Schlapp, 1998; Stark, 1998) is essential for explicit explanation (see Appendices 1-8). The literature was screened systematically, using a pre-determined inclusion criterion (Table 2). Additionally, to avoid the risk of search and selection bias by the researcher (Blaxter, Hughes and Tight, 2010; Machi and McEvoy, 2016; Gough, 2007; Booth, Sutton and Papaioannou, 2016) six different electronic databases were utilised (Table 3) with a predetermined and clear appraisal standard (Table 5). This review sought to find out if there were any recent research informed answers to the following question:

What evidence does the current literature provide about the primary ITT trainees' competence and confidence in mathematics teaching in the UK?

The following seven steps were identified and followed (Gough, 2007) to ensure the review was conducted and reported systematically; 1. The Review Scope, 2. Search Strategy, 3. Screening the Studies, 4. Describing and Systematic Mapping of Research, 5. Quality and Relevance Appraisal, 6. Synthesising Study Findings, 7- Discussion and Conclusion.

1. The Review Scope: While the aim of this review was to identify as many relevant studies as possible about the review question, the researcher acknowledges the challenges of managing the data (Fink, 2019). To overcome this challenge, a set of criteria for inclusion (Gough and Thomas, 2011) was identified with the inclusion areas of; subject, type of source, time scale, area coverage, research methodology and reliability (Table 2). To ensure a degree of validity and reliability of the articles, refereed journals were utilised (Harlen and Schlapp, 1998) using some high index rated databases in the UK.

Inclusion Areas	**Criteria for Inclusion**
Subject (relevance to the topic)	Study must directly relate to the research question.
Type of source	Study must be from a peer reviewed journal.
Time scale	Study must be published between 2010 and 2020.
Area coverage	Study must be based on primary research carried out in the UK.
Research methodology	The methodology should be clearly explained (qualitative and/ or quantitative).
Reliability	The findings of the study must be valid and reliable.

Figure **2.** Criterion for Inclusion.

Studies that did not meet the criteria or if they focused on the competence and confidence of school children were excluded. Due to the limited number of studies found, the search criterion was broadened twice. At the start, the search was carried out for studies conducted in England in the last 5 years, however, only 5 articles were identified for full text screening (Appendix 1 & 2). As a result, the search criteria were broadened to the UK but, this search only provided 3 articles for full text screening (Appendix 3 & 4). Therefore, the decision was made to broaden the search timescale

between 2010- 2020. When the criteria were adjusted (Clough and Nutbrown, 2012) with the new search terms and the timescale, 16 more articles were identified as eligible for further screening (Appendix 5 and 6). Introducing a different search term, *anxiety* was considered, but this search provided only 1 result (Appendix 7 and 8) which was not eligible for inclusion.

2. Search Strategy: In order to identify the eligible studies, literature searches were conducted in peer-reviewed articles from six UK databases in January and February in 2020. The databases searched were; British Education Index, Education Research Complete, Scopus, Education Abstracts, Teacher Reference Centre and Academic Search Premier. Adapted from the Preferred Reporting Items for Systematics Reviews and Meta- Analyses (PRISMA) screening tool (Moher et al., 2009), the process of the search strategy is demonstrated in a flow diagram below.

PRISMA FLOW DIAGRAM

	STAGES	**Articles Identified**
IDENTIFICATION	**Records identified**	Competence /Confidence
	British Education Index	422
	Education Research Complete	635
	Scopus	154
	Education Abstracts	410
	Teacher Reference Centre	200
	Academic Search Premier	461
	TOTAL	2282
	Additional records identified through other sources	0
	Records after duplicates removed	705
SCREENING		
	Records screened	705
	Records Included	106
	Records Excluded	599
ELIGIBILITY	Full text articles assessed for eligibility	23
	Full text articles excluded	17
INCLUDED	Studies included in synthesis	6

Figure 3. Types of Sources Searched and Literature Identification.

To refine the search (Phelps, Fisher and Ellis 2007), a variety of the key search terms 'ITT, confidence, competence, mathematics' as well as the Boolean logic (Ridley, 2012) with the operators; OR, AND and NOT were used and a record of it was kept (see Appendices 1-8). Different versions of the terms were used to ensure the search was as comprehensive as possible (Gough, Oliver and Thomas, 2013) such as 'competence' as well as 'ability, skills and competency' (Table 4). To narrow and/or broaden the search, the words AND and OR were used (Machi and McEvoy, 2016; Fink, 2019).

Chosen search terms	**Terminology variations**
ITT	teacher education, teacher training
trainee teacher	student teacher, pre-service teacher
competence	ability, skills, competency, knowledge
mathematics	maths
confidence	belief, perception, view, attitude
England	UK, United Kingdom, Wales, Scotland, Ireland

Figure 4. Search Term Identification.

4. Screening the Studies: The search results were screened twice (Ridley, 2012); once as the first stage of practical screen on title and abstract, then, as methodological quality screen (Fink, 2019) stage, where whole study was screened in depth (Brunton and Thomas, 2011). In order to avoid hidden bias, the inclusion criteria were used consistently at both screening stages. During this process, two main questions were sought to be answered: 1-At the first level, whether the study was eligible to be included, and 2- at the second level, what was useful in the included studies (Machi and McEnvoy, 2016).

5. Describing and Systematic Mapping of Research: After the stage 1 screening, the methodology and findings of included studies were outlined for the research question (see Appendices 2, 4 and 6). Each of these studies were than appraised in terms of quality and relevance using the pre- determined descriptive (Machi and McEvoy, 2016) that shown in Table 5. The studies that scored unsatisfactory for study relevance part in the inclusion criteria, were excluded without the methodology relevance and quality appraisal. All together 23 studies were identified as eligible for the second level full text screening stage. Upon reading the full texts, further 13 studies were excluded, because, while some of these studies scored the lowest point in terms of study relevance, they were not conducted in the UK. If the location of the study was not referenced in the paper, then, it was assumed that it was carried out in the origin of the author's institution. Similarly, 4 more studies were eliminated without the methodological quality appraisal when the difference on their focus became very clear. For example, Brown, Rowley and Smith (2016) focus on school direct teacher training route; Woolhouse and Cochrane (2015) focus on secondary school Subject Knowledge Enhancement (SKE) programmes at PGCE mathematics course; Bolden, Harries and Newton (2010) focus on teaching mathematics creatively and Hardy, Spendlove and Shortt (2015) focus on Teachers' Standards. Finally, only 6 studies were identified as eligible for appraisal for both study relevance and methodological relevance and quality.

6. Quality and Relevance Appraisal: In order to gain a deeper understanding (Booth, Sutton and Papaioannou, 2016), each study in the descriptive map was analysed and evaluated. As Harden and Gough (2011) point out, creating an appraisal tool assist with the process of assessing the quality and relevance of the studies. To determine the quality of the study, the design of the research and how it was conducted were considered (Gough, 2007; Booth, Sutton and Papaioannou, 2016). To this end, the studies' quality and relevance was assessed at four different levels and weighed on three components (Gough, 2007); 1) relevance of the study, 2) relevance of the methodology and 3) quality of the methodology (Booth, Sutton and Papa, 2016). To measure the overall quality of the study, a scoring system ranging from 3-9 with the levels of outstanding, good, satisfactory, and unsatisfactory were used (see Table 5). Studies with the lowest score considered to be the most relevant and methodologically robust.

Standard	Relevance of the study	Relevance of the methodology	Quality of the methodology
1 Outstanding	Very closely aligned to the review question. Provides very strong evidence which could be used for future action.	Study's research questions are distinctly stated. Findings answer the research questions in detail.	The research design is outstanding. Methodology decisions are clearly explained and justified. Measures are taken to ensure validity and reliability.
2 Good	Broadly in line with the review question. The evidence is strong.	Study's research questions are obvious and/or can be inferred from the text. Findings address the research questions.	The design of the research is clearly outlined. Appropriate measures are taken to provide valid and reliable findings.
3 Satisfactory	Only part of the study findings is relevant to the review question.	Study's research questions are implicit or not matched by design.	The research design is implicit or not stated. It appears to provide useful data.
4 Unsatisfactory	No part of the study finding is relevant to the review question	------	-----

Figure 5. Study Appraisal Components.

7. Synthesising Study Findings: The results of the descriptive mapping exercise about the individual studies were integrated together to answer the review questions. In the process, when extracting the data (Ridley, 2012), some patterns emerged (Gough, Oliver and Thomas, 2013) and the studies were classified into thematic categories (Table 6). While accepting that the data could be summarised in other ways, the researcher decided to examine the current findings systematically (Harlen and Schlapp, 1998). The ***themes identified*** were: a) studies that focused on mathematics subject knowledge and the mathematics qualifications obtained before entering the ITE (Initial Teacher Education) in Scotland, b) studies focused on the confidence of ITT trainees in mathematics in the UK and c) studies that focused on cultural differences ITT trainees have in their mathematical views.

	Title	Author/ Year	Content	Area coverage	Appraisal score
Subject Knowledge	Student primary teachers improving their mathematics subject knowledge: Cognition and affect intertwined	Henderson, 2012	Relationship between the mathematical competence and the mathematical qualification held.	Scotland	3
	Do advanced qualifications equate to better mathematical knowledge for primary teaching?	Stephen and Sandra, 2015	Advanced level mathematics qualifications and SK enhancement.	Scotland	5
Confidence	A representational approach to developing primary ITT trainees' confidence in their mathematics	Bolden, Barmby and Harries, 2013	Developing trainees SK and confidence in mathematics and mathematics teaching.	England	3
	Student Primary Teachers' Perceptions of Mathematics	Jackson, 2015	How ITT trainees' perceptions of mathematics is developed.	United Kingdom	5
Cultural comparison	Prospective teachers' beliefs about problem-solving: Cypriot and English cultural constructions	Xenofontons and Andrews, 2012	Beliefs about problem solving those prospective teachers bring from school to teacher education.	England and Cyprus	7
	Why Use Multiple Representations in the Mathematics Classroom? Views of English and German Preservice Teachers	Dreher, Kuntze and Lerman, 2015	Views about use of multiple representations in the classroom.	England and Germany	6

Figure 6. Peer-reviewed research articles about the competence and confidence of ITT trainees in mathematics teaching in the UK since 2010.

Themes Identified

A) Primary School ITT Trainees' Subject Knowledge in Mathematics Teaching

Two studies (Henderson, 2012; Day and McKechan, 2015) focused on mathematics subject knowledge and they were both carried out in Scotland. Henderson (2012) investigated the relationship between Scottish student primary teachers' mathematical competence, confidence, and the mathematical qualifications they held. From all four years of a Bachelor of Education (BEd) programme, 80 student teachers participated in the study. The study's aim was to determine the reasons for different levels of engagement with an online maths assessment (OMA) tool. OMA was created to help trainees to identify the gaps in their SK and address them. All trainees had unlimited access to OMA for five months and it was found that there were four patterns of engagement; a) those who made one or two attempts and stopped at or just over the threshold, b) multiple attempts and stopped at or just over the threshold, c) multiple attempts and scored more than 5% over the threshold, d) one-two

attempts and scored more than 5% over the threshold. In order to establish the reasons behind, stratified random sample of 80 trainees were invited to take an online survey.

The finding of the research was that 'the majority of trainees on the programme are either competent enough to achieve well above the 80% threshold or motivated enough to continue trying the OMA until they achieve a score higher than the threshold' (Henderson, 2012; 380). Interestingly, the trainees who had a Higher (SCQF level 6) Mathematics were not any more competent in the test compared to those who had SCQF level 5 qualification. Another important finding of the study was that the trainees who achieved high scores in a mathematics competence test were not necessarily confident in their own SK or had positive self- concept. On the other hand, the study indicates that 'a positive mindset and improving OMA scores can increase levels of confidence and motivate trainees to improve further' (Henderson, 2012; 384).

In a second study carried out in 2015, Day and McKechan examined if the advanced level of mathematics qualifications provided better SK for primary teaching. 149 trainees from two cohorts of undergraduate primary teaching trainees participated in this case study where the trainees' subject content knowledge (SCK) was measured using an assessment exercise. The focus mathematics areas were fractions, decimal fractions, and percentages.

The study found that the trainees who had Higher Mathematics scored better than those who did not. However, they found no significant difference between the trainees who held a SCQF level 6 Higher Grade and SCQF level 5 standard Grade Credit pass. Interestingly, though, SCQF level 5 intermediate two mathematics qualification holders performed significantly worse than the ones who had a Higher Grade. This also means that the trainees who had an Intermediate two pass performed worse than trainees who held a lower-level qualification, Standard Grade Credit. The results of the study indicate that SQCF level 6 qualification does not necessarily guarantee the competence required to teach primary mathematics. Day and McKechan (2015; 96) further explain that the reason for this finding maybe 'it does not necessarily follow that because a student can demonstrate a good conceptual understanding of differential calculus..., that they will be able to demonstrate a good conceptual understanding of fractions, decimal fraction and percentages as required for primary teaching'. They argue that there may be disconnection between the mathematics SK the primary student teachers have and the mathematics content knowledge and understanding required at higher and advanced mathematics curriculums.

B) Primary School ITT Trainees' Confidence in Mathematics Teaching

There were two studies in this category one of which was carried out in England (Bolden, Barmby and Harries, 2013) and the other was carried out in the UK (Jackson, 2015). In their research, Bolden, Barmby and Harries (2013) investigated the application of a representational approach in order to develop the trainees' understanding of mathematics, SK competence and confidence in teaching mathematics. Their objectives were:

> 1) To measure any change in pre-service teachers' attitudes towards their SK in mathematics, and also towards teaching the subject.
> 2) To gain some qualitative insight into whether the input incorporating representations might impact on teacher attitudes (p74).

The main study participants were a cohort of 77 trainees at a PGCE course while, further 69 trainees participated were the first-year trainees of a three-year undergraduate trainees. The authors clearly explain the similarities and the differences of the groups and take appropriate measures to ensure the internal validity and reliability. Same tutors delivered the same mathematical topics to both cohorts in lecture- seminar structure. The only difference was that the tutors applied greater emphasis to

mathematical representations with the main study group. At the end of the research, Bolden, Barmby and Harries (2013) found that the main study trainees' attitudes towards both studying and teaching mathematics significantly improved. To further understand the reasons behind this, the authors also examined the trainees' reflections on their learning during the course and found out that value of discussion (71%) was the most common response followed by visual representations (62%). The authors explain that sole increase in the variety of representations would not be enough to improve the trainees' attitudes towards learning and teaching of mathematics. And that the teachers must understand the connections between the range of the representations as well as understanding the connections between the visual representations, symbolic representations, and algorithms. They argue that **discussions** play a vital role in developing these *connections* between the range of representations, and that would explain their findings. However, it is important to note that, the representational approach did not have similar impact on pre-service teachers' knowledge in fractions. This is identified by the authors as an area of common difficulty faced by student teachers and therefore further research is needed.

In the second study in this category, Jackson (2015) investigated the primary ITT trainees' range of perceptions of mathematics. In this phenomenographic study, 37 trainees took part at outset of ITT. The author carried out semi-structured and open-ended interviews and the collective interview data was amalgamated. In the analysis of the interviews, four different categories were identified to describe the perceptions held by student primary teachers; 1) Knowledge learnt from an external relationship, 2) Knowledge learnt from an internal relationship, 3) Understanding learnt from an internal relationship and 4) Understanding taught through perspective of an internal relationship. The first two categories evidence of instrumental learning and negative experiences faced by the trainees. On the other hand, the following 2 categories evidence that there is also a positive attitude toward mathematics among primary student teachers.

C) Examining Cultural Comparison

Two studies (Xenofontos and Andrews, 2012; Dreher, Kuntze and Lerman, 2015) examined the cultural differences in preservice teachers' views and beliefs on some aspects of mathematics teaching at the primary school level. In their small-scale study carried in 2012 between Cyprus and England, Xenofontos and Andrews compared the beliefs of prospective teachers about problem-solving. The volunteering participants were the first-year undergraduate primary education trainees; 14 from England and 13 from Cyprus. The researchers adopted an exploratory approach to their narrative research. The participants had semi-structured interviews in the first week of the course lasting no more than 35 minutes. The limitation of the study is the representation of the student teachers in both countries as the participants are a small number of volunteers.

The paper reports on the first three of 8 themes that emerged: 1) nature of mathematical problems, 2) nature of mathematical problem solving (MPS) and 3) the expert problem solver. 1) While Cypriot trainees thought the problems were in a verbal context that need to be analysed by the solver, the English trainees did not mention words and described problems as a number involved task. 2) In terms of beliefs about the MPS, although different from each other, both cohorts described it as a process. For example, Cypriot trainees discussed a process of reading, understanding, collecting the data and analysing, whereas; the English trainees thought the process as a reduction or simplification. Interestingly, they found that the English trainees saw the problem-solving as something undertaken once new concepts and procedures were taught. This was the practice of the previous curriculum where the teachers taught the procedures at the start of the week and then on Fridays had problem solving activity to apply the skills taught. This is identified as *teaching for problem solving* (Van de Walle, Karp and Bay- Williams, 2015). 3) Another important finding of the study was that while the Cypriot trainees emphasised understanding, discovering and cognition as the expert problem solver, the English trainees prioritised recalling facts and memorising. The authors argue that this belief may

underpin the English education system - founded on the traditional route memorisation rule rather than understanding the concept. This study's findings suggest that trainees had culturally effected beliefs about mathematical problems and problem- solving and the authors argue that these differences should be considered when preparing the ITT curricula.

Another comparative study was carried out by Dreher, Kuntze and Lerman, in 2015, focusing on the views of English and German preservice teachers about the use of multiple representations when teaching mathematics at primary classrooms. The participants of the study were 139 English and 219 German preservice teachers, and they took a questionnaire before they started their course at university.

In the questionnaire, regarding the views on the importance of using multiple representations for teaching fractions, there were four scales: 1) necessity for mathematical understanding, 2) learning types and input challenges, 3) motivation and interest and 4) supporting remembering. Analysing the results, the authors found no significant differences except for the last scale; 'the German preservice teachers attributed a higher significance to the contribution of multiple representations to remembering mathematical facts than did their English counterparts' (p 374). An important finding of this study is that, both groups of trainees attributed less importance to the role of *mathematical understanding* multiple representations have, compared to the other three reasons highlighted above. The authors argue that this demonstrates the importance of using the multiple representations with a purpose. They draw the conclusion that 'awareness of the crucial role of multiple representations and their connections for conceptual understanding of mathematics should be seen as a key element in the development of pedagogical content knowledge' to support the preservice teachers (p 379).

Discussion and Conclusion

There is a new expectation from the ITT providers regarding the trainee's mathematics subject knowledge standards. Considering this change, the purpose of this research was to explore the current evidence in the literature related to the competence and confidence of the primary ITT trainees in mathematics teaching in the UK. Despite using six databases in a timescale of 10 years, only a very limited amount of peer-reviewed research articles were identified that provided findings to address this study's question. This highlights the need for conducting and disseminating current research into the matter by the ITT providers. There is a scope for the ITT providers to address the trainees' mathematics subject knowledge competence and confidence levels. Additionally, while the synthesised research is 5 to 10 years old, their findings are important and further research can be developed from them. The strategies which proved to have an impact and supported the trainees, could be utilised by the ITT providers when meeting the new responsibility of developing the trainees' subject knowledge to the expected standards.

Firstly, there is some evidence that some student teachers lack the competence and confidence in mathematics both in terms of how they could learn and how they could teach (Bolden, Barmby and Harries, 2013). Teachers' own subject knowledge in mathematics as well as their own mindset about learning the subject can have considerable impact on their ability to teach effectively (Boaler, 2016) and for ITT trainees just primary mathematics 'curriculum coverage' would not be enough (Murray and Passy, 2014).While some trainees have more positive experience, understanding and attitude towards mathematics, some do not and need further development in both their SK and attitude towards the subject (Jackson, 2015). On the other hand, there is evidence that use of representational approaches, coupled with discussions about the connections between them, can have a significant impact on student teachers' attitude towards both their own learning as well as teaching mathematics (Bolden, Barmby and Harries, 2013).

In contrast, there is also evidence that high level of mathematics studied before entering the primary ITT programmes does not guarantee high level mathematics content knowledge and confidence to teach it at primary school (Henderson, 2012; Day and McKechan, 2015). However, both these studies were conducted in Scotland and the qualifications required for ITT programmes in England are different (DfE, 2020). Important to note though, a much earlier study carried out in England by Askew et al. (1997) also found out that higher qualifications did not mean highly effective SK and confidence in primary mathematics teaching.

Finally, there is some evidence from the cultural comparative studies that the trainees bring views that they gained at school based on their own learning and curricula (Xenofontos and Andrews, 2012) though their views are not consistent yet (Dreher, Kuntze and Lerman, 2015). This suggests, tackling student teachers' SK issue may have to start from the curriculum they are exposed to at school as young learners. There was also evidence that the English teachers paid more attention to procedural understanding for both problem solving and use of multiple representations. Again, this finding suggests that improvement in the primary and secondary school mathematics curriculum in terms of conceptual understanding, could assist with improving the student teachers' mathematics knowledge. The current conceptual curriculum at primary schools has been implemented only in the last six years (DfE, 2014) and for the next several years, the prospective ITT trainees will have come through the procedural curriculum at least in parts. This increases the need for further support by the ITT providers to develop the trainees' conceptual understanding of mathematics.

Methodological considerations

This study reviewed the literature about the primary ITT trainees' competence and confidence in teaching of mathematics subject to primary school children in the UK. As with every research, it has limitations (McGregor, 2018) and, therefore, the findings of this literature review must be interpreted considering its limitations. The review scope covers the studies carried out in the UK between 2010 to 2020. Six databases were utilised in this study and therefore significant research published on other databases may have been missed. Furthermore, the study is limited to the literature about the trainees studying at the ITT programmes at Higher Education (HE) and does not include the trainees being trained through other teacher training routes, such as School- Centred ITT (SCITTs) or Employment-Based routes (EBITTs) i.e., TeachFirst, Graduate Teacher Programme (GTP), Overseas Trained Teacher Programme (OTTP) (Whitty, 2014; Whiting et al., 2018). And finally, while the researcher employed a systematic approach to avoid bias, the possibility of missing relevant study during the screening or appraisal process cannot be entirely dismissed.

Implications for Further Research

Despite the limitations, the findings of this study shed valuable insight into the needs of the ITT regarding the research in trainees' mathematics subject knowledge and confidence in the UK. This study found out that only limited amount of research has been carried out in this area and the most recent ones are five years old. There seems to be a lack of recent research in this area in the UK, especially in England. To meet this need and to assist the ITT providers' new responsibility for meeting the subject knowledge requirements, a case study has been undertaken at the researcher's university to compare the trainee's confidence and competence in mathematic teaching to English teaching, and some interventions have been implemented to address the issues arising. The findings of this research will be the subject of a further paper. Finally, further studies should be carried out to extend the research question to the trainees who are following other teacher training routes.

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