The dimensionality of personal beliefs; the investigation of beliefs based on the field study

La dimensionalidad de las creencias personales; la investigación de creencias a partir del estudio de campo

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Abstract
The purpose of this study is to examine whether personal epistemological beliefs are more sensitive to domain study or not. We also examine the relation of this belief with other relevant factors such as parent education, gender, attitude, and academic performance. Two hundred seventy-six students from mathematics education and primary teacher education participated in this study (15 % male and 85% female, mean age = 20.65). A quantitative approach was used in the present study. The finding of this study suggested that certainty of knowledge and attainability of the truth are more specific domains. Mathematics education students hold stronger beliefs about the certainty of knowledge than primary teacher education students, the principle in mathematics is unchanging, and most of the truth in mathematics is already found. In contrast, the beliefs about the justification for knowing and the source of knowledge are more general domains. We found mathematics education students and primary teacher education are equal in their beliefs about the justification for knowing and the source of knowledge. The influence of these beliefs on academic performance is significant. In both field studies, personal epistemological beliefs correlate with attitudes toward academic performance. Both Male and female students in the mathematics education and primary teacher education department are equal in personal epistemological beliefs. This study contributes to improving students' academic performance in higher education.
Keywords: beliefs, attitudes, performance, parent education, gender.

Resumen
El propósito de este estudio era examinar si las creencias epistemológicas personales son más sensibles al estudio del dominio o no. También examinamos la relación de esta creencia con otros factores relevantes como la educación de los padres, el género, la actitud y el rendimiento académico. Participaron en este estudio 276 estudiantes de educación matemática y de magisterio de primaria (15 % hombres y 85 % mujeres, edad media = 20,65). En el presente estudio se utilizó un enfoque cuantitativo. El hallazgo de este estudio sugirió que la certeza del conocimiento y la posibilidad de alcanzar la verdad son dominios más específicos. Los estudiantes de educación matemática tienen creencias más sólidas sobre la certeza del conocimiento

que los estudiantes de formación docente primaria, el principio de las matemáticas no cambia y la mayor parte de la verdad en las matemáticas ya se encuentra. Por el contrario, las creencias sobre la justificación del conocimiento y la fuente del conocimiento son dominios más generales. Encontramos que los estudiantes de educación matemática y la formación de maestros de primaria son iguales en las creencias sobre la justificación del conocimiento y la fuente del conocimiento. La influencia de estas creencias en el rendimiento académico es significativa. En ambos estudios de campo, las creencias epistemológicas personales se correlacionan con las actitudes hacia el rendimiento académico. Tanto los estudiantes masculinos como femeninos en el departamento de educación matemática y el departamento de formación de maestros de primaria son iguales en creencias epistemológicas personales. Este estudio contribuye a mejorar el rendimiento académico de los estudiantes de educación superior.
Palabras clave: creencias, actitudes, desempeño, educación de los padres, género.

1. Introduction

The growth of digital technology in the 21st century changed many things in various aspects (Danesi, 2016; Hidalgo-Cajo & Gisbert-Cervera, 2021; Wang Ng, 2018). In the educational context, the integration of digital technology has been conducted massively and affected the changes in teacher-student interaction patterns (Danesi, 2016). In social life, modern jobs require new skills beyond cognitive ability because digital technology has eliminated human roles in some aspects (NRC, 2011). OECD has conceptualized 21st-century skills and competencies for a learner. These are cognitive, intrapersonal, and interpersonal skills (Geisinger, 2016; NRC, 2011). The most important thing that should be known is how to build these individual skills. Students' conceptions, the extent to which learner believes in knowledge, make meaning, and justify their knowledge, have been known plays a key role in determining their performance in various aspect (Buehl et al., 2002; Buehl & Alexander, 2001; Hidayatullah & Csikos, 2022; Hofer, 2000) such as cognitive, intrapersonal, and interpersonal skill. For instance, in cognitive skills, the ways students solve non-routine tasks are governed by their beliefs about word problems (Garofalo, 1989; Greer et al., 2002; Reusser & Stebler, 1997; Verschaffel et al., 2020). However, the previous investigation regarding personal epistemological beliefs has left one problematic issue that should be clarified: that is the sensitivity of these beliefs in other domains or field studies.

In the literature review, there has been controversy among researchers on whether beliefs system are more general or specific domains. One group of researchers perceive personal epistemological beliefs across domains or more general domains. Whereas other researchers viewed that personal epistemological beliefs are sensitive to field study or more specific domain (Limón (2006). The concept of beliefs as a domain-general was driven by Schommer's epistemological beliefs that consisted of four dimensions; fixed ability, simple knowledge, quick learning, and specific knowledge (Clarebout et al., 2001; Schommer-Aikins, 2004). The authors also proved that individual general beliefs are linked with beliefs about problems solving, reading ability, problem-solving ability, and grade point average (GPA). In other words, the authors successfully showed that general beliefs mirror students' cognition and specific beliefs, such as problem-solving beliefs.

Other empirical research suggested that beliefs about knowledge are more specific domain. Through empirical study, Hofer & Pintrich (1997) investigated and compared students' epistemological beliefs based on the different domains. The researchers proposed discipline-focused epistemological beliefs (DFEQ) as the theoretical framework of personal epistemological beliefs to prove the specificity of domain beliefs. DFEQ consists of four dimensions: beliefs about the certainty of knowledge, beliefs about the justification of knowledge, beliefs about the Source of knowledge, and beliefs about the attainment of the truth. This empirical study compared two groups of students: psychology and science. This study also examined whether their beliefs relate to Schommer's epistemological beliefs (Hart, 2005; Hofer, 2000; Muis et al., 2006). The author found that the influence of disciplinary differences was very significant, indicating that students in different domains hold different beliefs about knowledge. Students in science hold stronger beliefs that knowledge is unchanging than students in psychology (Hofer & Pintrich, 1997).

Although prior studies (Hofer, 2000; Hofer & Pintrich, 1997; Op 't Eynde et al., 2006) have shown that beliefs about knowledge are related to academic performance, and Hofer (2000) has shown that personal epistemological beliefs are more sensitive to field study, the dimensionality of these beliefs in the different field is still unexplored questions. A clearer understanding of whether the sensitivity of personal epistemology also exists in other domains is necessary to provide a new explanation of the role of these beliefs on academic performance and other aspects. Little is known whether personal epistemological beliefs based on the field are associated with attitudes and academic performances.

This investigation aims to explore whether personal epistemological beliefs are more specific domains or more general domains. This study also explores whether these personal epistemological beliefs are associated with attitudes and influence academic performance in the field study. Pehkonen & Pietilä (2003) suggested that beliefs in mathematics could pertain to subjective knowledge, while attitudes can pertain to an emotional aspect. Caprara et al. (2003) showed through their empirical investigation that beliefs determine personal attitudes. The stronger students hold their beliefs, their attitudes toward an object are more positive. Moreover, we investigated another factor (e.g., gender and parents' educational level) relevant to exploring students' epistemological beliefs in the Indonesian context. Therefore, the research questions below guided our investigations:

1. Through the empirical investigation of personal epistemological beliefs in the different field studies, are the students' beliefs more specific or general domains?
2. Do personal epistemological beliefs influence students' academic performance?
3. Do personal epistemological beliefs correlate with students' attitudes toward the academic context?
4. Were there any differences between male and female students in personal epistemological beliefs?
5. Do parents' educational backgrounds generate different personal epistemological beliefs?

2. Theoretical framework

2.1 Beliefs definitions.

Beliefs are very difficult to define precisely. Because the differences in the academic background sometimes generate different definitions and conceptualizations. In the literature review, the term beliefs time was written with other words such as ideology, religion, attitudes, ideas, thinking, value, and perceptions. There are wide definitions of beliefs based on the domain of field study. The most confusing thing is that sometimes authors do not differentiate between self-efficacy beliefs and beliefs about a certain object. However, Pajares (1992), research about beliefs is merit in various domains, such as mathematics, anthropology, education, physiology, science, medicine, law, sociology, and business. Although there is no consensus among researchers regarding the definitions of beliefs, some definitions can be used to conceptualize the structure.

Some researchers, such as Goldin (2002), said that beliefs as part of the cooperative or affective configuration that constitute some attributes such as value. The consequence of these definitions may affect the inclusion of some values as part of belief constructions in certain domains. Besides, based on these definitions, perceive beliefs as an affective domain. While other researchers, such as Di Martino & Zan (2011), perceive those beliefs as not having an affective or cognitive aspect. But, belief positions between the two may also consist of affective and cognitive aspects. Hestener & Sumpter (2018) define belief as a person's understanding that influences how they conceptualize and involve mathematics in all behavior, actions, and thoughts. Thus, beliefs are the roots of activities and ideas involving mathematics. In other words, what anyone does daily reflects their beliefs about an object or something. For example, we can trace one’s beliefs based on behavior patterns during problem-solving learning. We also can identify teacher beliefs based on their style and strategies during teaching and learning in the class.

Other researchers, such as Rokeach (1968) and Grootenboer & Marshman (2016), defined beliefs as personal assumptions of truth that act as a predisposition to action. This definition is also in line with the previous definitions by Hestener & Sumpter (2018). Therefore, in the educational context, what a person perceives about an object would generate the consequence of the activity, although it does need justification. Because they believe that what they do in their activity is true. Bobis et al.(2016) define beliefs as conceptions about an object, ideology of personal, a world of view, and values about their purposes and their daily practices. What people perceive about themselves in environmental situations imply to the extent to which they read and evaluate a phenomenon. An important definition of beliefs is proposed by Dewey (1993), who said that beliefs as something outside the individual that be tested according to their perceptions. One’s beliefs generate statements about facts and legal principles. These definitions indicate that beliefs definitions depend on the current domains and mention that there is no single definition of beliefs correct or fit. All of them rely on the situation and domains.

2.3 Personal epistemological beliefs

According to Hofer (2000), the core of the personal beliefs system is the nature of knowledge (how someone deals with beliefs and knowledge) and the nature of process knowing (how someone comes to know). The beliefs of the nature of knowledge may consist of certainty and simplicity of knowledge, and the nature of process knowing consists of the source of knowledge and justification of knowledge (Watson, 2020). Using exploratory factor analysis, Hofer (2000) generated four dimensions, beliefs about the certainty of knowledge, beliefs about the justification of knowledge, beliefs about the Source of knowledge, and beliefs about the attainment of the truth.

Ernest (2016) postulated that certainty has two meanings; the first is those whose adherents admit no uncertainties and are aware that they can endure any tests and skeptical inquiry. In modern epistemological frameworks, such views are viewed as indisputable. Another definition of certainty is an assessment of knowledge's actual objects or propositions that reflect beliefs. They can also be said to be certain or to have certainty if they are thought to be objectively justified and now able to withstand any doubts, inquiries, or challenges to their veracity. Certainty of knowledge is the dimension of the belief system that elaborated to the extent to which students perceive knowledge as fixed or fluid (Chen et al., 2019). These beliefs were adapted from Perry and Schommer's work to explore whether students perceive knowledge as tentative or fixed. Perry investigated how students in higher education deal with knowledge and knowledge attainment (Trautwein & Lüdtke, 2007). The finding of Perry's investigation exerted the tendency of first-year university students to perceive that knowledge was certain. In the last year's study, students recognized that knowledge was tentative (Schommer, 1990). In the present study, certain absolute truth exists at lower levels. At more advanced levels, knowledge is provisional and in constant evolution (Hofer, 2000)

The simple of knowledge is the person's belief whether knowledge is simple or complex. Simple knowledge relates to the perception of isolated facts (Schommer, 1990, 1993). Knowledge is considered as a collection of information or as correlating with one another on a continuum. At the lower-level beliefs, someone will perceive knowledge as concrete facts, but at the high level, someone will acknowledge that knowledge is more contextual (Hofer, 2000). Regarding the Source of knowledge, Hofer (2000) argued that the Source of knowledge is how a person perceives the Source of knowledge from the outside person and resides in an external authority. In lower models, knowledge derives outside the self and exists in the external authority from whom it may be transferred.

Justification of knowledge relates to how people perceive how to gain knowledge and clarify their claims. Justification of knowledge is a way for people to prove their knowledge, such as following the information from the experts or doing research to discover the answer (Chen et al., 2019). In her empirical research, Hofer (2000) proposed a new dimension, namely, the attainment of the truth. Chen et al.(2019) interpreted the attainment of the truth as a concern with how someone believes that the ultimate truth can be obtained or unobtainable. The items in this dimension are closer to the justification of knowledge but emphasize the justification of experts, such as the statement that "experts in this field can ultimately get the truth" and "if the scholars try hard enough, they can find the answers to almost anything."

2.5 The relation of personal epistemological beliefs and attitudes

Attitudes are defined as the evaluation dimension of a concept, such as whether the concept is good or bad. They are described as mediating evaluative responses, including liking, enjoyment, and interest, or the opposite side dislikes concepts or objects (Ernest, 1989; Fishbein, 1963). Attitudes relate to affective responses that involve moderately intense and reasonably stable positive or negative feelings. For example, attitudes toward mathematics include liking geometry, disliking word problems, or disliking analysis-real mathematics (McLeod, 1992). If students tend to dislike a certain topic, it will imply their behavior during the learning process.

The relationship between attitudes and performance has been extensively researched. Particularly, the empirical study examines the contribution of a positive attitude to students' performance. Attitude has also been conceptually linked to students' engagement in class, homework completion, and abstinence (Green et al., 2012; Pitsia et al., 2017). The history of attitudes research also attracted attention to the critical issue in affect study, particularly on beliefs, because attitudes and beliefs have rarely been differentiated (Di Martino & Zan, 2011). Sometimes, attitudes and beliefs are used interchangeably with each other. Pehkonen & Pietilä (2003) bunched beliefs as subjective knowledge or cognitive aspect while attitudes are emotions. See figure 1. Then, the authors explained that the two sub-domains interconnect since someone can imagine statements that can be comprehended simultaneously as beliefs and attitudes. For instance," *I am not good at mental calculations*" can be understood as a belief and attitude toward mathematics. In this study, we assumed that attitudes are more emotions and beliefs are more cognition, both of which strongly correlate. However, empirical study that connects attitudes to students' beliefs is still rare.

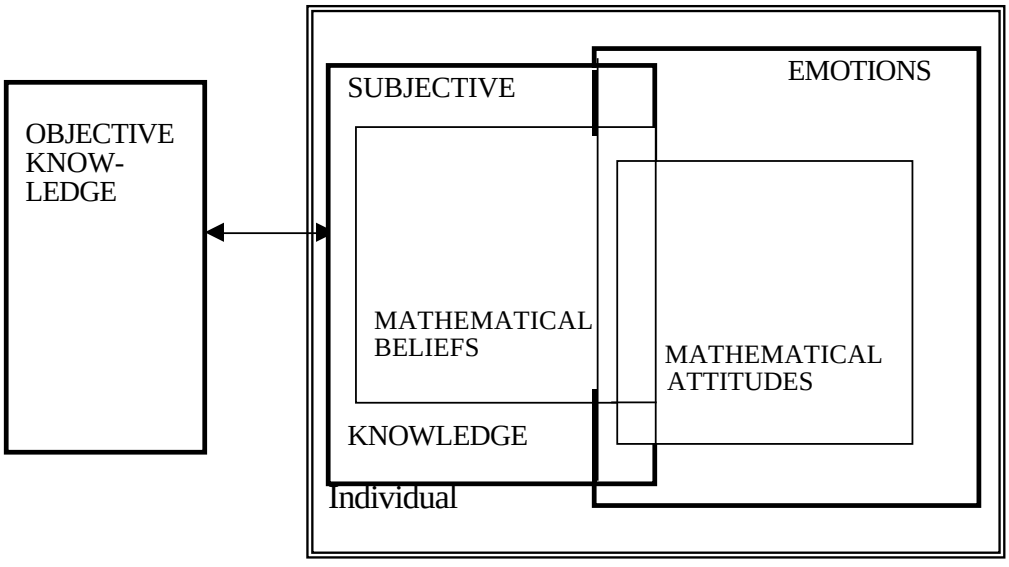

Figure 1. the relationship between beliefs, attitude, and knowledge (Pehkonen & Pietilä, 2003).

2.6 Gender and personal epistemological beliefs

Gender is also questioned in the Indonesian educational context as the most prominent Muslim country. Religion is one of the issues that cause inequality in gender (Muliah, 2016). There is evidence that gender differences in academic contexts still exist in several Muslim countries. For example, Shafiqs' (2013) investigated the differences in gender in an academic context in some Muslim countries. This research involved students from Turkey, Indonesia, Kyrgyzstan, Jordan, Azerbaijan, Qatar, and Tunisia. The researcher compares students' performance in those countries based on gender differences. The research found that the mathematics performance of girls' students in Indonesia, Tunisia, and Kyrgyzstan is lower than boys' students. The significant differences have also been proved by Martha et al. (2021), who found significant differences in learning competence between male and female students in higher education in Indonesia. Other studies suggested that women are more likely to work in some aspects, such as STEM and social work, than men (Maskur et al., 2022).

Nowadays, males and females have the same chance to access education in Indonesia. However, in Indonesian education, several private Islamic schools segregate male and female students. These divisions were founded on the presumption that putting male and female pupils in the same class or an environment where they may interact would have a negative effect on behaviour (Srimulyani, 2007). In higher education, universities follow a modern education system where there is no segregation between male and female students.

Concerning the relation between gender and beliefs in an academic context, researchers have recorded that gender issue also exists in the context of beliefs study. Li (2004) investigated gender differences and beliefs in mathematics education. The authors found that beliefs about mathematics are really different based on gender differences, where males showed higher beliefs than females. Samuelsson & Samuelsson (2016) also reported that male students perceive themselves can do more in mathematics than females. However, no association between personal beliefs and gender differences study has been conducted in the Indonesian context. Therefore, in the present study, we explained the personal epistemological beliefs based on students' gender differences.

2.4 Parents' educational level and personal epistemological beliefs.

Parents' education as part of social-economic status is another factor that has been recognized to influence students' performance. Parents with a high level of education, such as more than four years of experience in higher education, spend more time with their children than parents with less educational experience (Guryan et al., 2008). Parents' education may affect how they interact and send messages to their children. Some of their messages to their children provide information regarding the values and importance of education, such as in mathematics and science fields (Jacobs & Bleeker, 2004). Research by Azhar et al. (2014) reported that parents' education significantly influences students' performance in the university.

The relationship between personal epistemological beliefs and parents' educational study has rarely been studied. There is little evidence of the relationship between the two. For instance, the study by Davis-Kean (2005) reported that parents' education influences their beliefs and behavior, leading to positive outcomes for children and youth. The role of parents in students' beliefs has also been recorded by Gladstone et al.(2018). In that study, researchers investigated students' beliefs about mathematics in grades 5-12, students' abilities towards mathematics, and parents' beliefs about their children. This study's result showed an association between students' beliefs, students' ability in mathematics, and parents' beliefs about their children in mathematics. Therefore, in the present study, we will examine the relations between parents' educational background and students' personal epistemological beliefs.

3. Method

3.1 Participants

This study took place in Surabaya city-Indonesia, which is an urban or a metropolitan city. A total of 276 higher education students participated in this research, where 86 % of participants were females and 14 % were males (*Mean* age = 20.65, *SD* = 2.29). The participants in the present study are from the Primary teacher education (PME) department and the mathematics education (MED) department. We used the snowball random sampling method to collect our data using the online system with Google Forms. When we spread our instruments online to students in higher education, various students from different backgrounds also participated in the present study. We decided to focus on the two departments, mathematics teacher education, and primary teacher education. We excluded students from another department since the number of participants from other departments is not enough to be calculated using statistical analysis.

Finally, 146 students in MED and 130 students in PME departments participated in this study (See table 1). Although the students in these two departments have similarities because of the same faculty, the differences lie in the curriculum structure. MED students' college focused on mathematics for teaching, and they obtained several topics for teaching-learning mathematics in primary-senior high school. Students in MED learned natural mathematics such as calculus, algebra, geometry, theory graph, analysis real and statistics mathematics, etc. Students also study teaching and learning strategies, assessments, and training for teaching methods, etc. PME students' college, on the other hand, focused on all topics for primary teacher education teaching and learning method pedagogy. Students from these departments learned about mathematics for elementary, teaching and learning strategies, assessments, and instruction training. Based on those subject differences, MED students learn more in the mathematics area, while PME students learn more in teaching and learning strategies for elementary students. The output from these two departments is different, MED students have been trained to be secondary school teachers or junior and senior high schools teacher in the Indonesian context. While PME students have been trained to be a teacher for primary students or elementary students in the Indonesian context.

Table 1
Summarize the demography of participants

Characteristic	Full sample	Percentage
Major		
Mathematics education (MED)	146	53%
Primary teacher education (PME)	130	47%
Gender		
Males	39	14%
Females	237	86%
Father Education		
Elementary Schools	81	29%
Junior High Schools	35	13%
Senior High Schools	109	39%
Higher Education	51	19%
Mother Educations		
Elementary Schools	70	26%
Junior High Schools	56	20%
Senior High Schools	102	37%
Higher Education	48	17%

3.2 Instruments

Personal epistemological beliefs. We adapted the Discipline-focused epistemological beliefs questionnaire (DFEQ) was used to measure students' beliefs, their perceptions about knowledge, and knowing their discipline study. This questionnaire was developed by Hofer (2000) and consisted of four dimensions with 18 items: *certainty of knowledge* consisted of eight items. For example: "All experts in this field understand the field in the same way, "and "Truth is unchanging in this subject." *Justification for knowing* entails four items: "Firsthand experience is the best way of knowing something in this field," and "I am more likely to accept the ideas of someone with firsthand experience than the ideas of researchers in this field." The *Source of knowledge* consisted of four items. For example: "Sometimes you just have to accept answers from the experts in this field, even if you don't understand them "and "If you read something in a textbook for this subject, you can be sure it's true." *Attainability of truth* entails two items: "Experts in this field can ultimately get to the truth" and "if scholars try hard enough, they can find the answers to almost anything. This instrument was rated with a Likert scale from 1-5 (1 = strongly disagree, 5 = strongly agree).

Attitude for academics. We adapted the instruments of attitude from Kennedy et al. (2016) were adopted in the present study. For example, *I find many interesting and important things in this field.* Both questionnaires were administrated using a Likert scale rate range of 1-5 (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Parents' educational background. For the personal background data, we obtained from parents' educational level. We asked students what their father and mother's educational level is; 1 = primary school, 2 = Junior high school, 3 = Senior High School/ Vocational school, 4 = Higher education. *Student achievements* were collected by asking students for their grade point average (GPA). In Indonesian, the system GPA range from 1-4.

3.3 Procedure

In the present study, we identified students' personal beliefs about knowledge in their field study. Therefore, we adapted the Discipline-focused epistemological beliefs questionnaire (DFEQ) developed by Hofer (2000). In the first step, we translated the instruments into the Indonesian language. Before we administered this questionnaire, there are three researchers from Indonesia validated the instrument. We tried to communicate with students and colleges from universities in Indonesia. We explained our research aims. Also, we tried to communicate with some lecturers in Indonesia to get information on how to collect data. Then we used snowball random sampling methods. Both the students and the lecturers in Indonesia helped us to spread our online survey. In the present study, most students from two departments (mathematics and Primary teacher education) were asked to respond to this survey package consisting of the instrument discipline-focused epistemological beliefs questionnaire (DFEQ), a student attitude, and a brief demographic questionnaire such as their parents' education. We excluded the participants from another department since the number of participants was insufficient to be accounted for with statistical methods. The measurement of this study took place in Surabaya, the capital city of East Java province, during the pandemic. We collected our data on 1-30 April 2022. It means that the online collection of data was the only possible solution.

3.4 Data analysis

This study uses a quantitative study approach. Several data analyses were performed in the present study: confirmatory factor analysis (CFA) was used to confirm the stability of validity instruments. The model fit for confirmatory factor analysis can be presented by the comparative fit index (CFI), tucker-Lewis index (TLI), and the root means a square error of approximation (RMSEA). According to van de Schoot et al. (2012), the coefficient of CFI $\geq .90$, TLI $\geq .90$, and RMSEA $\leq .08$ are adequate. Cronbach's alpha was used to examine the reliability of DFEQ instruments. Descriptive statistics were used to analyze students' discipline-focused epistemological beliefs, and a t-test was used to compare students' discipline-focused epistemological beliefs for mathematics education students and primary teacher education students. Regression analysis was used to examine the contribution of personal epistemological beliefs to students' achievements. We also performed a t-test to examine the differences in personal epistemological beliefs based on gender differences. Finally, we performed ANOVA to identify the differences in personal epistemological beliefs based on parents' educational backgrounds.

4. Results

4.1 Confirming the validity dan reliability instruments

We performed confirmatory factor analysis (CFA) in this study to confirm the model of discipline-focused epistemological beliefs in the Indonesian context (see table 2). We found the acceptable fit model (Chi-squared = 5024.33, $df = 153$, $p < .001$, NFI = .93, RNI = .96, GFI = .97, TLI = .94, CFI = .96, RMSEA = .08). All items had a good factor loading, range .45 - .83. We checked the internal consistency of this model using Cronbach alpha.

Table 2
Construct validity of epistemological beliefs and attitudes toward academic

Variables	χ^2	CFI	TLI	RMSEA	Alpha
Personal epistemological beliefs	5024.33	.96	.94	.08	.89
Attitudes towards academic	234.43	.98	.96	.04	.73

Regarding the reliability of our instruments, the result of Cronbach alpha analysis showed that all of our instruments are reliable. Overall, the factors of discipline-focused epistemological beliefs had good reliability (*Cronbach alpha = .71 - .80*). Attainability of truth got the highest reliability ($\alpha = .80$) among factors of these beliefs. Certainty of knowledge also gained high reliability ($\alpha = .78$), and the Source of knowledge gained high reliability ($\alpha = .71$). Justification for knowing had the lowest reliability among other factors ($\alpha = .67$).

Concerning the attitudes instruments, we also examine the construct validity and the reliability of attitudes toward academic performance. The instrument of attitudes also presented a fit model (Chi-squared = 234.43, *df* = 21, *p* <.001, NFI = .93, RNI = .98, GFI = .98, TLI = .96, CFI = .98, RMSEA = .04). The Cronbach alpha coefficient showed that this instrument is reliable (*Alpha =.73).*

4.2. Descriptive statistics

As shown in Table 3, each factor of personal epistemological beliefs is correlated with attitudes toward academics. The highest correlation was shown by the pair of the source of knowledge and attitudes towards academics (*r* = .71). Students who hold beliefs about the source of knowledge, such as believing that the source knowledge (e.g., textbooks and experts) is favorable to have positive attitudes towards academics. The pair of certainty of knowledge and attitudes towards academics obtained a strong correlation (*r* = .67). The more students believe that knowledge is certain, the more favorable students are to have a positive attitude towards academics. The lowest correlation has been shown by the pair of the attainability of truth and justification for knowing (*r* = .39). The correlation between the source of knowledge and justification for knowing has gained moderate correlations (*r* = .55). It means, the level of student's beliefs about the source of knowledge such as textbook is correlated with their beliefs how to make meaning and justify their knowledge. Attainability of the truth has a strong correlation with the certainty of knowledge (*r* = .63) and the source of knowledge (*r* = .61). Justification for knowing was moderately correlated with attitudes towards academics (*r* = .59).

Table 3.
Descriptive statistics and correlation of each variable

	Variables	Mean	SD	Max	Min	1	2	3	4
1.	Certainty of knowledge	28.87	5.53	40.00	8	1			
2.	Justification for knowing	13.73	2.98	20.00	4	.59			
3.	Source of knowledge	13.34	2.97	20.00	4	.61	.55		
4.	Attainability of truth	7.79	1.72	10.00	2	.63	.39	.61	
5.	Attitudes towards academic	24.67	4.18	35.00	7	.67	.59	.71	.62

4.3. RQ1: Through the empirical investigation of personal epistemological beliefs in the different field studies, are the students' beliefs more specific or general domains?

We performed an independent sample t-test (see table 4) to examine whether personal epistemological beliefs are more specific or more general domain, in the context of mathematics education field and primary education fields. As we discussed earlier, students in MED learned a lot of mathematics topics, such as calculus, algebra, geometry, etc. Although PME students also learned mathematics in elementary students, most of the subjects in their field are related to pedagogy teaching and learning. In the Indonesian context, the main output of MED is mathematics teachers in secondary schools. At the same time, the output of PME is to provide elementary teachers. Therefore, the differences between the two will be identified if personal epistemology is more specific to the domain study. In contrast, both studies will have no significant differences if personal epistemological beliefs are more general domains.

The data in table 5 described significant differences between the two in the context of personal epistemological beliefs but not in all dimensions. MED students hold stronger beliefs about the certainty of knowledge than PME students; M = 29.75, SD = 5.01 and M = 27.88, SD = 5.93, respectively, t (274) = 2.84, $p < .05$. MED students also hold stronger beliefs about the attainability of truth than PME students (M = 8.18, SD = 1.47 and M = 7.35, SD =1.87, respectively, t (274) = 4.13, $p < .05$). However, MED and PME were equal in the beliefs about the justification for knowing (t (274) = 0.62, p = .54). It means the way students in both field study had the same conception how to justify their knowledge. Both the students were also equal in their beliefs about the Source of knowledge (t (274) = 1.75, p = .08). This data showed that either MED or PME were in the same way in believing about the Source of knowledge in their area. In other words, the certainty of knowledge and attainability of truth were more sensitive to domain study. In contrast, justification for knowing and the Source of knowledge was across domains.

Table 4
Comparison of students' beliefs based on their discipline

Factors	Mathematics education (MED)	Primary teacher education (PME)	*t* (274)	*p*
	M (SD)	M (SD)		
Certainty of knowledge	29.75 (5.01)	27.88 (5.93)	2.84	.005
Justification for knowing	13.62 (2.92)	13.85 (3.04)	0.62	.54
Source of knowledge	13.63 (2.77)	13.00 (3.15)	1.75	.08
Attainability of truth	8.18 (1.47)	7.35 (1.87)	4.13	.005

Note. N_{MED}= 146, N_{PME} = 130, $p < .05$ indicated significant. Certainty significant, t (274) = 2.84, p = .005, attainability of truth significant, t (274) = 4.13, p = .001 < .05.

We further examine the differences between the two in the level items by performing an independent t-test (See table 5). The first factor is belief in the certainty of knowledge. In general, the differences between the two have been identified based on the mean result, although not in all items. For instance, both students in MED and PME are equal in their beliefs about the answer to the questions in their field study is very dependent on the experts' findings, as indicated by the high mean result of the corresponding items (3.52

and 3.64, from a five-point likers scale, 5= strongly agree). 58% agreed or strongly agreed, while 13% strongly disagreed or disagreed with the item "Answers to questions in this field change as experts gather more information." However, both students are really different in some beliefs about the certainty of knowledge. MED students were more positive than PME students with respect to the item "all experts in this field understand the field in the same way" (M = 3.49, SD = 1.10 and M = 3.24, SD = 0.94, respectively, $p < .05$). MED students hold stronger beliefs that the truth was never changing rather than PME students (M = 3.47, SD =1.27, and M = 3.05, SD = 1.23, respectively, $p < .05$). MED students expressed more positive beliefs than PME students that there is only one right answer in their field based on the mean results (M = 3.88, SD = 1.09 and M = 3.28, SD =1.18, respectively, p <.001). MED students (M = 4.05, SD = 0.87) were more positive than PME students (M = 3.76, SD = 0.96, p <.05) in their beliefs that the idea should be questioned in their field study.

Second, justification of knowing. From these beliefs, we noted a few differences in personal epistemological beliefs based on the field study preferences. Both MED (M = 4.08, SD = 0.92) and PME students (M = 4.06, SD = 0.98) expressed strong beliefs that their first experience is the best strategy to know about some things, as indicated by the high mean result of the corresponding item. Both students also viewed that they were more likely to accept the idea from firsthand experience rather than the result of research (M = 3.40, SD = 1.03 and M = 3.49, SD = 1.04, respectively).

Third, Source of authority. The data showed that both students expressed strong beliefs that they had just accepted the answer from experts, although they did not quite understand the problems, as indicated by the mean result (3.71 and 3.51, in five of the point likers scales). Both students had minor differences in their beliefs about the truth in the textbook. MED students (M = 3.52, SD = 0.89) were more positive than PME students (M= 3.25, SD = 1.00, $p < .05$) in their beliefs that they were sure about the truth when they read the textbook resource in their field study. However, both students were equal with respect to the item "If my personal experience conflicts with ideas in the textbook, the book is probably right" (M = 2.73, SD = 1.08 and M = 2.80, SD = 1.07, respectively). MED and PME students were also equal in response to the item "I am most confident that I know something when I know what the experts think "(M = 3.66, SD = 0.97 and M = 3.45, SD = 1.00, respectively)

Table 5
The t-test of students' personal epistemological beliefs in MED and PME

Variables	MED			PME			sig
	Mean	Med	SD	Mean	Med	SD	
Certainty of knowledge							
Answers to questions in this field change as experts gather more information.	3.52	4.00	1.11	3.64	4.00	0.99	.66
All experts in this field understand the field in the same way.	3.49	4.00	1.10	3.24	3.00	0.94	.04*
The truth never changes in this field	3.47	4.00	1.27	3.05	3.00	1.23	.006*
There is only one right answer in this field	3.88	4.00	1.09	3.28	3.00	1.18	.00**
Principles in this field are unchanging.	3.42	4.00	1.18	3.22	3.00	1.14	.17

The answers to questions from experts are the same in this area.	3.76	4.00	1.05	3.65	4.00	1.09	.38
The idea should be questioned in this field	4.05	4.00	0.87	3.76	4.00	0.96	.008*
Most of the truth has been known in this field.	4.09	4.00	0.94	4.04	4.00	1.02	.67
Justification for knowing							
Firsthand experience is the best way of knowing something in this field.	4.08	4.00	0.92	4.06	4.00	0.98	.90
I am more likely to accept the ideas of someone with firsthand experience than the ideas of researchers in this field.	3.40	4.00	1.03	3.49	3.00	1.04	.48
Correct answers in this field are more a matter of opinion than fact.	3.24	3.00	1.07	3.09	3.00	1.05	.25
There is really no way to determine whether someone has the right answer in this field.	2.90	3.00	1.18	3.20	3.00	1.04	.03*
Source of knowledge							
Sometimes you just have to accept answers from the experts in this field, even if you don't understand them.	3.71	4.00	1.06	3.51	4.00	0.99	.100
If you read something in a textbook about this subject, you can be sure it's true.	3.52	3.00	0.89	3.25	3.00	1.00	.02*
If my personal experience conflicts with ideas in the textbook, the book is probably right.	2.73	3.00	1.08	2.80	3.00	1.07	.60
I am most confident that I know something when I know what the experts think.	3.66	4.00	0.97	3.45	3.00	1.00	.07
Attainment of truth							
Experts in this field can ultimately get to the truth.	3.92	4.00	0.88	3.54	4.00	1.00	.001**
If scholars try hard enough, they can find answers to almost anything.	4.27	4.00	0.77	3.81	4.00	1.01	.001**

Fourth, attainment of the truth. Generally, we found that students in both fields believed that experts in their field can gain the truth and discover the answers if they try hard enough based on the mean results. 61% of students from both fields agreed or strongly agreed, whilst 6% disagreed or strongly disagreed with the item "Experts in this field can ultimately get to the truth." 73% agreed or strongly agreed, and 5% disagreed or strongly disagreed with the item "If scholars try hard enough, they can find answers to almost anything." However, we find the differences between students in these beliefs' level item. MED students expressed more positive beliefs than PME students that the expert in their field can obtain the truth (M = 3.92, SD = 0.88 and M = 3.54, SD = 1.00, respectively, $p < .001$). MED students were more positive about the belief that scholars can discover the answer to all things if they try hard enough than PME students (M = 4.27, SD = 0.77 and M = 3.801, SD = 1.01, respectively, $p < .001$).

4.3 RQ2: Do personal epistemological beliefs influence students' academic performance?

Multiple regression analysis was used to answer the fourth question, whether personal epistemological beliefs influence students' performance in both MED and PME. Table 6 shows the contribution of each belief's dimensions to academic performance. The result indicated that in MED, personal epistemological beliefs contribute more to academic performance than PME.

Table 6
The regression of DFEQ on students' academic performances

Factors	r	β	r.β. 100	t (4)	p
Mathematics Ed (MED)					
Certainty of knowledge	.62	.32	19.84	3.99	.001
Justification for knowing	.51	.16	8.16	2.18	.03
Source of knowledge	.60	.31	18.6	4.08	.001
Attainability of truth	.47	.10	4.7	1.38	.17
Total variance explained			51%		
Primary Ed (PME).					
Certainty of knowledge	.47	.22	10.34	1.73	.09
Justification for knowing	.44	.19	8.36	1.73	.09
Source of knowledge	.43	.14	6.02	1.12	.26
Attainability of truth	.39	.05	1.95	.39	.70
Total variance explained			26%		

Note. N = 146; F-statistics MED. = 14.55. $p < .001$. $N = 130$*; F-statistics PME* = 11.09, $p < .001$. Academic performance ranges from 1-4.

In the context of MED, data table 6 showed that all predictors explain students' academic performance, 51% of the total variance academic performance, $R^2 = .51$, $p < .001$. The model regression of discipline-focused epistemological beliefs were significant, $F\ (142) = 14.55$, $p < .001$. All the dimensions, but not the attainability of truth, significantly influence academic performance. Certainty of knowledge positively influences academic performance ($\beta = .31$, $t\ (142) = 3.99$, $p < .001$). Justification for knowing was also positively significant in influencing academic performance ($\beta = .16$, $t = 2.18$, $p = .03$) as well as the Source of knowledge ($\beta = .23$, $t = 4.08$, $p < .001$). However, we did not find the influent partially of the attainability of truth ($\beta = .10$, $t = 1.38$, $p < .001$) on the academic performance in MED.

Whilst in the PME context, the result indicated personal epistemological beliefs could predict and explain students' academic performance, 26% of the total variance, $R^2 = 26$, $p < .001$. The regression model also indicated that all the dimensions of the discipline-focused epistemological beliefs influence students' academic performance, $F\ (126) = 11.09$, $p < .001$. However, in the partial dimensions, none of the discipline-focused epistemological beliefs dimensions partially influence students' academic performance.

4.4 RQ3: Do personal epistemological beliefs correlate with students' attitudes toward the academic context?

Table 7 presents the relationship between students' beliefs and attitudes toward their discipline study. We performed a simple correlation to evaluate whether each of these beliefs' dimensions correlates significantly with their attitudes toward academic performances.

Table 7
The correlation between epistemological beliefs and students' attitudes

Dimensions	MED	PME
Certainty of knowledge	.55**	.73**
Justification for knowing	.56**	.65**
Source of knowledge	.68**	.72**
Attainability of truth	.51**	.68**

Note. * $P < .05$, **$p < .001$

Table 3 data describes that in MED, the pair of sources of knowledge and attitude has the highest correlation coefficient (r = .68). It means the more students' beliefs about the Source of knowledge, such as the statement "Sometimes you just have to accept answers from the experts in this field, even if you don't understand them, "the more students have high attitudes toward academic context. The other dimensions have shown a moderate correlation with attitude. The correlation between the certainty of knowledge and attitudes is 55(r = .55). Justification for knowing also has a moderate correlation with attitude (r = .56). The more students' beliefs about the certainty of knowledge, such as believing that knowledge in mathematics unchanging or the principle in this field is unchanging, the stronger positive attitude students towards mathematics. Attainability of truth showed moderate relation with attitude toward academic context (r = .51).

In PME, the correlation between personal epistemological beliefs dimension and attitude is stronger than in mathematics education. Certainty of knowledge gained the highest correlation coefficient to attitude (r =.73). It means the more students perceive that knowledge in their field is stagnant, the more students have positive attitudes toward academic context. Justification of knowing is the lowest correlation among other dimensions. However, the correlations between these beliefs and attitudes are also strong (r = .65). The correlation between the Source of knowledge and attitude academic performance is strong (r = .72). The moderate correlation has been shown by the attainability of truth (r =.68) and attitude toward academic context.

4.5 RQ4: Were there any differences between male and female students regarding personal epistemological beliefs?

Table 8 below presents the differences in students' epistemological beliefs based on gender differences. We performed an independent sample t-test to measure the role of their gender on beliefs in both MED and PME. Because according to a prior study (Li, 2004), there was an association between beliefs and gender preferences. Males students showed higher beliefs about mathematics education than female students. In this study,

generally, we did not find differences in beliefs about mathematics education in terms of gender preferences, either for MED students or PME students.

Table 8
Comparison of students' personal epistemological beliefs based on the gender differences

Factors	Male	Female	*p*
	M(SD)	M(SD)	
Certainty of knowledge	29.96 (3.82)	29.70 (5.25)	.81
Justification for knowing	12.85 (2.60)	13.80 (2.98)	.13
Source of knowledge	13.63 (2.87)	13.63 (2.76)	1.0
Attainability of truth	8.26 (1.70)	8.17 (1.42)	.77

Note. Significant if the $p < .05$

First, the data from table 8 indicated that either males or females hold strong beliefs about the certainty of knowledge (M = 29.96, SD = 3.82 and M = 29.70, SD = 5.25, respectively, t (274) = .97, p = .33). We further investigated by performing a t-test on the level items. For instance, both males and female students perceived that all experts understand the field in the same way according to the mean result (M = 3.46, SD = 1.02, and M =3.36, SD = 1.11, respectively). Males (M = 3.41, SD = 1.12) and females (M= 3.24, SD = 1.29) have the same level of belief that the truth is not unchanging in their study.

Second, for justification for knowing, males (M = 12.85, SD = 2.60) and females (M = 13.80, SD = 2.98) students indicated that they had the same conception of how they justify the knowledge (t (274) = -.14, p = .16). For further investigation in the level items, we also examine students' responses for these beliefs by performing a t-test. For instance, males (mean = 4.05) and females (mean = 4.07, sig = .90) are equal in the belief that firsthand experience is the best way of knowing something.

Third, in Source of knowledge, there was no significant difference between males and females in this belief (M = 13.54, SD = 2.75 and M = 13.30, SD = 3.00, respectively, t (247) = .46, p = .65). In the level items, for instance, both males (M= 3.64, SD = 1.09) and females (M = 3.61, SD = 1.03) students are equal in beliefs that they only have to accept answers from the experts, even if they don't understand them.

Fourth, there were no significant differences between males and females students in beliefs about the attainment of the truth (M = 8.10, SD = 1.70 and M = 7.74, SD = 1.72), respectively, t (274) = 1.21, p = .23). Then, we examine the differences between the two in the items level. Males (M = 3.79, SD = 0.98) and females (M = 3.73, SD = 0.96) are equivalent in perceiving that experts in their field study can ultimately get to the truth. Males (M = 4.31, SD = 0.89) and females (M= 4.01, SD = 0.92) also expressed the same belief that if scholars try hard enough, they can find answers to almost anything.

4.6 RQ5: Do parents' educational backgrounds generate different personal epistemological beliefs?

We performed ANOVA to answer whether parents' education generated significant personal epistemological beliefs for both MED and PME students. We used mothers'

and fathers' education as the independent variables (See table 9). In mathematics education departments (MED), we did not find personal epistemological belief differences based on parents' education, either father or mother's education. For instance, students were equal in beliefs about the certainty of knowledge (F (3) = 1.34, p = .27), justification for knowing (F (3) = 0.69, p = .65), Source of knowledge (F (3) = 1.57, p = .20), and attainment of the truth (F (3) = 0.72, p = .54) according to mothers' education. Students' personal epistemological beliefs were also equal according to the father's education level, the certainty of knowledge (F (3) = 0.53, p = .66), justification for knowing (F (3) = 0.14, p = .94), Source of knowledge (F (3) = 0.36, p = .78), and attainment of the truth (F (3) = 0.16, p = .92)

Table 9

Personal epistemological beliefs according to mothers' and fathers' educational level

Variables	Edu Level	Mother education				Father Education			
		M	SD	F	*p*	M	SD	F	*p*
Mathematics education department (MED)									
Certainty of knowledge	ED	28.75	6.42	1.34	.27	28.97	5.59	0.53	.66
	JHS	29.33	4.70			29.35	6.16		
	SHS	30.65	4.55			30.08	4.51		
	Univ.	29.75	3.98			30.32	4.45		
Justification for knowing	ED	13.91	3.20	0.69	.65	13.44	2.67	0.14	.94
	JHS	13.44	2.94			13.45	3.98		
	SHS	13.80	2.84			13.68	2.77		
	Univ	12.86	2.78			13.88	2.84		
Source of knowledge	ED	13.42	3.22	1.57	.20	13.22	2.92	0.36	.78
	JHS	13.19	2.86			13.90	3.04		
	SHS	14.15	2.60			13.72	2.74		
	Univ	12.90	2.21			13.76	2.45		
Attainment of the truth	ED	8.27	1.44	0.72	.54	8.22	1.48	0.16	.92
	JHS	8.00	1.69			8.25	1.89		
	SHS	8.23	1.21			8.21	1.27		
	Univ	7.86	1.93			8.00	1.47		
Primary Education Teacher department (PME)									
Certainty of knowledge	ED	26.76	6.75	0.84	.47	27.13	6.67	0.52	.67
	JHS	29.07	5.92			28.67	7.00		
	SHS	28.08	5.86			28.66	4.90		
	Univ.	27.85	4.76			27.62	5.68		
Justification for knowing	ED	13.78	3.73	0.61	.61	13.78	3.35	0.04	.99
	JHS	14.14	2.84			13.73	3.58		
	SHS	13.35	2.71			13.86	2.54		
	Univ.	14.29	2.67			14.00	3.11		
Source of knowledge	ED	12.46	3.97	1.15	.33	12.80	3.68	0.22	.89
	JHS	13.31	2.77			12.73	3.77		
	SHS	12.73	2.61			13.11	2.47		
	Univ.	13.81	2.91			13.35	2.95		
Attainment of the truth	ED	6.95	2.16	1.31	.27	7.13	2.14	0.40	.75
	JHS	7.24	1.92			7.40	2.16		
	SHS	7.78	1.67			7.57	1.52		
	Univ.	7.44	1.58			7.35	1.79		

Note. ED = elementary education level, JHS = Junior high schools level, SHS = senior high schools level, and Univ = University level.

The differences in personal epistemological beliefs according to parents' education in the primary education (PME) department were insignificant. For example, students' personal epistemological beliefs were equally based on the mother's educational level, the certainty of knowledge (F (3) = 0.84, p = .47), justification for knowing (F (3) = 0.61 p = .61), source of knowledge (F (3) = 1.15, p = .33), and attainment of the truth (F (3) = 1.31, p = .27). There were no significant differences of personal epistemological beliefs according to fathers' educational level in PME, the certainty of knowledge (F (3) = 0.52, p = .67), justification for knowing (F (3) = 0.04, p = .99), Source of knowledge (F (3) = 0.22, p = .89), and attainment of the truth (F (3) = 0.40, p = .75)

5. Discussion

The finding of this study contributed to clarifying specificity and generality domain beliefs in mathematics education and primary teacher education. The relation of personal epistemological beliefs with achievements, attitudes, parent education, and gender is also explored. We explore the validity and reliability of each questionnaire by performing confirmatory factor analysis (CFA) and Cronbach alpha before we further analyze the data. Our instruments are valid and reliable for the Indonesian context. Most important, by investigating the role of personal epistemological beliefs as proposed by Hofer (2000), this study found the critical role of these beliefs on academic performance and attitudes.

Surprisingly, our finding not only supports that personal epistemological beliefs are a more specific domain, but our finding also supports that certain beliefs are more general. We found that MED students hold stronger beliefs about the certainty of knowledge than PME students. For instance, MED students more positively viewed that the principles in their field study are not changing than PME students. Also, MED students hold stronger beliefs about the attainability of truth than PME students. This finding partially reveals the same result as the previous study by Hofer (2000), who found the dimensionality of personal epistemological beliefs. In other words, the result showed that the beliefs (certainty of knowledge and attainability of truth) are more specific domains. Our interpretation regarding the differences between the two is that MED students frequently receive subjects more about natural mathematics in their classroom than PME students. They frequently encounter the formula and problem-solving that are more certain than PME students. Bandura (2001) mentioned that students' cognitions and behavior are influenced by their learning experience in the class. Interestingly, we found that MDE and PME students are equal in their beliefs about the justification for knowing and the Source of knowledge. This finding is in line with the study by Schommer et al. (2005), which suggested that beliefs are more general. For instance, MED and PME students are equal in believing that firsthand experience is very important to know something in their field study. Limón (2006) argued that both general and specific beliefs domains are the theoretical framework and method matter. In other words, possibly there may be some differences and some similarities in beliefs about knowledge based on the field study, but it depends on the theoretical framework and the methodological issue.

The second finding of this study explains that personal epistemological beliefs significantly influence students' academic performance. This finding is consistent with the prior research (Csíkos et al., 2011; Hidayatullah & Csíkos, 2022; Hofer, 2000; Schommer-aikins et al., 2005) that suggested the stronger students' beliefs, the higher their achievement in academic performance. Cartagena Beteta et al. (2022) argued that personal beliefs would affect intrinsic and extrinsic behavior and academic performance. In MED, we found all of the factors of personal epistemological beliefs can explain 51% of students' academic performance. This prediction statistically is higher than PME students. Besides, all of the factors of personal epistemological beliefs significantly influence academic performance except the attainability of truth. Although personal epistemological beliefs in PME also determine students' academic performance, the partial influence of each factor is not significant. From this stage, the possible explanation of what students learned during mathematics class contributed to their personal epistemological beliefs, such as certainty of knowledge and justification for knowing, and in turn, affected their academic performance. In comparison, PME students get more general topics about teaching and learning for primary education. So, their personal epistemological beliefs on academic performance are lower than MED students.

The third finding of this study showed the relationship between personal epistemological beliefs and attitudes toward academic performance. As mentioned by McLeod (1992) and Pehkonen & Pietilä (2003), beliefs are cognitions aspect, while attitude is a more emotional aspect. We found a significant correlation between personal epistemological beliefs and attitudes in both MED and PME fields. All of the factors have high correlations with attitudes toward academic performance. Our interpretation for this stage is that if students increase their personal epistemological beliefs about knowledge, it will affect their attitude toward the academic context. The impact of students' beliefs and attitudes toward the academic context in the university may also reduce the possibility of college students dropping out of their studies.

Fourth, we find no significant differences between males and females in their personal epistemological beliefs. Both MED and PME students are equal in all the factors. This finding contradicts the prior research (Samuelsson & Samuelsson, 2016; Li, 2004), which finds significant differences between the two. Our interpretation of this stage is that the Indonesian government provides opportunities for all students to pursue their high education. Higher education also provides equal access for males and females in Indonesia. Although we do not find any significant differences between male and female students, gender equity it remains should be considered because equity is a process. We do not say male and female students are equal in all subjects or field studies. Therefore, further investigations are still needed to investigate gender differences.

Finally, our findings showed no significant differences in personal epistemological beliefs according to the mother and father's educational background. Students with fathers with no educational background or students with parents with high education backgrounds showed equal personal epistemological beliefs. The differences in the mother's educational level also do not show the differences in students' personal epistemological beliefs. This finding contradicts the previous study (Guryan et al., 2008; Jacobs & Bleeker, 2004) that the level of parents' education may affect students' cognition and behavior, as mentioned by Davis-Kean (2005) and Gladstone et al.(2018) that the

number of education parents receives may affect how they set the environment at their home. We assume that students in higher education in the Indonesian context are more independent than secondary schools. Therefore, the parental educational level influence is not significant.

However, several limitations in the present study should be noted. The limitation of this study lies in the number of participants, and students' field studies are in the same area, which is education. Therefore, further research may consider the different dimensionality of students based on the different areas, such as the comparison beliefs in social humanities and engineering faculty. Although we found that students in MED show hold stronger certainty of knowledge than PME, we have no information on whether their beliefs change or not at the end of their study. Therefore, a longitudinal study is required to confirm whether the personal epistemological beliefs of students changes or not. In this study, we only measured the association between personal epistemological beliefs and general point academic (GPA). We have no information on how personal epistemological beliefs influence academic performance and its relation to other aspects. Future research also needs to examine the influence of these beliefs on academic performance indirectly and directly.

6. Conclusion and Implication

To summarize this study, the finding of this research is significant because it provides empirical data to clarify the debatable among researchers about the general and specific domain of beliefs in different studies. In the Indonesian context, this finding supports both general and specific domains. Certain beliefs (certainty of knowledge and attainability of the truth) are more specific domains, and other beliefs (justification for knowing and source of knowledge) are more general. We also found that personal epistemological beliefs influence academic performance and correlate with attitudes toward academic performance. We did not find significant differences in personal epistemological beliefs based on gender and parents' educational background preferences.

The wealth result of this study is very important for academic research, teaching, and learning. For academic research, the finding of this study can be used as an analysis discourse in mathematics education and the primary teacher education departments. For the educator in both departments, the improvement of students' beliefs in justification for knowledge is needed because our data showed that students' response to these beliefs is weak. The educator in primary teacher education should put much effort into improving students' beliefs about the source of knowledge. Our findings also mention that personal epistemological beliefs are associated with students' academic performance and attitudes. The educators need to improve and maintain students' personal epistemological beliefs because these beliefs would affect their attitude and their academic performance. Therefore, educators should design their class environment, so that students can shape their beliefs about knowledge in their area to improve their academic performance.

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