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Education, Reflection, Development**EPISTEMOLOGICAL BELIEFS AS A PREDICTOR OF
METACOGNITIVE AWARENESS: PRE-UNIVERSITY TEACHING
PRACTICE IMPLICATIONS**

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Abstract

Metacognitive teaching holds an essential role today since it facilitates the development of lifelong learning skills and prepares students for their professional careers. It is crucial to show if metacognition is strongly related to epistemological beliefs, this influencing how teachers use various teaching strategies and are in tune with their students' learning process. This research sheds light on how metacognition relates to epistemological beliefs in the educational context and aims to find the relationship between these two variables and test the predictive role of epistemological beliefs on metacognition. Two self-reported instruments on a five-point Likert scale were completed by 146 pre-university teachers, who took part in our online investigation. Metacognition used in teaching practices was measured with The Metacognitive Awareness Inventory for teachers and teachers' epistemological beliefs with The Epistemological Questionnaire Beliefs Inventory. Data analysis included specific demographic characteristics such as age, teaching experience, teaching level, specialization, job type, and teaching degrees, which were related to both epistemological beliefs and metacognitive awareness. In terms of the relationship between epistemological beliefs and metacognitive awareness, a strong predictive model has been revealed: epistemological beliefs are a strong predictor of metacognitive awareness. The findings are analysed in relation to their practical implications.

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1. Introduction

In a society in which information can be easily accessed by hundreds of millions of people with a simple click / from a simple cellphone, acquiring a huge amount of information / knowledge is not as useful as it has been in the past. Today, it is essential to know how to deal with the huge amount of information or how to select and use the information in your everyday life. Therefore, knowing how to learn and how to use knowledge in lifelong learning or professional development is more important than having only a strong knowledge base. In the specialty literature this emphasis on how to learn is known as metacognition. The concept of metacognition has become central in educational studies along with the studies published by Flavell (1979). Metacognition has been studied in relation to various concepts such as academic performance (Schommer, 1993), gender (Ciascai & Haiduc, 2011), reading skills (Hall, 2004; Haiduc & Ciascai, 2011; McKeown & Beck, 2009; Spörer et al., 2009; Williams & Atkins, 2009).

1.1. Epistemological beliefs

The concept of epistemological beliefs refers to the subjective beliefs of individuals about what science is and how the learning process takes place. Epistemological beliefs reflect personal opinions in response to questions such as: "What is science?", "How is knowledge assimilated?", "What is the degree knowledge accuracy", "What are the criteria and limits of science?" (Aksan, 2009).

Theories of epistemological beliefs can be divided into two areas: "development models" and "multidimensional models". Phase models (one-dimensional) involve successive stages of development of epistemological beliefs. These models propose a development trajectory about epistemological beliefs, starting with the objectivist or dualist point of view on knowledge. Passing through the phasis individuals become aware of the changing nature of knowledge and integrate different perspectives. Moreover, they acknowledge the importance of inquiry and evidence. Once the individual enters the last phase, knowledge is seen as a work in progress and the learner is also seen as a possible source of knowledge (Hofer & Pintrich, 1997; Zinn, 2012).

At the basis of the development model stands the first epistemological belief research study made in 1968 by William Perry, who using a qualitative approach interviewed students on their beliefs at the beginning and at the end of their bachelor's degree program. The results showed a change in the evolution of students' beliefs, from immutable truths from the authorities to relativistic perspectives in which the source of knowledge includes the self (Perry, 1968).

Later developments of the topic have been made by Schommer (1990, 1993, 1994) in a quantitative approach showing sophisticated epistemic beliefs as being associated with better academic performances. Schommer (1994, p. 25) defined epistemological beliefs as thoughts regarding "the nature of knowledge and the means of acquiring it". To sum up, epistemological beliefs involve beliefs about the source of knowledge, how is knowledge developed, where it exists and what is important when we talk about knowledge.

The multidimensional model (dimension-based model), developed by Schommer, in 1990, includes a series of relatively independent dimensions. According to this model, epistemological beliefs have five dimensions: structure, source, certainty (beliefs about knowledge) and speed and control

(beliefs about the accumulation of knowledge). These dimensions can develop individually on a continuum and can manifest bipolar characteristics, especially offering the possibility to choose between a “naive” or a “sophisticated” position (Zinn, 2012).

In addition, in the educational psychology field there is a very popular theoretical background that includes the identification of four dimensions of beliefs, related to a certain extent, of the "nature of science" and the “nature of knowing”: the certainty of science (the power of evidence), the structure of science, the rationale of science, and the source of science (Bromme et al., 2010).

Research on epistemological beliefs has increased considerably in recent years. A major theoretical statement on this topic is that the development of the learner's epistemological beliefs can span from "naive" perspectives (science is certain; knowledge is acquiring absolute truths) to more "sophisticated" beliefs (science is a complex; knowledge is relative and contextual). Moreover, a large amount of research papers show that these sophisticated beliefs are associated to more proper learning strategies and higher academic performances (Zinn, 2012), evidence from research highlighting that individuals with a higher level in sophisticated epistemological beliefs have a greater engagement in critical thinking (Valanides & Angeli, 2005).

Although important in the use of metacognition in learning, epistemological beliefs have not been the focus of research in this field. There is research that shows the predictive role of epistemological beliefs in the use of metacognition and self-regulation (Koksal & Yaman, 2012; Muis, 2007; Metallidou, 2012; Yilmaz-Tüzün & Topcu, 2010). Koksal and Yaman (2012) investigated the role of epistemological beliefs of the 9th grade science students in self-regulated learning. Their study shows that epistemological beliefs are significant predictors of self-regulated learning and explain 53% of the variance in the self-regulated learning (which includes metacognitive self-regulation as well).

However, there is research that shows that the relationship between epistemological beliefs and metacognitive learning is more complex than shown in earlier research. Several studies challenge the idea of a positive direct relationship between epistemological beliefs and metacognitive learning. For instance, Metallidou (2012) shows that in a sample of 8th and 9th grade students in Greece, epistemological beliefs predicted the use of both surface and deep learning strategies. These differences in the predictive role of epistemological beliefs in student's metacognition and self-regulated learning might be explained by intercultural differences. Felbrich et al. (2012) use the TEDS-M (Teacher Education and Development Study in Mathematics) data to investigate how teachers' beliefs in Mathematics vary among 15 countries. They conclude that teachers' beliefs about the nature of Mathematics are significantly different among the countries included in the study. These cultural differences in beliefs might explain the inconsistent results of the studies that analysed the relationship between metacognition and epistemological beliefs. Based on the studies mentioned above, there is a need to further analyse the role that epistemological beliefs hold in using metacognition in learning.

1.1 Metacognition

Metacognitions are classically defined as “a person's cognitions about his or her cognitions” (Flavell, 1979). Another traditional definition states metacognition as one's ability of controlling different cognitive processes (Pintrich, 2002). These differentiate from other kinds of cognitions in terms of

quality, but they are different only from a relational point of view because they regard an individual's self-cognitions (Bromme et al., 2010).

Flavell, a pioneer in metacognition research, claims that there is an association between students' knowledge, experience, metacognitive skills, and their cognitive control during the learning process. Metacognitive knowledge can be defined as beliefs about tasks, strategies, and goals, with metacognitive experiences including affective experiences related to cognitive processes, and metacognitive skills as strategies used to control cognitive processes (Flavell, 1979).

Besides the Flavell's approach on metacognition (1979), there is another created by Brown in 1987, saying that metacognition making up two dimensions, namely metacognitive knowledge, and metacognitive regulation. Metacognitive knowledge refers to the way learners understand declarative, procedural, and conditional knowledge, and metacognitive regulation encompasses planning, monitoring, and evaluation strategies (Brown, 1987; Spada et al., 2010).

In what concerns the connection between epistemological beliefs and metacognition, Bromme et al. (2010) have shown a positive correlation between the two variables. In other words, epistemological beliefs with a higher degree of sophistication are associated to greater levels of metacognition (Bromme et al., 2010).

2. Methodology

2.1. Participants

This study has 145 participants, who are Romanian teachers from all preuniversity teaching levels in Romania: preschool, elementary, middle, and high school levels. The mean age of participants is 43.88 years old, and the mean of experience is 20.12 years. Most participants have the 1st grade in teaching (66.9%) and the highest percent teach at the elementary level (55.2%) and middle level (35.9). Females are highly represented in this study, with a percent of 94.5 %.

2.2. Instruments

Two self-assessment scales were translated and adapted to be used in this research: The Metacognitive Awareness Inventory for Teachers (Balcikanli , 2011) and EQEBI (Ordoñez et al., 2016). The first scale, the MAIT, has 24 items and two main dimensions: metacognitive knowledge (declarative knowledge, procedural knowledge, and conditional knowledge) and metacognitive regulation (planning, monitoring, and evaluating) measured on a 5-point Likert Scale (from 1-strongly disagree to 5 - strongly disagree). The Alpha Cronbach reported in the literature varies from 0.79 to 0.85. Concerning the scale's validity, Cem reported a KMO of 0.794 and a significant value for the Bartlett Test (2513,474). The second self-assessment scale was the Epistemological Questionnaire Beliefs Inventory (Ordoñez et al., 2016), with 27 items measured on a 5-point Likert scale (from 1- strongly disagree to 5- strongly disagree). The 27 items are organized in the following four dimensions: certain knowledge (4 items), simple knowledge (4 items), quick learning (11 items) and innate ability (8 items). In the present study, the Alpha Cronbach was 0.768 for the EQEBI and 0.783 for MAIT.

2.3. Procedure

As a first step, both scales were translated into Romanian and then back into English to check for language validity, the process being carried out by two PhD students and one university teacher. Both MAIT and EQEBI were used with all their original items. The second step was the distribution of the scales in teachers' online communities such as Facebook groups, WhatsApp groups and emails. All the data were collected in an online environment, mainly due to the pandemic and post-pandemic restrictions regarding school access, using the google forms application.

2.4. Data analysis

Data were analyzed using quantitative data analysis methods and the main variables introduced in the analysis were sociodemographic characteristics, metacognitive skills, and epistemological beliefs.

3. Results

Table 1 and Table 2 represent the demographic characteristics of the sample included in the study. We included both qualitative (gender, teaching level and didactical grade) and quantitative (age and experience) demographic variables.

Table 1. Demographic characteristics (qualitative variables)

Variable	Categories	Frequency	Percentage
Gender	Female	137	94.5
	Male	8	5.5
Teaching level	Preschool	13	9
	Elementary	80	55.2
	Middle	52	35.9
Didactical grade	First level	20	13.8
	Second level	28	19.3
	Third level	97	66.9
Teaching area	Urban	112	77.2
	Rural	33	22.8

Almost all participants are females (94.5%), a feature of the Romanian educational system in which female employees predominate. The highest percentage of participants teach at the primary/elementary teaching level, and more than half have reached the highest professional level.

Table 2. Demographic characteristics (quantitative variables)

Variable	Mean	Std. Error of Mean
Age	43.88	0.81
Experience	20.12	0.88

With a mean age of 43.88 years and 20.12 years of teaching experience, most teachers work in urban area schools (77.20%) and only a small percentage in rural ones (22.80%). These demographic variables were introduced in the study to test their potential impact on metacognitive awareness and epistemological beliefs. Thereby, we applied the necessary tests to identify the differences between these

demographic data and the variables of interest introduced in the study. The results of these analysis (Table 3) indicate that only one demographic variable, the teaching grade, has an impact on metacognitive awareness [$F(2, 142) = 11.51, p < 0.01$], but not on epistemological beliefs.

Table 3. ANOVA (Teaching grade)

Variables		Sum of Squares	df	Mean Square	F	Sig.
Metacognitive awareness	Between Groups	2184.84	2	1092.42	11.51	.000
	Within Groups	13469.91	142	94.85		
	Total	15654.75	144			
Epistemological beliefs	Between Groups	221.63	2	110.81	1.11	.331
	Within Groups	14134.13	142	99.53		

Data in Table 4 illustrate the differences in metacognitive awareness according to the teaching grade. The Tukey Post Hoc test showed that the group of participants with the 1st level in teaching differ significantly from the other two groups at $p < 0.01$. Moreover, the difference in metacognitive awareness was further identified between those who have the 2nd level in teaching and the 1st one (but not with those who have the 3rd level) and those who have the 3rd level and the 1st one in teaching.

Table 4. ANOVA multiple comparisons

Multiple Comparisons							
Metacognitive awareness	(I) 7. Teaching grade:	(J) 7. Teaching grade:	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	First level	Second level	-9.96*	2.85	.00	-16.72	-3.21
		Third level	-11.47*	2.39	.00	-17.13	-5.80
	Second level	First level	9.96*	2.85	.00	3.21	16.72
		Third level	-1.50	2.09	.75	-6.45	3.45
	Third level	First level	11.47*	2.39	.00	5.80	17.13
		Second level	1.50	2.09	.75	-3.45	6.45

* The mean difference is significant at the 0.05 level.

Table 5 below shows the correlation between metacognitive awareness and epistemological beliefs.

Table 5. Pearson correlations

		Metacognitive awareness	Epistemological beliefs
Metacognitive awareness	Pearson Correlation	1	.277**
	Sig. (2-tailed)		.001
	N	145	145
Epistemological beliefs	Pearson Correlation	.277**	1

Sig. (2-tailed)	.001
Correlation is significant at the 0.01 level (2-tailed). **	

The correlation analysis conducted in SPSS reveals a positive and significant correlation between metacognitive awareness and epistemological beliefs. As expected, these two variables are interrelated, although the correlation coefficient is quite low: $r=0.277$, $p=0.01$. Based on these results and on the literature review, we continued the analysis of the data with the simple linear regression analysis to verify if the epistemological beliefs represent a significant predictor for metacognitive awareness. The results of the regression analysis are presented below, in Table 6, Table 7, Table 8 and Table 9.

Table 6. Regression: variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Epistemological beliefs b	.	Enter
a Dependent Variable: Metacognitive awareness			
All requested variables entered.			

Table 7. Regression: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.277 ^a	.077	.070	10.054
a Predictors: (Constant), Epistemological beliefs				

Table 8. Regression: ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1198.07	1	1198.07	11.85	.001 ^b
	Residual	14456.68	143	101.09		
	Total	15654.75	144			
a Dependent Variable: Metacognitive awareness						
b Predictors: (Constant), Epistemological beliefs						

Table 9. Regression coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	80.27	6.75		11.88	.000
	Epistemological beliefs	.289	.084	.277	3.44	.001
a Dependent Variable: Metacognitive awareness						

The overall regression was statistically significant: $R^2=0.07$, $F(1,143)=11.85$, $p=0.001$. It was found that epistemological beliefs significantly predicted pre-university teachers' metacognitive awareness ($\beta=0.277$, $p=0.001$).

4. Conclusions

This paper's purpose is to contribute to the ongoing discussions on the relationship between epistemological beliefs and metacognition, paying particular attention to teachers as a target group due to their role in modelling and scaffolding the metacognition of their students and in directing their students to more sophisticated epistemological beliefs. Moreover, we have also considered the consequences of the two variables on the academic achievement, more sophisticated epistemological beliefs (Zinn, 2012) and higher levels of metacognitive awareness (Schommer, 1990, 1993) being associated with better learning outcomes.

These results are consistent with other studies which have shown that epistemological beliefs are associated with metacognition. Nevertheless, epistemological beliefs are a predictor for the metacognitive awareness of teachers, significant differences being found about the metacognitive awareness in terms of the teaching grade.

The findings are of practical relevance for developing training programs for pre-service and in-service teachers. These could be improved by designing activities to cultivate teachers' epistemological beliefs and to increase the level of their metacognitive awareness. Another practical implication of the present study regards the development of curriculum framework to address metacognitive skills as a finality of the education process.

The finding of the paper presents possible limitations in terms of the research design based on self-reported scales. To overcome this inconvenient future research should be focused on a mixed-methods approach. Moreover, future work will include the experimental confirmation of the efficacy of a teachers' training program helping the development of teachers' metacognitive awareness through the development of their epistemological beliefs.

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