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Can epistemic belief predict the pedagogical belief of prospective elementary school teachers?

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ABSTRACT

It is important for prospective elementary school teachers to know their epistemic beliefs because this is related to beliefs about how to teach in schools and how learning should be done, which are called pedagogical beliefs. This study aims to investigate whether epistemic beliefs can predict the pedagogical beliefs of prospective elementary school students. This research method used a quantitative method with 179 elementary school teacher education students as research subjects. The data obtained were analyzed using a linear regression test. The results of this study indicate that students' epistemic beliefs can predict students' pedagogical beliefs, especially in terms of social studies learning concepts in elementary schools.

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1. INTRODUCTION

University students have beliefs regarding the nature of knowledge and knowing. This belief is related to how knowledge should be obtained, and how this knowledge can be immediately believed to be true, or knowledge needs to be tested and studied first so that the truth can be trusted. This is called an epistemic [1]. Epistemic beliefs are individual beliefs about the nature of truth. Apart from this many independent beliefs about nature and the acquisition of knowledge [2]. So epistemic beliefs are individual beliefs about how he understands knowledge and how someone acquires it.

For prospective elementary teachers, epistemic beliefs related to their learning activities. Epistemic beliefs can be a predictor of their pedagogical practice in the future [3]. It is also associated with the processes of reasoning, learning and decision-making [4]. Its mean epistemic beliefs have an important role in determining the designs and strategies used in learning. These beliefs may have an indirect effect on student academic performance, because beliefs about knowledge can influence learning strategies [5], influence the standards set by an individual to achieve predetermined goals, [6] influence the types of achievement goals adopted by individuals, which in turn affect the type learning strategies used by individuals in learning , achieving their goals, [7] affect information processing, reasoning approaches, and decision making carried out by an individual [8]. A recent study [9] also reinforces that the epistemic beliefs of students as individuals have an impact on their own learning settings. The intended learning arrangement is the ability of students to define assignments, plan approaches to assignments, choose strategies to be used in carrying out learning, and evaluate previous stages to produce their own feedback and make adaptations for the implementation of future learning activities.

Epistemic beliefs distinguish between developmental epistemic beliefs and dimensional epistemic beliefs. Research by Hofer and Pintrich [10] categorize epistemic beliefs into four dimensions representing the nature of knowledge and the nature of knowing; each of these dimensions is divided into two continuums it's called naïve epistemic beliefs and sophisticated epistemic beliefs. Each of these dimensions includes sources of knowledge (beliefs about how knowledge obtained and where it came from); justification of knowledge (beliefs about how knowledge should be evaluated, ideas about evidence and how it is reasoning): certainty of knowledge (beliefs about individual tentative knowledge): and simplicity of knowledge (beliefs about the complexity of knowledge). knowledge when its complex, tentative , justified by the use of evidence, and derived from self as knowing is more advanced (or 'sophisticated') and beneficial for learning [10].

While the developmental stage perspective was first put forward in the 1970s, by Perry [11]. Perry's ideas led to an examination of a developmental model of epistemic beliefs, usually with development from naive beliefs to a more nuanced position [11]. In line with Perry [11], and King and Kitchener [12] also developed a model of epistemic development in 2002 and by Kuhn in 2000 [13]. According to Kuhn *et al.* [14] the stage of development of an individual's epistemic beliefs starts with the absolutist stage. In this level (as well as a pre-absolutist realist) knowledge seen as an objective entity, that lies in the external world and can be known with certainty. Then it develops into the multiplicity stage. The multiplicity transfers the source of knowledge from object as known to subject as knowing, thereby becoming acquainted with the subjective and uncertain nature of knowing. However, its takes on such proportions that it overpowers and obliterates any objective standard that could serve as a basis for comparison or evaluation of conflicting claims. Since claims are subjective free opinions, everyone entitles them with their opinions, so that all opinions are considered equal truth. Evaluative reintegrate the objective dimension of knowledge, by acknowledging uncertainty without ignoring evaluation.

This epistemic belief will influence the decisions of future teachers when they will design learning. Recent study [15] shows that teachers with more sophisticated epistemic beliefs tend to apply constructivist learning activities compared to teachers with naive epistemic beliefs. This means that epistemic beliefs can be a predictor of how prospective teacher students will apply learning activities later. This is also reinforced in other study [16] stating that epistemic beliefs are important predictor of their preference for conceptions of teaching and learning whether they are constructivist or traditional. From this information, it can be seen that in some of the conditions described, epistemic beliefs can predict teacher pedagogical beliefs, namely choosing or determining learning designs that are more constructivist or tend to more traditional pedagogical beliefs.

Recent study [17] linked epistemic beliefs, pedagogical beliefs, and beliefs in the use of information and communications technology (ICT), showing that teachers' sophisticated epistemic beliefs about sources of knowledge align with constructivist pedagogical beliefs and constructivist uses of ICT, with one belief being strongly linked to the other. Meanwhile, other researcher [18] conducted research on teachers' epistemic and pedagogical beliefs in the context of ICT reform showed that teachers' epistemic and pedagogical beliefs were related to teachers' awareness of student readiness and what they considered their priorities in the school context. This pedagogical belief is directly related to the determination of learning designs in the field. Pedagogical beliefs also influence the selection of didactic strategies that will be applied by teachers in class and related to knowledge about classroom learning practices [19]. The results of several studies show how important epistemic beliefs and pedagogical beliefs on students' future teaching practices.

As previously stated, there are two main opposing conceptions of learning; it's called constructivist pedagogical beliefs and traditional pedagogical beliefs. The constructivist conception is based on the theories of Vygotsky and Piaget. This theory emphasizes the importance of individual experience and active participation in the learning process in the construction of knowledge [20]. The constructivist conception uses student-centered teaching strategies because this type of learning will help students develop critical thinking and collaboration, and learning takes place in an environment where students can actively participate while the traditional conception of learning uses teacher-centered teaching strategies. This conception views the teacher as a source of knowledge and students as passive recipients of that knowledge [3].

The pedagogical beliefs of student teacher candidates in several studies are related to epistemic beliefs. A recent study [21] on sports teachers student candidate, explained that students who have epistemic beliefs that knowledge is an innate ability or tend to be naïve have more traditional pedagogical beliefs compared to students who have epistemic beliefs that knowledge is a personal authority or are more sophisticated. Other study claimed [22] there was a significant relation between epistemological beliefs and students' teacher candidates conceptions of how they believed in learning and teaching (pedagogical beliefs).

Prospective elementary school teachers attend lectures in order to prepare them to become professional teachers. One of the skills that must be possessed is the ability to design social studies lesson in

elementary schools. Social studies in elementary has the goal of helping students develop a social, historical, and civic understanding (that is, the ability to think and act as democratic citizens in a diverse country and an interdependent world) [23]. In order to achieve these goals, students in the lecture process are equipped with the knowledge and skills to develop social studies learning designs in elementary schools. However, students as unique individuals can have various conceptions related to the concept of social studies learning in elementary school. Baytelman [24] show his research findings explaining that students have diverse conceptions regarding their views in arguing about controversial issues in the social sciences. This is one of them influenced by student epistemic beliefs. While other researchers [25] stated that the beliefs of prospective teacher students led them to determine the social studies learning method they would choose. Although previous research has explored the relationship between epistemic beliefs and pedagogical beliefs, it has not explicitly explained whether epistemic beliefs can predict pedagogical beliefs, so this study investigates epistemic beliefs and their possible influence on the pedagogical beliefs of prospective elementary school teacher students especially in their social studies conception, provides an overview of the student's situation and the steps that need to be taken next to develop both beliefs simultaneously.

2. METHOD

This research used descriptive and inferential methods. Descriptive statistics are used to describe data related to students' epistemic and pedagogical beliefs, while inferential statistics are used to determine the relationship between epistemic beliefs and student pedagogical beliefs. The subjects of this study were elementary school teacher education level II students at Nusantara University PGRI Kediri totaling 117 students using nonprobability sampling. The reason for selecting the student sample was that they took a course on social studies learning strategies and planning and had taken a course on the basic concepts of social studies in elementary school. So that they already have a conception of how social studies teacher in elementary schools and how to design learning in elementary schools. The number of samples has met adequacy for the research because this research used non probability sampling. It is in line with Saunders *et al.* [26], that state if sample are selected based on personal judgement, the sample method used nonprobability sampling.

The data collection technique used was a closed questionnaire adapted from the discipline focused epistemic belief questionnaire (DFEBQ) [10], [27]. The questionnaire was compiled based on five dimensions of epistemic belief, namely certainty of knowledge, simplicity of knowledge, source of knowledge, justification of knowledge, and attainment of truth. The data collection procedure was carried out by distributing questionnaires used Google forms. The number of questions can be seen on the Table 1.

Table.1 Epistemic belief questionnaire

Category	Range	Question
Certainty	Fixed	a. Social studies material in elementary school cannot be doubted b. Material in elementary school contains definite fact
	Fluid	a. Social studies material can develop according to the latest review b. Social studies material in elementary school that we know today may be less relevant in the future
Simplicity	Sets of facts	a. The facts presented in social studies learning in elementary school are not related to each other b. The answer to the social studies problem is simple and definite
	Highly interrelated concepts	a. Social studies material in elementary school contains concepts that are related to each other b. There can be more than one answer to social studies problems in elementary school
Source knowledge	Outside the self	a. The main source of social studies in elementary school is the teacher b. The elementary school social studies concept explained by the lecturer is definitely correct
	Within the self	a. The concept of social studies can be learned by students themselves by discussing with their friends b. The social studies concept can be developed by students themselves based on the experiences the students have
Justification	Relying on authority and experts	a. Definition draft material in elementary social studies learning is definitions made by experts and the government b. Social studies concept can be recognized the truth only if conveyed by experts and the government
	Relying on personal experience and evaluation	a. Social studies can be defined by students themselves as well as teachers b. Social studies material can be evaluated the truth
Attainability truth	Attainable	a. Problem in elementary social studies always can be found the solution b. Questions that arise in social studies learning always own one correct answer
	Non attainable	a. Problem in elementary social studies may not find the solution b. Questions in social studies learning may not have definite answers

The epistemic belief questionnaire consists of 20 statements, after validity testing 12 statements tend to be valid and reliable (Cronbach Alpha's=0.602). Meanwhile, the pedagogical belief questionnaire was adapted from the teaching and learning conception questionnaire (TLQC) developed by Chan and Elliot [28]. Students choose the contents contained in the google form starting from the range "strongly disagree", "disagree", "agree", and "strongly agree". The number of statements can be seen on the Table 2.

Table 2. Pedagogical belief questionnaire

Traditional belief	Constructivist belief
1. A teacher's job is to immediately correct students' learning misconceptions rather than verify them themselves (teacher-centered)	1. Students' ideas are important and should be considered carefully
2. Learning to teach simply means practicing the ideas of the lecturer without questioning them	2. Effective teaching encourages more discussion and hands-on activities for students
3. No learning can occur unless the student is controlled by the teacher	3. Students should be given many opportunities to express their ideas
4. The main role of a teacher is to transfer knowledge to students	4. In a good classroom there is a democratic and free atmosphere that stimulates students to think and interact
5. Learning occurs primarily from drill and practice	5. Every child is unique or special and has the right to receive education that is adapted to other special needs
6. During lessons, it is important to ensure that students focus on sitting and reading textbooks seriously	6. Good teachers always encourage students to think about their own answers
7. Teachers must control what students do at all times	7. It is best if the teacher exercises as much authority as possible in the classroom (is in control)
8. Teaching is just telling, presenting or explaining lesson material	8. Different goals and expectations in learning should be applied to different students
9. I really learn something when I can remember it later	9. Teaching is more about providing students with accurate and complete knowledge than encouraging them to discover it for themselves (teacher-centered)
10. Good teaching occurs when most teachers talk in class (Teachers lecture more)	10. Good teachers always make their students feel important
11. Students should be on call at all times to ensure they are under supervision	11. Instruction must be flexible enough to accommodate individual differences among students
12. The main task of a teacher is to impart knowledge/information to students, assign them drills and exercises, and test their memory	
13. Learning primarily involves absorbing as much information as possible (empty glass concept)	
14. Good students are silent and follow the teacher's instructions in class (whether they feel right or wrong)	
15. Traditional teaching/lecture methods are the best because they include more information/knowledge	

After validity testing, 25 statement tend to be valid and reliable (Cronbach Alpha = 0.795). The data analysis technique used to determine epistemic and pedagogical beliefs is by looking at the average of each continuum. While the data analysis technique to find out the relationship between epistemic beliefs and pedagogical beliefs is by using simple regression analysis using SPSS ver.22.

3. RESULTS AND DISCUSSION

3.1. Student epistemic and pedagogical beliefs

The questionnaire about epistemic belief and pedagogical belief were distributed via the Google form then analyzed descriptively. It should be noted that students sometimes agreed to two contradictory statements, for example in statements related to epistemic beliefs on the certainty dimension of knowledge, there are statements related to the concept of social studies material containing definite facts and social studies is material that may be less relevant, some students agreed with these two statements even though looks the opposite. The result can be seen in the Table 3.

The percentage of each dimension, on two different continuums on naïve and sophisticated epistemic beliefs almost all dimensions show a percentage of agreement above 50%, except for the statement that "social studies material is a fact that is not related to one another." others". Student epistemic beliefs are categorized into naive epistemic beliefs and sophisticated epistemic beliefs. For naive epistemic beliefs, the mean score obtained is 2.16 out of a maximum score of 4, meaning that 54% of students from 100% agreed with statements in the continuum of naive epistemic beliefs. Meanwhile, for sophisticated epistemic beliefs, a mean score of 3.01 out of a maximum score of 4 means that 75% agree on the continuum of sophisticated epistemic beliefs.

Meanwhile, in the pedagogical belief questionnaire, several statements of pedagogical beliefs on the traditional continuum still received a fairly high percentage of approval above 50%, such as the statement that "the teacher's role is to transfer knowledge to students", "the teacher must control what students do as

long as time", "learning primarily involves absorbing as much information as possible" whereas, for the statements that show a continuum of constructivist pedagogical beliefs, all statements get above 50% agreement.

The mean score obtained on the dimensions of traditional pedagogical beliefs was 2.27 out of a score of 4 meaning that 57% of students agreed with the statements on the continuum of traditional pedagogical beliefs. While the average score obtained on constructivist pedagogical beliefs, shows an average of 3.48 out of a maximum score of 4 meaning that 87% of students agree with the continuum of constructivist pedagogical beliefs. The result can be seen on the Table 4.

Table 3. Result of epistemic belief questionnaire

Number of questions	Certainty		Simplicity		Source of knowledge		Justification		Truth attainment	
	Fixed (N)	Fluid (S)	Sets of facts (N)	Highly interrelated concepts (S)	Outside the self (N)	Within the self (S)	Relying on authority and experts (N)	Relying on personal experience and evaluation (S)	Attain-able (N)	Non-attain-able (S)
a	29.7%	70.3%	13.5%	86.5%	55%	45%	51.4%	48.6%	74.8%	25.2%
b	63.1%	38.9%	29.9%	72.1%	30.6%	69.4%	40.5%	59.5%	70.3%	29.7%

N = Naïve; S = Sophisticated

Table 4. Mean score for each pedagogical belief statement

Traditional	Constructivist
1.602339	3.403509
2.187135	3.333333
2.625731	3.614035
1.982456	3.649123
2.807018	3.444444
2.719298	3.45614
2.274854	3.298246
1.847953	3.538012
2.25731	3.614035
2.690058	
2.444444	
2.181287	
2.461988	
2.070175	
Mean = 2.29	Mean = 3.48

From these results, it can be seen that 75% of students have a tendency to have sophisticated epistemic beliefs and 85% of students have a tendency to have constructivist pedagogical beliefs about the social studies learning concept in elementary schools.

3.2. The relationship between epistemic beliefs and pedagogical beliefs

To find out whether epistemic beliefs can influence pedagogical beliefs, testing was carried out using a linear regression test. However, before that, the prerequisite regression tests were carried out. It is normality test, linearity test and heteroscedasticity test. The result of normality test can be seen on the Table 5.

Table 5. One-sample Kolmogorov-Smirnov test

		Unstandardized residual
N		118
Normal parameters[a,b]	Mean	.0000000
	Std. deviation	.21765616
Most extreme differences	Absolute	.065
	Positive	.057
	Negative	-.065
Test Statistic		.065
Asymp. Sig. (2-tailed)		.200[c,d]

a. Test distribution is normal.
b. Calculated from data.
c. Lilliefors significance correction.
d. This is a lower bound of the true significance.

Based on the results of the normality test, the significance value is 0.2 > 0.05, it can be concluded that the residual values of the two variables are normally distributed. Furthermore, the results of the linearity test can be seen in the Table 6. Deviation from linearity shows a significance of 0.767 > 0.05 so it can be said that there is a significant linear relationship between epistemic beliefs and pedagogical beliefs. The last perquisite is heteroscedasticity test. It can be seen on the Table 7. The significance value is 0.531 > 0.05, so there are no symptoms of heteroscedasticity. Based on the results of the tests carried out, the classical assumption test has been fulfilled so a simple linear regression analysis can be carried out. Result of simple linier regression can be seen in the Table 8.

Table 6. ANOVA test result

			Sum of squares	df	Mean square	F	Sig.
Pedagogic * epistemic	Between groups	(Combined)	1.448	16	.090	1.824	.038
		Linearity	.918	1	.918	18.491	.000
		Deviation from linearity	.530	15	.035	.712	.767
	Within groups		5.012	101	.050		
	Total		6.460	117			

Table 7. Heteroscedasticity test result

			AbsRes	Epistemic
Spearman's rho	AbsRes	Correlation coefficient	1.000	-.058
		Sig. (2-tailed)	.	.531
		N	118	118
	epistemic	Correlation coefficient	-.058	1.000
		Sig. (2-tailed)	.531	.
		N	118	118

Table 8. Linear regression coefficients

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.717	.232		7.402	.000
	epistemic	.408	.093	.377	4.382	.000

a. Dependent variable: pedagogic

The constant value is 1.717, this means, if there is no change in the student's epistemic beliefs or 0 then the value of the dependent variable or pedagogical beliefs is 1.717. The epistemic belief regression coefficient value of 0.408 is positive, so that if the epistemic belief value increases by 1% then pedagogical confidence will increase by 0.408. Based on the significance value in the coefficient table, a value of 000<0.005 is obtained, so it can be concluded that epistemic belief variable has an effect on pedagogical belief.

We found students' epistemic beliefs correlated with students' pedagogical beliefs in the social studies learning concept in elementary school. The more sophisticated the student's epistemic beliefs, the more constructivist the pedagogical beliefs held by the student. And conversely, the more naïve the epistemic beliefs of students are, the more traditional the pedagogical beliefs they have.

The exploration regarding student epistemic beliefs shows that students still agree on both the continuum of naïve and sophisticated epistemic beliefs simultaneously. However, the results of the average analysis show that 75% of students have a tendency to agree with sophisticated epistemic beliefs. This means that although agreement on naive epistemic beliefs is above 50%, agreement on sophisticated epistemic beliefs is still much higher. What needs to be underlined, this research was conducted on students at the initial level, it could be that students' epistemic beliefs about social studies learning that they understand will change as they gain more experience later on. This is in accordance with the results of previous research [29] on students in Hong Kong which shows that students identify the transition of higher education as the main source of changes in epistemic beliefs, they associate changes in epistemic beliefs mostly with educational encounters. This meeting is characterized by a multi-perspective curriculum, taught by lecturers who can provide cognitive guidance for the resolution of epistemic beliefs. This proves that epistemic beliefs can change along with changes in the student's environment and the interventions carried out in the world of education that they follow.

From the results of this study, it can be revealed that elementary school teacher students have a tendency towards sophisticated epistemic beliefs rather than naïves. This result in line with the recent study [30] which shows the perception that most teacher candidates strongly believe that academic work is more important than innate abilities, believe strongly in changing knowledge, and tend to confront the authority of knowledge. In addition, the results of this study are also in accordance with other findings [31] shows that the epistemic beliefs of elementary school teachers student predict the concept of teaching and learning. The difference with the results of this study is that this study uses a proprietary model [10] that looks at epistemic beliefs in five dimensions and two continuums, called naive and sophisticated. Even so, the results of research related to student epistemic beliefs have the same conception which leads to more sophisticated epistemic beliefs.

However, the meaning of the concept of epistemic belief in the results of this study may be different in the context of different conditions and cultures. The diversity of students' epistemic beliefs that are influenced by various factors such as the characteristics of the class where they study can affect the epistemic beliefs they believe [32]. As shown in recent [33] that conducting research on the epistemic beliefs of Dutch and American students shows that Dutch students are more likely to be subjective than American students in describing knowledge, information, and truth and defining knowledge and information as synonyms. Similarities and differences related to educational background are considered in terms of instructional implications. This means that different cultural backgrounds can affect the epistemic beliefs held by students. So, the epistemic beliefs of prospective teacher students will have different conceptions and meanings because they are related to different cultural contexts.

Compared to epistemic beliefs, student pedagogical beliefs are more clearly different. Students already have a belief tendency that leads to a constructivist continuum. This finding is also support with other research [34] that exploring the pedagogical beliefs of elementary school teacher students in Turkey. The results of this research show that prospective elementary school teacher students have a tendency toward more constructivist pedagogical beliefs. This result is also in line with research [35] on prospective mathematics teachers which states that the pedagogical beliefs of prospective mathematics teacher students are more constructivist pedagogical beliefs. This belief also influences their acceptance of technology-based learning models. Thus in the end pedagogical beliefs can influence the learning and teaching practices of prospective teacher students, as stated by Mihaela and Alina-Oana [36] pedagogical beliefs influence pedagogical behavior, resulting in the formation of educational styles, conceptions of the educational process, and use of certain methods. It is important for students to have more constructive pedagogical beliefs; this is because these pedagogical beliefs affect various aspects such as the use of technology in learning that is more adaptive.

Epistemic beliefs can predict students' pedagogical beliefs. The results of this study are in line with the findings of research conducted by Aypay [20] that conducted research on 341 teacher candidates which showed that the epistemic beliefs of teacher candidates (in this case using the fixed ability, innate ability epistemic belief model) are directly related to pedagogical beliefs. In addition, gender differences show that female students tend to have a more constructivist pedagogical conception than male students. This study did not consider gender differences among the subjects observed. In addition, other research findings of prospective elementary school teachers on science learning reinforce that the teacher-centered orientation of science learning is largely predicted by unhelpful learning approaches, naive epistemological beliefs, and traditional conceptions of learning in science (traditional pedagogical beliefs). On the other hand, learning with a student-centered/development orientation is largely predicted by constructivist conceptions of learning (constructivist pedagogical beliefs) [37]. Our study demonstrate that epistemic belief can serve as a predictor of students' pedagogical beliefs, future research could explore ways of developing more sophisticated epistemic beliefs.

4. CONCLUSION

Our findings provide conclusive evidence that Epistemic beliefs can predict students' pedagogical beliefs. Students who have naive epistemic beliefs tend to have traditional pedagogical beliefs while students with more sophisticated epistemic beliefs have more constructive pedagogical beliefs. This research is specific to prospective elementary school teacher students who do have clear pedagogical knowledge. Different results might be obtained if the research subjects were non-teaching students who did not have sufficient pedagogical knowledge. So, the results of this research cannot be generalized to all students. This study explored a comprehensive epistemic belief with pedagogical belief. However, further and in-depth studies may be needed to confirm its differences in student cultural backgrounds, especially regarding a learning culture that allows students to determine their understanding regarding beliefs about the nature of knowledge and knowing. Future studies may explore learning design that facilitates the development of students' epistemic beliefs and pedagogical beliefs as preparation for becoming competent teachers.

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