Participatory Educational Research (PER)
Special Issue 2016-III, pp., 236-243 November, 2016
Available on
line at http://www.partedres.com
ISSN: 2148-6123

Examining Of Epistemological Beliefs Of Students In Science Education, Biology Education And Biology-Related Pedagogical Formation Course According To Some Variables

Mehmet YAKIŞAN* and Şadiye KARAŞAH
Ondokuz University, Samsun, Turkey

Abstract
This study was performed in order to examine the epistemological beliefs of students who study science education, biology education and take the biology-related pedagogical formation course in Ondokuz Mayıs University. In this study, In order to determine epistemological beliefs of the students for this study that were conducted with a total of 107 students, including 32 from students of the fourth class science teacher, 41 from students of the fourth class biology teacher and 34 from the formation training biology students studying in Ondokuz Mayıs University.
In this study, "The Epistemological Beliefs Scale" was used with the aim of determine students' epistemological beliefs that was developed by Schommer (1990) and adopted in Turkish by Deryakulu and Büyüköztürk (2005). The scale is a thirty five-point scale consisting of three factors. The first studies on epistemological beliefs are based on the examination of these beliefs in general as one-size. In this study used as The Epistemological Beliefs Scale was adopted in Turkish by Deryakulu and Büyüköztürk (2002) "The Belief of Learning Depends on Effort", "The Belief of Learning Depends on Ability" and "The Belief of There is Only One Unchanging Truth" consists of three factors. Research is a descriptive study of college students' by gender and departments, epistemological beliefs in causal comparative models.
The data collected were analyzed with SPSS 21 program. The descriptive statistical methods were used to evaluate the data, t-test and one-way analysis of variance (One-Way ANOVA) was calculated. According to analysis the result of the demonstrated that there is no statistically significant difference between students' scientific epistemological beliefs and their gender of all three factors. According to the students' departments, it was found out those two beliefs, one of which is that "The Belief that Learning Depends on Effort" and the other one is that "The Belief that Learning Depends on Ability", differ. However; the belief concerning that "The Belief That There is Only One Unchanging Truth" does not differ.

Key words:epistemological beliefs, science education, biology education, epistemology

* yakisanm@gmail.com

Introduction

Beliefs adopted by living creatures affect their ideas, movements, behaviours and characters. Beliefs that we have within the context of personal development have an effect on us. Schommer (1994) states that personal epistemological beliefs have a pragmatic impact on self-cognitive and metacognitive processes. Demir and Acar (1993: 179) define belief as "assumptions that are not dampened directly by certain reasons related to something that is so, or information outside the inquiry platform".

Studying knowledge and its nature, the concept of epistemology was first introduced by philosopher J. F. Ferrier (Dağ, 1980). The concept of epistemological beliefs is used to answer questions such as "What is knowledge?", “How is knowledge gained?", "What is the degree of accuracy of knowledge?", and "How is knowledge structured by students?” In addition to numberless definitions on the concept of epistemological belief, it is also defined as "subjective beliefs regarding what is knowledge and how do knowing and learning happen" (Shommer, 1994). Assumptions of teachers about the nature and source of knowledge, that is their epistemological beliefs, have significance on their methods and techniques of teaching that they will use during their educational career, as well as on their relationship with students and its role in classroom management. There are several researches that prove the fact epistemological beliefs are important on the basis of approaches to learning and teaching (Cano, 2005; Phan, 2008; Phillips, 2001). Therefore, it is necessary to know the epistemological beliefs of teachers and teacher candidates (Öngen, 2003).

In his research conducted on scientists, class teachers and science teachers, Pomeroy (1993) sought to determine the understanding of scientists and teachers of science, scientific method and science education. According to results of the research, it was found that the teachers have a more traditional understanding of science compared to scientists. It was also identified that science teachers had more traditional understanding of science compared to the class teachers.

Although the concept of epistemology was first introduced by J. F. Ferrier, foundations of the study of epistemological beliefs were first laid in 1968 by Perry. Since then, epistemological beliefs are still accepted to be a field of study. Since 1968, several models of epistemological beliefs have been created. Recently the most often preferred model is the model developed by Schommer. Epistemological belief models developed till today are given below.

(1) Perry and Scheme of Intellectual and Ethical Development
(2) Belenky and Women's Ways of Knowing
(3) Magolda and Epistemological Reflection
(4) King-Kitchner and Reflective Judgement
(5) Kuhn and Argumentative Reasoning
(6) Schommer and Epistemological Beliefs

In all of the first 5 models of epistemological development listed above, beliefs are considered in one-dimensional manner. In other words, they are dealt with only in a way to have a coverage on beliefs about knowledge. Schommer thought this one dimensional epistemological belief model to be restrictive on determination of the subtler relationships between students' beliefs towards learning and various aspects of learning, meanwhile re-conceptualising epistemological beliefs as an independent system of beliefs. By "independent

system of beliefs", Schommer indeed wishes to underline the fact that epistemological beliefs may develop in different rates. He also uses the word "independent" to emphasise whether or not beliefs develop simultaneously (Aksan and Sözer 2007, Schommer et. al., 1997: 175; Schommer and Dunnell, 1997: 153). Schommer reveals four independent dimensions on epistemological beliefs, which he named (1) Simple Knowledge, (2) Certain Knowledge, (3) Quick Learning, and (4) Innate Ability. This study was performed according to the model of Schommer and Epistemological Beliefs, while the structure of information is examined in three dimensions.

Methodology

This study was conducted in order to investigate epistemological beliefs of students from departments of science and biology teaching as well as students from formation process at OndokuzMayıs University. This research is a descriptive study where students' epistemological beliefs and genders are examined based on their fields of study, while also using causal-comparative research method. In cases which include the comparative investigation of events or statuses, casual-comparative research method is generally preferred (Fraenkel and Wallen Hyun, 2012).

The study was conducted with the participation of 107 students, 32 of which were from the department of science teaching, 41 of which were from the department of biology, and 34 of which were from formation training, all of whom were senior students studying at OndokuzMayıs University.

The "Scientific Epistemological Belief Scale", developed by Schommer (1998) and adapted into Turkish by Deryakulu and Büyüköztürk (2002), was used in this research as an epistemological belief scale. The scale is a 35-article scale consisting of 3 factors. The Scientific Epistemological Belief Scale, adapted into Turkish by Deryakulu and Büyüköztürk (2002), consists of 3 factors, namely "The Belief that Learning Depends on Effort ", "The Belief that Learning Depends on Ability", and "The Belief that there is Only One Unchanging Truth". Scientific Epistemological Belief Scale was reviewed in 2005 by Deryakulu and Büyüköztürk, then revised to consist of 3 factors and 34 articles with the removal of one article. Within the scale of 34 articles, 17 of them are based on “The Belief that Learning Depends on Effort” factor, whereas 8 on "The Belief that Learning Depends on Ability" factor, while 9 on "The Belief that There is Only One Unchanging Truth" factor. Moreover in the study conducted by Deryakulu and Büyüköztürk (2005), Confirmatory Factor Analysis was used in order to determine the correctness of the 3-factor Epistemological Belief Scale. For each factor found within the scale, Cronbach alpha internal consistency coefficient was calculated for “The Belief that Learning Depends on Effort" as 0.84, for "The Belief that Learning Depends on Ability" as 0.69, and for "The Belief that there is Only One Unchanging Truth" as 0.64. In this study, however, Cronbach alpha internal consistency coefficients were calculated as 0.79, 0.80, and 0.62, respectively. It can be seen that the values calculated in this research show resemblance to those found in the study by Deryakulu and Büyüköztürk (2005).

It is given in a way that high scores obtained from “The Belief that Learning Depends on Effort” subdimension indicate "advanced / mature epistemological beliefs"; whereas high scores obtained from “The Belief that Learning Depends on Ability” and “The Belief that

There is Only One Unchanging Truth" sub dimensions indicate "undeveloped / immature epistemological beliefs" (Deryakulu and Büyüköztürk, 2002).

Results

This section includes findings related to the problems of the research. It was also analysed whether there would be any difference among the sub dimensions of Epistemological Belief Scale based on variables of gender and fields of study of the university students.

According to the gender variable, no significant difference between students in terms of the sub dimensions of epistemological beliefs scale was found. According to the gender variable, values of sub dimensions of epistemological belief scale are shown in Table 1.

Table 1: Breakdown of Sub Dimensions of Epistemological Belief Scale Based on Gender

SubDimensions of EpistemologicalBeliefs	Gender	n	$\overline{X}$	S	t	p
1. "*The Belief that Learning Depends on Effort"*	Female	91	69.94	6.91	1.84	0.068
	Male	16	66.18	10.38		
2. "*The Belief that Learning Depends on Ability*"	Female	91	17.74	5.57	-1.36	0.176
	Male	16	19,87	6.82		
3. "*The Belief that There is Only One Unchanging Truth*"	Female	91	27.49	5.37	-0.17	0.861
	Male	16	27.75	5.39		

Examining Table 1 shows no significant difference among Sub Dimensions of Epistemological Beliefs of teacher candidates based on the gender variable ($p > 0.05$). Despite the statistical indifferences based on gender, it was found that female students have a higher average score on sub dimensions of epistemological beliefs and a more advanced, mature epistemological beliefs compared to male students.

How the scores of Sub Dimensions of Epistemological Beliefs change based on the department they study at was examined, and the data for each sub dimension are given separately below. In general, it was found that based on the departments they study, sub dimensions appeared to be different in terms of "The Belief that Learning Depends on Effort" and "The Belief that Learning Depends on Ability"; however, no differences were found based on the departments they study in terms of "The Belief that There is Only One Unchanging Truth".

Table 2: Breakdown of Scores from the Sub Dimension of "The Belief that Learning Depends on Effort" by Fields of Study

Fields of Study	N	$\overline{X}$	S	sd	F	p
1. FormationBiology	34	71.11	5.40	2	4.92	0.009
2. BiologyEducation	41	70.58	5.30			
3. ScienceEducation	32	66.00	10.61			

As shown in Table 2, after analysing the average scores of students regarding the "The Belief that Learning Depends on Effort" sub dimension, it can be seen that there are remarkable differences between groups with regard to their fields of study. ($F(2)=4.92$, $p<0.05$). According to the data, biology students having formation training on the sub dimension of "The Belief that Learning Depends on Effort" have more advanced / mature beliefs compared to other groups.

Results of Scheffe test of Post-Hoc tests are given below, which were conducted in order to determine among which groups the score differences can be found.

Table 3: Post-Hoc test results acc. to department variable for "The Belief that Learning Depends on Effort"

Fields of Study		**Mean Difference**	**Std. Error**	**p**
Formation Biology	Biology Education	0.53	1.69	0.952
	Science Education	5.11	1.80	0.021
Biology Education	Formation Biology	-0.53	1.69	0.952
	Science Education	4.58	1.72	0.033
Science Education	Formation Biology	-5.11	1.80	0.021
	Biology Education	-4.58	1.72	0.033

As shown on Table 3, significant differences ($p=0.021$) between biology students having formation training and students from science education, and additional differences ($p=0.033$) between students from science education and students from biology education were found based on the data obtained for the sub dimension of "*The Belief that Learning Depends on Effort"*.

Table 4: Breakdown of Scores from the Sub Dimension of "*The Belief that Learning Depends on Ability*" by Fields of Study

Fields of Study	N	$\overline{X}$	S	sd	F	p
1. FormationBiology	34	17.52	4.24	2	4.29	0.016
2. BiologyEducation	41	16.65	4.50			
3. ScienceEducation	32	20.43	7.77			

Examining Table 4 and the average scores of students related to "The Belief that Learning Depends on Ability" shows significant differences among groups based on their fields of study. ($F(2)=4.29$, $p<0.05$). Accordingly it can be put forward that students from the department of biology teaching have more advanced/mature epistemological beliefs compared to others based on "The Belief that Learning Depends on Ability" sub dimension of the epistemological belief scale.

Table 5: Post-Hoc test results acc. to department variable for "The Belief that Learning Depends on Ability"

Fields of Study		**Mean Difference**	**Std. Error**	**p**
Formation Biology	Biology Education	0.87	1.30	0.80
	Science Education	-2.90	1.38	0.11
Biology Education	Formation Biology	-0.87	1.30	0.80

	Science Education	-3.77*	1.32	0.02
Science Education	Formation Biology	2.90	1.38	0.11
	Biology Education	3.77*	1.32	0.02

Examining Table 5 shows significant difference (p=0.020) only between students from science education department and students from biology education department based on data obtained from "The Belief that Learning Depends on Ability" sub dimension and on department variable.

Table 6: Breakdown of Scores from the Sub Dimension of "The Belief that There is Only One Unchanging Truth" by Fields of Study

Fields of Study	N	$\overline{X}$	S	sD	F	p
1. FormationBiology	34	28.76	4.34	2	1.38	0.25
2. BiologyEducation	41	27.14	5.05			
3. ScienceEducation	32	26.71	6.52			

As shown in Table 6, no significant difference was found based on department variable and the sub dimension of "The Belief that there is Only One Unchanging Truth". $F(2)=1.38$, $p<0.05$). Accordingly, students may be expressed to have similar epistemological beliefs in terms of this sub dimension.

Conclusion

In this study, it was aimed to perform an analysis on how epistemological beliefs of university students change based on gender and their fields of study. Results of the analyses show clear data on the fact that sub dimensions of epistemological beliefs of students significantly differ based on gender. In other researches on epistemological beliefs, it was found that epistemological beliefs did not significantly vary based on gender, as shown in this research (AksanveSözer, 2007; Izgar and Dilmaç, 2008; Terzi, 2005; Tümkaya, 2012). Besides in literature review, it was observed that different results were obtained from studies on the relationship between gender and epistemological beliefs. In the study conducted by Deryakulu and Büyüköztürk (2005), no statically significant differences were found on epistemological beliefs based on gender; however, it was found that arithmetic mean was higher with female students, that is, female students supported the idea that learning depends more on effort, in contrast to male students. Nevertheless, in some researches, significant differences were found in favour of female students based on sub dimensions of "The Belief that Learning Depends on Effort" and "The Belief that Learning Depends on Ability" between male and female students, and no significant differences were found based on gender in terms of "The Belief that There is Only One Unchanging Truth" sub dimension (Demir, 2005; Deryakulu and Büyüköztürk, 2005; Erdem, 2008; Eroğlu and Güven, 2006; Öngen, 2003; Schommer, 1993). In his study, Schommer (1990) found no significant differences between male and female students in terms of "The Belief that There is Only One Unchanging Truth" sub dimension; yet he determined that male students believed more on fast-learning compared to female students.

According to the results of this study, significant differences were found on teacher candidates based on “The Belief that Learning Depends on Effort” and "The Belief that Learning Depends on Ability" sub dimensions as well as their departments; whereas no significant differences were found among students in terms of "The Belief that There is Only One Unchanging Truth" sub dimension. In their study conducted on students from faculties of Education and Arts & Sciences, Aksan and Sözer (2007) concluded that gender and faculty interaction created a significant difference in terms of “The Belief that Learning Depends on Effort” and "The Belief that Learning Depends on Ability" sub dimensions. Such results of the study constitute a supportive basis for this study. In his study on epistemological beliefs of students from departments of Physics, Chemistry, Public Administration, Economy, Education of the Mentally Challenged, and Turkish Education; Eren (2006) found no significant differences related to "The Belief that There is Only One Unchanging Truth" and "The Belief that Learning Depends on Ability" sub dimensions based on department, but he found significant differences related to “The Belief that Learning Depends on Effort”. Such results fall in parallel with this study. However, unlike these results, Aksan (2006) examines the epistemological belief differences among students from Faculty of Arts & Sciences and Faculty of Education. Based on the statistical results related to faculties, no significant differences were found among students for each sub-dimension of the epistemological belief scale.

It is accepted that epistemological beliefs have important role through the period of education. Therefore, data collected from researches on epistemological beliefs are necessary to be taken into consideration in education, and to create the opportunity of facilitating education at its best possible form. For the period of education to be more productive on the students' behalf, knowledge of epistemological beliefs and the know-how of their design of structuralisation are important. Attitudes of students towards education can be positively improved and the realisation of a more effective facilitation of education can be achieved in an atmosphere of determined epistemological beliefs.

References

Aksan, N. (2006) The relationship between epistemological beliefs and the problem solving skills of college students, M.Sc. Thesis, Çanakkale On Sekiz Mart University, Institute of Social Sciences: Çanakkale.

Aksan, N. veSözer, M. A. (2007).The Relationshıps Among Epistemological Beliefs And Problem Solving Skills of University Students, AhiEvran University Journal of Kırşehir Education Faculty, 8: 31-50.

Cano, F. (2005). Epistemological beliefs and approaches to learning: their change through secondary school and their influence on academic performance. British Journal of Educational Psychology, 75(2), 203-221.

Demir, İ. (2005) Examining the relationship between the pre-service teachers' epistemological beliefs and their authoritarian tendencies. XIV. National congressional book of educational sciences, 730-736.

Demir Ö. &Acar. M. (1993), Social Sciences Dictionary, Vadi Publications

Deryakulu, D., &Büyüköztürk, S. (2002). Validity and reliability study of epistemological beliefs questionnaire. Eurasian Journal of Educational Research, 8, 111-125.

Deryakulu, D., &Büyüköztürk, Ş. (2005). The re-examination of the epistemological beliefs questionnaire’s factor structure: comparing epistemological beliefs in terms of gender and program type. Eurasian Journal of Educational Research, 18, 57-70.

Erdem, M. (2008). The effects of mixed teaching practice processes on teachers' self-efficacy and epistemological beliefs of teacher candidates. Eurasian Journal of Educational Research, 30, 81-98.

Eren, A, (2006). Examining the general and domain-specific epistemological beliefs of undergraduates. Doctoral dissertation. AbantIzzetBaysal University, Bolu.

Eroğlu, S. E., &Güven, K. (2006). Analysis of Some Variables of Epistemological Beliefs of Universıty Students. Selcuk University Journal of Social Sciences Institute, (16), 295-312.

Fraenkel, J., Wallen, N., & Hyun, H.H. (2012). How to Design and Evaluate Research in Education (8th Ed.). Boston: McGraw Hill.

Izgar, H., &Dilmaç, B. (2008). Yöneticiadayıöğretmenlerinözyeterlikalgılarıveepistemolojikinançlarınincelenmesi. SelçukÜniversitesiSosyalBilimlerEnstitüsüDergisi, 20, 437-446.

Öngen, D. (2003). Relationships between epistemological beliefs and problem solving strategies: A study on education faculty students. Journal of Educational Research, 3 (13), 155-162.

Schommer, M. (1990). Effects of Beliefs about the Nature of Knowledge on Comprehension. Journal of Educational Psychology, 82, 498-504.

Schommer, M. (1993). Epistemological development and academic performance among secondary students. Journal of Educational Psychology, 85(3), 406-411.

Schommer, M. (1994). Synthesizing epistemological belief research: Tentative understandings and provocative confusions. Educational Psychology Review, 6, 293-319.

Schommer, M. (1998). The influence of age and schooling on epistemological belief. The British Journal of Educational Psychology, 68(4), 551-560.

Schommer, M. veDunnell, P. (1997). Epistemological beliefs of gifted high school students. Roeper Review, 19 (3), 153–156.

Phillips, F. (2001). A research note on accounting students' epistemological beliefs, study strategies, and unstructured problem-solving performance. Issues in Accounting Education, 16 (1), 21-39.

Pomeroy, D. (1993). Implications of teachers' beliefs about the nature of science: Comparison of the beliefs of scientists, secondary science teachers, and elementary teachers. Science Education, 77(3), 261-278.

Phan, H. P. (2008). Multiple regression analysis of epistemological beliefs, learning approaches and self-regulated learning. Electronic Journal of Research in Educational Psychology, 6(1), 157–184.

Terzi, A. R. (2005). A research on scientific epistemological beliefs of university students, 7(2), 298-312

Tümkaya, S. (2012). Examination of epistemological beliefs of university students according to gender, class, educational field, academic achievement and learning styles. Educational Sciences; Theory and Practice, 12 (1), 75-95.