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Pedagogical Content Knowledge (PCK) Ability of Mathematics Teachers According to Certification and Non-Certification Criteria to Improve Competence in Learning in the New Normal Era

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Abstract

This descriptive qualitative study aims to describe the Pedagogical Content Knowledge (PCK) of certified and non-certified mathematics teachers in the Knowledge Content and Student (KCS) component of the fractional number of the part-whole written settings. The research subjects were teachers at SMP Negeri 04 Makassar, consisting of 1 certified mathematics teacher and one noncertified mathematics teacher. Data was collected using a student's conceptual understanding test and vignette. The results showed differences in the KCS component of certified and non-certified mathematics teachers concerning fractions of the concept of part-whole written settings. Certified math teachers are better than non-certified math teachers. The difference in KCS can be seen in the indicators of the two (2) subcomponents of KCS, namely, 1) The subjects of certified mathematics teachers have overall PCK KCS components in subcomponents a) teacher knowledge about students' ideas regarding the topic of the whole number of fractions and subcomponents b) Teacher knowledge about conception and students' misconceptions on the topic of the section overall fractions, 2) Non-certified mathematics teacher subjects have overall PCK KCS components but are limited to subcomponents a) teacher knowledge of students' ideas regarding the topic of the whole fractional number section and subcomponent b) Teacher knowledge about students' conceptions and misconceptions on section whole number fraction.

Keywords: Pedagogical Content Knowledge (PCK); Knowledge Content and Student (KCS); Certified Mathematics Teacher; Non-certified Mathematics Teacher.

INTRODUCTION

Education is an essential part of the development and progress of the nation. Teachers are an important part of the learning process as a support for educational success. Based on the Government Regulation of the Republic of Indonesia (PPRI) number 19 of 2017 concerning amendments to government regulation number 74 of 2008 concerning teachers article 1, "Teachers are professional education with the main task of educating, teaching, guiding, directing, training, assessing, evaluating, students in early childhood education pathways of formal education, basic education, and secondary education." Therefore, teachers must have a deep understanding and knowledge related to the material to teach students. Based on Law number 14 of 2005 concerning Teachers and Lecturers, article 10 paragraph (1) states, "Teacher competencies as referred to in Article 8 include pedagogical competence,



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personality competence, social competence, and professional competence obtained through professional education".

One of the competencies of teachers that can support the learning process is pedagogical competence and professional competence. The combination of pedagogic competence and professional competence is known as Pedagogical Content Knowledge (PCK). Ball, Thames, & Phelps (2008) propose a PCK framework. The framework describes PCK in three types of knowledge, namely: (a) Teacher knowledge of content and students (KCS)), (b) Teacher knowledge of content and teaching (KCT)), (c) Teacher knowledge of content and curriculum (KCC)), (c) Teacher knowledge of content and curriculum (KCC)). Usman (2013), of the three domains, KCS and KCT, are the key domains of teachers' knowledge.

According to Phelps et al. (2020), teacher is expected to know the content charged to them to help their students learn. Ward, Tsuda, Dervent, & Devrilmez (2017) state that the basis of understanding and quality teaching is the teacher's understanding of the content they teach. Nur'aini & Pagiling (2020) teachers are a vital component in learning, especially in mathematics learning which has a crucial role in facilitating students to think. A teacher must master the mathematics content and know how to transfer lessons so students can easily understand them. Barut, Wijaya, & Retnawati (2020) state that content knowledge includes mastery of facts, concepts, procedures, and mathematical rules.

Usman et al. (2018), the subject matter to be presented must be mastered with earnest breadth and depth by the teacher so that the teacher can organize it appropriately in terms of its complexity (from the easiest to the hardest, from the concrete to the complex). Mulyasa & Mukhlis, quoted in Fitriyah, Putro, & Widiyaningtyas (2018), state that pedagogical competence is the teacher's ability to manage student learning which at least includes the following: (1) understanding (2) understanding of students; (3) development of a curriculum or syllabus; (4) the implementation of educational and dialogical learning; (5) utilization of learning technology; (6) learning evaluation; and (7) learner development. Usman et al. (2018) pedagogy mean ways that can be done to help students learn and solve scientific problems.

Aminah, quoted in Falachi, Kartana, & Utami (2017), states that a professional teacher not only can master good material but also must know how to teach appropriately. Dazrullisa (2017) Pedagogical Content Knowledge (PCK) combines unique content and pedagogic knowledge abilities that are formed over time and increase teaching experience. A good PCK is synonymous with a professional teacher. Usman et al. (2018) PCK is an idea rooted in the belief that teaching requires more than just providing subject content knowledge to students, and students learning not just by absorbing information but more than its application.

Budayasa & Juniati (2018) Pedagogical Content Knowledge (PCK) is a kind of special knowledge as essential knowledge for teachers that includes the connection of various knowledge and representation skills, analogies, examples, and demonstrations of material so that students can understand it. Chick & Beswick (2017) PCK is recognized as a center for explaining specific knowledge needed exclusively by teachers, so the development of PCK in mathematics teachers is a significant concern. Cueto, Leon, Sorto & Miranda (2017) PCK is an emerging field of research, and it is considered a critical condition of the instructional qualities of teachers. Jatisunda & Kania (2020) Pedagogical Content Knowledge (PCK) is teacher knowledge and beliefs about various aspects such as pedagogics, students, subject matter, and curriculum. Nur'aini & Pagiling (2020). A teacher must master the mathematics content taught and know how to transfer lessons so students can understand them easily. Barut, Wijaya, & Retnawati (2020) showed a significant positive correlation between the PCK level of mathematics teachers and student mathematics learning achievement.

Rohimah, Hasan, & Sulaiman (2018) state that teacher certification needs to be seen besides teacher PCK. In Indonesia, certification was implemented in 2007. The implementation of certification given by teachers is a government commitment as an implementation of the mandate of Law Number 14 of 2005. Teachers, for their professionalism, carry out various ways to become an educator, one of which is by achieving a teacher certification program. Certification is the process of providing educator certificates to teachers and lecturers, and educator certification is used as formal proof of recognition of teachers and lecturers as professionals.



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Utomo, Sulasmono, & Mawardi (2019) state that teachers who have been certified must have creative abilities and good teaching performance in carrying out their daily duties as teachers and educators. Koswara & Rasto (2016), the competence and performance of teachers who have followed professional certification are better than teachers who have not followed professional certification. Yuniartikasari & Mampouw (2019), the subject of certification teachers, can know students' difficulties when learning opportunity materials take place. In understanding the two subjects regarding the curriculum, it can be concluded that both subjects can know the curriculum reference standards that apply in schools at this time.

The results of observations that researchers have made of one of the teachers of UPT SPF SMP Negeri 4 Makassar found that there were six teachers of mathematics subjects. Five mathematics teachers have been certified (certified), and one mathematics teacher has not been certified (non-certification). The observations of one of the mathematics teachers showed that there are still students who still experience misconceptions (misconceptions), especially in fractional numbers. An example of a misconception obtained by one of the teachers whom students have observed has not been able to distinguish between images with the same area and broad images that are not the same. As in a square cut vertically, the square is cut not the same area but shaded 1 of 5 parts, but some students still need

to be corrected in answering, assuming that the arrangement of the square is a fractional number⁵ when this is not the case. Based on these problems, this is one of the components of PCK, namely content and student knowledge or KCS, how the teacher can explain or understand the student in misconceptions. Another observation result is that each teacher has different characteristics, in this case, namely the application of learning strategies and mastery of the material or content taught. Especially in the learning system during the current pandemic, each teacher uses their learning strategies based on effectiveness in learning, especially in online mathematics learning.

Pertanyaan penelitian ini diformulasi sebagai berikut, Bagaimana analisis profil pengetahuan pedagogik konten guru matematika sertifikasi dan nonsertifikasi komponen pengetahuan guru tentang konten dan siswa atau KCS di SMP Negeri 04 Makassar. Penelitian ini bertujuan untuk mendeskripsikan profil Pedagogical Content Knowledge (PCK) guru matematika sertifikasi dan nonsertifikasi dengan komponen Knowledge of Content and Student (KCS) terhadap bilangan pecahan konsep relasi bagian-keseluruhan setting tertulis di SMP Negeri 04 Makassar.

METHOD

This type of research is qualitative research with a descriptive approach. This study describes the PCK profile of mathematics teachers of KCS components on fractional numbers of the concept of part-whole relations. This research was carried out in Makassar City, the subject of this study was a mathematics teacher at SMP Negeri 04 Makassar who had been certified (certification) and had not been certified (non-certification). The focus of this study is the profile of pedagogical content knowledge (PCK) ability of mathematics teachers in the Knowledge of Content and Students (KCS) component based on teachers who have been certified (certification) and teachers who have not been certified (non-certification) at SMP Negeri 04 Makassar.

The subject in this study is a certified mathematics teacher who must meet relatively the same criteria as the subject of a mathematics teacher who has not been certified to avoid biased data. The criteria met are 1) Educational Qualifications from the same university, 2) Have relatively the same teaching experience. 3) Same gender, 4) Certified and uncertified math teachers are willing to work together and provide the necessary information.

The data collection technique in this study used three stages: providing a vignette-forming student concept understanding test, vignette-based interviews for teachers, and conducting interviews. The instruments in this study are the researchers as the primary instruments equipped with supporting instruments, namely, vignette-forming student concept understanding test sheets, vignette-based interview guidelines that experts have validated, and field notes. This study used data analysis while in



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the field Model Miles, Huberman, and Saldana, namely 1) Data Condensation, 2) Data Display (data presentation), 3) Conclusion Drawing / Verification.

RESULT AND DISCUSSION

Results

Subject and Characteristics of the Research Subject

Table 1. List of Research Subjects

No.	Subject	Category	
1.	Subject-	Certified Teacher Mathematics	
	01		
2.	Subject-	Non-certified Mathematics Teacher	
	02		

Based on the subject criteria, each is S2 qualified and comes from the same university. The work period of the two subjects at the time of determination as research subjects is relatively the same, namely for mathematics teachers who have been certified for 17 years and mathematics teachers who are non-certified for ten years and have criteria with the same gender. Some of the essential characteristics that were successfully collected from both subjects of the study are presented in Table 2.

	Karakteristik Subjek				
Subject	Gender	Teaching Experience	Higher Education Qualifications	Position	Education/Workshops That Have Been Attended
Subject- 01	Male	17 Year	 S1 Mathematics Education (2003) UNM S2 Mathematics Education UNM 	Pembina Tk. I/ IV.a	 Workshop Bedah SKL Pendidikan dan Soal-Soal AKM Workshop Pembuatan Media Pembelajaran
Subject- 02	Male	10 Year	 S1 Mathematics Education (2011) UVRI S2 Mathematics Education UNM 	Penata/ III.c	 Pelatihan Pembuatan RPP K13 PKP CGP

Table 2. Characteristics of the Research Subject

The staffing status of the two subjects, the certified mathematics teacher is a teacher who has the status of a civil servant (PNS) at SMP Negeri 04 Makassar and is a member of the Makassar City PGRI, while the non-certified mathematics teacher is also a teacher with the status of a Civil Servant (PNS).

KCS Mathematics Teachers Based on Certification and Non-Certification

PCK analysis of the KCS component of Mathematics Teachers Based on Certification and Non-Certification on fractional numbers of the concept of part-whole relations consisting of Area Models, Measurement Models, and Discrete Set Models at SMP Negeri 04 Makassar below.



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Table 3.	PCK Map of KCS Components of Mathematics Teachers Based	on Certification and
	Non-Certification	

Math Teacher	Component Indicators Knowledge of Content and Student (KCS)	Fractional Numbers The Concept of a <i>Part-Whole</i> Relation		
Certified	Associating Prerequisite Knowledge and Using	1) KCS-Area Model: Have		
Teacher	Concepts or Definitions	2) KCS-Measurement Model:		
Mathematics	1) The subject explains the prerequisites of the	Have		
(Subject-01)	concept of fractional numbers by	3) KCS-Set Model: Have		
	understanding the concept of dividing equally			
	2) The subject explains the concept or definition			
	of a fractional number by explaining the			
	concept of the whole; that is, it must pay			
	attention to the whole of the object to be used			
	3) The subject explains the concept of fractional			
	numbers in dividing equally on an object			
	4) The subject describes an illustration that gives			
	an excuse for an object			
	Using Concrete Models	1) KCS- Area Model: Have but		
	1) The subject uses concrete examples of the	are limited		
	concept of <i>part-whole</i> relations consisting of an	2) KCS- Measurement Model:		
	Area model, a measurement model, and a	Have		
	discrete set model.	3) KCS- Set Model: Have but		
	2) The subject describes the specifics of the	limited		
	results of a concrete example			
	3) The subject has not noticed the example that			
	the concept of fractional numbers (Area model			
	and set model) is not only on a small, large size			
	in an object, but the size of the weight of an			
	object must also be considered			
	4) The subject explains to the measurement model			
	that the distance in determining the concrete			
	example must have the same distance measure			
	Identifying Conceptions and Misconceptions	1) KCS-Area Model: Have		
	1) The subject identified a misconception of	2) KCS-Measurement Model:		
	students who considered that the area of each	Have		
	2) The subject identifies conception by combining	3) KCS-Set Model: Have		
	2) The subject identifies conception by explaining the ensure to the conception by explaining			
	relation consisting of an area model.			
	relation consisting of an area model, a			
	2) The subject explains that fractional numbers			
	5) The subject explains that fractional numbers			
	denominators are mixed fractions			
	(1) The subject explains the conception with the			
	4) The subject explains the conception with the			
	Using Representations in Explaining Conceptions	1) KCS-Area Model: Have		
	and Misconceptions	2) KCS-Measurement Model		
	1) The subject gives questions to the student to	Ly KCS-Weasurement Would: Have		
	ascertain the presence of misconceptions	3) KCS-Set Model: Have		
	2) The subject uses examples or representations of	Sy ited bet widden. Have		



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Math Teacher	Component Indicators Knowledge of Content and Student (KCS)	Fractional Numbers The Concept of a <i>Part-Whole</i> Relation
	 the concept of part-whole relations consisting of area models, measurement models, and discrete set models. 3) The subject describes an example of a fractional number descriptively 4) The subject understands the concept by giving examples or representations. 	
Non contified	A appricting Drangwights Knowledge and Using	1) KCS Area Madali Hava but
Non-certified	Associating Prerequisite Knowledge and Using	1) KCS-Area Model: Have but
Teacher	1) The subject explains the prerequisites of the	2) KCS Measurement Model:
$(Subject_02)$	concept of fractional numbers by	2) KCS-Measurement Model. Have but limited
(Subject-02)	understanding the concept of dividing equally	3) KCS-Set Model: Have but
	on the concept of <i>part-whole</i> relations	limited
	2) The subject explains the concept or definition	
	of fractional numbers in measurement models	
	and set models, while area models are still	
	11mited 2) The subject explains the concent of fractional	
	5) The subject explains the concept of fractional	
	finite	
	A) The subject explains illustrations that give	
	excuses to objects on the area model, while the	
	measurement model and set model explain but	
	are limited	
	Using Concrete Models	1) KCS-Area Model: Have but
	1) The subject uses concrete examples of the	limited
	concept of part-whole relations consisting of an	2) KCS-Measurement Model:
	area model, a measurement model, and a	Have
	discrete set model.	3) KCS-Set Model: Have but
	2) The subject explains that the distance in	limited
	determining the concrete example must have	
	the same distance size in the measurement	
	model.	
	3) The subject has yet to notice the example that	
	the concept of fractional numbers (area model	
	and set model) is not only on a small, large size	
	in an object, but the size of the weight of an	
	object must also be considered.	1) VCC Area Madal Harrisher
	Identifying Conceptions and Misconceptions	1) KCS-Area Model: Have but
	1) The subject identified a misconception of students who considered that the area of each	2) KCS Massurament Model:
	niece on the object had the same area	Have but limited
	2) The subject identifies conception by	3) KCS-Set Model: Have but
	explaining the answer to the problem of the	limited
	concept of the area model and the set model	minted
	while the measurement model is still limited.	
	3) The subject explains that fractional numbers	
	whose numerators are more significant than	
	denominators are mixed fractions	



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Math Teacher		Component Indicators Knowledge of Content and Student (KCS)	Fractional Numbers The Concept of a <i>Part-Whole</i> Relation
	4)	The subject has yet to explicitly explain that	
		fractional numbers whose denominator value	
		is not a factor of the numerator.	
	5)	The subject explains conception by using	
		examples of measurement models and set	
		models, while model areas are still limited.	
	Us	ing Representations in Explaining Conceptions	1) KCS-Area Model: Have but
	an	d Misconceptions	limited
	1)	The subject gives questions to the student to	2) KCS-Measurement Model:
		ascertain the presence of misconceptions.	Have but limited
	2)	The subject uses examples or representations	3) KCS-Set Model: Have but
		of the concept of part-whole relations	limited
		consisting of area, measurement, and set	
		models.	
	3)	The subject describes an example of a	
		fractional but finite number descriptively.	
	4)	The subject understands conception by giving	
	,	examples or representations but is limited.	

Discussion

1. Profile Description *Knowledge of Content and Student* (KCS) Certified Mathematics Teacher Subject-01 on fractional numbers and the concept of *part-whole* relation.

The subject of the certification mathematics teacher tends to have an overall KCS on the fractional number of the concept of a *part-whole* relation consisting of an area model, a measurement model, and a discrete set model. This can be seen in relating prerequisite knowledge and using concepts or definitions. Using a concrete model, KCS is owned as a whole but is limited to fractional numbers; in the concept of *whole-part* relation, KCS is owned but limited, i.e., to the area model and the set model, while in the measurement model, it is owned as a whole. Identifying conceptions and misconceptions, KCS has, as a whole, the fractional numbers of the *whole-part* relation consisting of an area model, a measurement model, and a discrete set model. Using representations in explaining conceptions and misconceptions and misconceptions, kCS has, as a whole, the fractional numbers of the concept of *whole-part* relations.

Mathematics teachers who have been certified show they can master the learning material or have good content knowledge. This follows the results of research by Rozaili & Anwar (2020). The performance of teachers who have been certified is good in learning management, but it still needs to be improved so that they can achieve better performance in the future. Yuniartikasari & Mampouw (2019) mathematics teachers who have been certified are able to understand the material and formulate learning objectives by connecting in daily life activities or utilizing the surrounding environment in explaining the material in mathematics learning. The study's results align with this study that mathematics teachers who have been certified master the material as a whole and can relate the material to daily life according to the KCS indicator.

Zulfitri, Setiawati, & Ismaini (2019) teachers who have been certified can select and adapt teaching materials and plan, develop, and actualize a productive teaching and learning process. The study's results follow the findings that teachers who have been certified meet the planning stage that relates prerequisite knowledge before entering the material taught. The stage of developing and actualizing also enters the KCS indicators on the use of representations in explaining the concept of the material.



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Ardana, Yudana, & Divayana (2020) state that teacher certification is part of improving the quality of a teacher. Therefore, with the certification, it is hoped that teachers can become professional educators. The study's results are also in accordance with the findings that mathematics teachers who have been certified are professional teachers who master the material, especially in fractional numbers. Ahyanuardi, Hambali, & Krismadinata (2018) guru who have certified dapat menyampaikan materi pembelajar an dengan baik dan efektif. This study's results prove that certified mathematics teachers master the material of fractional numbers or content knowledge (KCS).

Lestari, Juniati, & Suwarsono (2019) KCS has a sufficient role for prospective mathematics teachers in designing learning. Students mastery of knowledge of the prerequisite material affects the depth of content. The study's results are in accordance with this study related to the teacher's KCS, which is related to students' knowledge of prerequisite materials and student difficulties. Borke (2021) states that teachers need KCS to help their students resolve misconceptions. The development of KCS teachers is recommended that they attend education or training, while in this study, it was found that mathematics teachers who have been certified have KCS as a whole, especially in fractional numbers. Stylianides & Delaney (2018) emphasized that teaching good mathematics must have KCS; this follows the findings in this study which explains that mathematics teachers who have been certified or have received special training (certification) have KCS as a whole. Martínez et al. (2020) KCS teachers exist in a second cycle focused on content knowledge, addressing students' general misconceptions about randomness, with teachers being asked to identify the underlying reasons. The study's results align with this study in that to find out the KCS of mathematics teachers, teachers are asked to respond to the results of the work of students who experience misconceptions and what is the basis of the results of their work.

2. Profile description of *Knowledge of Content and Student* (KCS) Profile non-certified Mathematics Teacher Subject-02 on Fractional Numbers and the concept of *part-whole* relation.

Non-certified mathematics teacher subjects tend to have *whole-part* but limited KCS to fractional numbers, the concept of a part-whole relation consisting of an area model, a measurement model, and a discrete set model. This can be seen in relating prerequisite knowledge and using concepts or definitions; KCS is owned as a whole but is limited to fractional numbers of the concept of the *whole-part* relation. Using a concrete model, KCS is owned as a whole but is limited to fractional numbers, the concept of a *whole-part* of the relationship. Identifying conceptions and misconceptions, KCS is owned as a whole but is limited to fractional numbers of the *whole-part* consisting of an area model, a measurement model, and a set model. Using representations in explaining conceptions and misconceptions and misconcepticate and a set model.

Non-certified math teachers tend to have an overall but limited KCS. This is in line with the research of Putra, Fikri, & Syofiani (2017), teachers who have not been certified or non-certified show low or limited performance, namely in mastering the material, mastering professional teacher training, and mastery of self-adjustment. The limitations described in the study are in accordance with this study, which found that teachers who have not been certified have limited knowledge of the material or content.

Koswara & Rasto (2016) explained that the competence of teachers who have passed certification differs from those who have not been certified. The highest score is in teachers who have been certified have better KCS than mathematics teachers who have not been certified. Farida & Pratiwi (2018) certification teachers are always more innovative in carrying out their duties than teachers who have yet to be certified. The results of Farida & Pratiwi's research align with this study, which found that certified mathematics teachers have better KCS than mathematics teachers have better KCS than mathematics teachers who have not been certified.

Surat (2020) differences in students' mastery of material on fractional numbers in each model, namely the use of the area, measurement, and set models. The study's results align with this study that the



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mastery of material or content in each fractional number model differs. Gozali (2018) has differences in professional competence between certified and non-certified teachers; certification teachers are better than non-certified teachers. The study's results are also in line with this study which found that certified mathematics teachers have KCS as a whole than mathematics teachers who have not been certified. Nurfarida (2018) differences between certified and non-certified teachers in learning, teachers who have been certified are better than teachers who have not been certified. The study's results are also in line with this study that certified mathematics teachers are better than mathematics teachers who have not been certified.

Shuilleabhain (2016) states that during each successive cycle, the teacher anticipates more often, pays attention to, and reflects on the student's mathematical strategy in the teacher's KCS. This has the same meaning in this study contained in the 4 KCS indicators. Lee, Lee, & Park (2016), when prospective teachers focus on the condition or question and its context, they seek to modify it using their KCS, especially the knowledge of misconceptions. The study's results have the same meaning as this, which explains that teachers who use KCS use their knowledge or content knowledge. Kind & Chan (2019) High-quality PCK is not characterized by knowing as many strategies as possible to teach a particular topic, plus all the misconceptions students may have about it, but by knowing when to apply specific strategies in learning. Kind & Chan explained the overall PCK of the teacher, who emphasizing that the teacher must know when to apply specific strategies in learning; the explanation also contains the teacher's KCS in this study, namely how to apply strategies to each student who experiences misconceptions of each material.

The results of this study show that with KCS in mathematics teachers subject-01 certification is better than non-certified mathematics teachers subject-02; it is seen when the certification mathematics teacher has an overall fractional number of the concept of a *whole-part* relationship consisting of an area model, measurement model, and set model while in non-certified mathematics teachers KCS is owned but limited to fractional numbers the concept of *part-whole* relations on all models.

CONCLUSIONS AND SUGGESTIONS

Based on the analysis and discussion results, it can be concluded that the subject has a PCK component of KCS or content knowledge. Students in fractional numbers have the concept of *partwhole* relations consisting of an area model, a measurement model, and a discrete set model through two (2) subcomponents based on the subcomponents of KCS Usman (2013), namely 1) teacher's knowledge of student ideas concerning the topic of the overall part of the fractional number and 2) p the teacher's knowledge of the conception and misconceptions of students on the topic of the *whole-part* of fractional numbers.

The certified mathematics teacher's subject-01 has an overall PCK component of the KCS against the fractional number of the concept of a *part-whole* relation consisting of an area model, a measurement model, and a set model. Subject non-certified mathematics teacher subject-02 has overall PCK components of KCS but is limited. This can be seen in the fractional number model; the KCS owned is still limited to all indicators. Based on the findings of the two subjects, the KCS of mathematics teachers certified in subject-01 is better than the KCS of non-certified mathematics teachers in subject-02.

The results of this study are expected to be a recommendation for teachers, in general, to pay attention to the PCK component of KCS or teacher knowledge of content and students, especially mathematics teachers. As a professional teacher, it is inseparable from the PCK that it must be owned so that teachers are expected to have an overall component in PCK consisting of KCT and KCS. Teacher Certification provides an overview of having a KCS as a whole. However, some parts still need to be owned so that it becomes a consideration to teachers who have not been certified that teacher certification is essential for KCS.



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