

The Relationship between Prospective Teachers' Belief Systems and Writing-to-Learn

Mehmet DEMİRBAĞ¹, Sevgi KINGİR², Salih ÇEPNİ³

ABSTRACT

The purpose of this study is to investigate the relationship between prospective teachers' belief systems and writing-to-learn. The participants comprised eight freshmen from the Department of Elementary Science Education at a public university in Turkey. The data were collected using semi-structured interviews. The results indicated that epistemological and pedagogical beliefs, attitudes and pre-experience were the main factors that affected the participants' writing processes. These prospective teachers also used a set of cognitive, meta-cognitive and affective strategies in their writing such as self-assessment, awareness, revising and empathising. Overall, writing provided the participants with benefits that helped them perform research, construct knowledge, understand conceptual change and acquire permanent learning. Therefore, this study concludes that the development of prospective teachers' belief systems can increase the quality of writing-to-learn and the strategies used for such activities.

Keywords: Belief systems, prospective teachers, writing-to-learn

Öğretmen Adaylarının İnanç Sistemleri ile Öğrenme Amaçlı Yazma Arasındaki İlişki

ÖZ

Bu araştırmada fen bilimleri öğretmen adaylarının inanç sistemleri ile öğrenme amaçlı yazma pratikleri arasındaki ilişki incelenmiştir. Araştırmaya üniversite düzeyinde 1. sınıfta öğrenim gören sekiz fen bilimleri öğretmen adayı katılmıştır. Öğretmen adayları ısı ve sıcaklık konusu ile ilgili öğrenme amaçlı yazma aktivitelerini gerçekleştirdikten sonra öğretmen adayları ile öğrenme amaçlı yazma ve inanç sistemlerini içeren görüşme formları aracılığıyla veriler toplanmıştır. Araştırmanın sonuçlarına göre öğretmen adaylarının inanç sistemlerinin öğrenme amaçlı yazma pratikleri üzerinde etkili olduğu görülmüştür. Bu sonuca göre öğretmen adaylarının inanç sistemlerinde ki olası değişim ve gelişimin, üst düzey stratejilerin ve muhakeme süreçlerinin kullanıldığı yüksek kalitede ki öğrenme amaçlı yazma pratiklerini olumlu yönde etkilemesi beklenmektedir.

Anahtar kelimeler: İnanç sistemi, öğretmen adayları, öğrenme amaçlı yazma

INTRODUCTION

The term 'scientific literacy' emerged within the science education literature due to the technological developments following World War II and the social impacts of these developments (DeBoer, 2000). In this sense, how to raise a scientifically literate individual has been the focus of science education programs

¹ Araş. Gör. Uludağ Üniversitesi, e- posta: mtdemirbag@uludag.edu.tr

² Doç.Dr. Hacettepe Üniversitesi, e-posta:kingirsevgi@gmail.com

³ Prof.Dr. Uludağ Üniversitesi, e-posta:cepnisalih@yahoo.com

for approximately half a century. Many countries have endeavoured and published reports to improve scientific literacy (Australian Academy of Science, 2013; Ministry of National Education, 2013; National Research Council, 1996) and in these reforms and reports, scientists have begun to emphasise the connection between science and language (Balgopal & Wallace, 2013; Collins, 1998; Hand, Norton-Meier, Staker, & Bintz, 2009; Millar & Osborne, 1998; Yore & Treagust, 2006). For example, Norris and Phillips (2003, p. 226) described the importance of language in science by stating, 'Just as we can imagine houses without glass windows, we should be able to imagine science without reading and writing'.

Researchers who discussed the importance of the connection between scientific literacy and language were inspired by numerous language studies (Lemke, 2004; Osborne & Dillon, 2008; Sadler & Zeidler, 2009; Yore, Bisanz, & Hand, 2003). Emig (1977) referred to four basic components of language: reading, writing, speaking and listening. While speaking and listening are not acquired through a prescribed instruction, it is believed that formal education should be provided for reading and writing. According to Emig, writing is superior to the other three language components. Through writing, an individual talks and listens to the inner self, reads what he/she writes and records what he/she thinks. Thus, the other three components of language are also active while writing. Moreover, processes such as imaging or inquiring, creating new meanings and organising knowledge while writing, enable individuals to construct and learn new knowledge (Wolfe & Reising, 1983). Some studies have also shown that opinions are easily expressed through writing (Langer & Applebee, 1987) and cognitively constructed meanings may evolve into new understandings (Gere, 1985).

Some linguists have developed numerous models to explain the process of writing (Bereiter & Scardamalia, 1987; Emig, 1977; Flower & Hayes, 1980; Galbraith, 1999). Bereiter and Scardamalia (1987) proposed the models of 'knowledge-telling' and 'knowledge-transforming'. In the knowledge-telling model, students use writing for communication purposes such as note taking and writing down what the teacher says in class. In this model, a student's success depends on the amount of knowledge stored in his/her memory. In the knowledge-transforming model, there is an interaction between rhetorical space and content space. While writing, students assess the interaction between these spaces and create new contents and meanings by revising what they have written. Galbraith (1999), who attempted to explain the relationship between writing and learning in his model, demonstrated that an individual's knowledge in the form of a semantic network and grammatical space are in continuous interaction with one another. During the text production process, the individual creates new meanings from his/her semantic network by considering the audience, format and grammatical rules. These activation cycles are considered to facilitate meaningful learning.

Prain and Hand (1996) developed a writing framework to facilitate learning from writing in science. According to this framework, the audience, purpose, type, topic and format of the writing can affect the construction of scientific knowledge. For Prain and Hand, the main components of writing-to-learn include the audience (peers, younger listeners, teachers, etc.); purpose (informing, hypothesising, performing research, etc.); type (letter, poster, poem, etc.); topic (chemical bond, heat and temperature, genetic diversity, etc.) and method of text production (individually or as a group, by hand or on a computer). Writing activities that are created using various combinations of the aforementioned components can support students' understanding of scientific concepts and the process of conceptual change (Kingir, 2013). For example, some studies have examined the effect of writing-to-learn activities (using different types of writing and audiences) on students' understanding of scientific concepts (Gunel, Hand, & Gunduz, 2006; Gunel, Hand, & McDermott, 2009; Gunel, Uzoglu & Büyükkasap, 2009; Kingir, 2013). Also, there are studies that have examined the impact of writing-to-learn activities (integrated with various multi-modal representations such as graphics, diagrams and pictures) on students' conceptual understanding and argumentative skills (Demirbag & Gunel, 2014; Hand & Choi, 2010; McDermott & Hand, 2013; Pantaleo, 2012, Tolppanen, Rantaniitty, McDermott, Aksela & Hand, B. 2013) Besides studies related to writing-to-learn with cognitive factors, there are studies that have demonstrated the impact of writing-to-learn activities on affective factors such as attitude (Gunel, Kabatas-Memis, & Buyukkasap, 2010, Uzoglu, 2014) and self-assessment (Ferrari, Bouffard, & Rainville, 1998; Hübner, Nückles, & Renkl, 2010).

Overall, previous studies have provided sufficient evidence for cognitive and affective development through writing-to-learn. Even though these studies focused on the impact of writing-to-learn activities on knowledge and attitude processing, limited research has been conducted on the affective and cognitive backgrounds of writing-to-learn activities. In other words, to date, we do not know what factors influence students' and teachers' writing-to-learn activities even though we are aware that such activities produce positive results about learning outcomes. To bridge this gap, we organised the present study to understand what individuals do before writing, the factors that affect the pre-writing decision-making process and how these factors affect individuals' writing process. It is worthwhile to answer these questions, examine prospective teachers' epistemological and pedagogical beliefs in detail and relate these beliefs with writing-to-learn, which in turn will strengthen the theoretical basis of writing-to-learn.

Teachers' Belief Systems

In general, people have a set of beliefs about themselves and their social and physical environments (Abelson, 1979; Rokeach, 1968). The term 'belief', which is effective in individuals' decision-making processes, can be defined as judgements of individuals regarding truth or falsity of a proposition (Pajares, 1992). Beliefs are composed of an individual's cognitive and motivational

factors stemming from his/her own experiences (Abelson, 1979; Nespor, 1987; Rokeach, 1968). These structures, which originate from one's experience, exist in a belief system that influences an individual's practice (Fives & Buehl, 2012; Kagan, 1992; Nespor, 1987; Pajares, 1992). This system forms the basis for the meanings given to certain experiences (Abelson, 1979; Rokeach, 1968). Furthermore, beliefs are psychologically organised along a central-peripheral dimension that reflects the degree or psychological strength in a belief system (Rokeach, 1968). Central beliefs are quite resistant to change, whereas peripheral beliefs are open to change.

Teachers develop belief systems for their professional lives and these systems include beliefs regarding the following: a) self; b) content and context; c) curriculum; d) students; e) learning and teaching and e) knowledge (epistemological beliefs) (Fives & Buehl, 2012). In particular, epistemological and pedagogical beliefs (e.g. conceptions of learning and teaching) take a central position in teachers' belief systems, whereas content-specific beliefs exist in peripheral positions (Kılınç et al., 2013).

Teachers' belief systems can influence the method of interpreting phenomena and learning tasks (Pajares, 1992). In writing-to-learn tasks, we consider that the belief systems of prospective teachers might be effective in interpreting and performing such tasks. In the present study, we particularly focused on central, core pedagogical beliefs, such as epistemological beliefs and conceptions of teaching and learning, which are potentially related to writing-to-learn activities.

Epistemological Beliefs

Epistemological beliefs may be defined as beliefs with regard to the nature of knowledge and knowing (Hofer & Pintrich, 1997; Kuhn Cheney & Weinstock, 2000). The certainty, source, justification and structure of knowledge are considered as sub-components of epistemological beliefs. Furthermore, the certainty and simplicity of knowledge are related with the nature of knowledge, while the justification and source of knowledge are related with the nature of knowing (Hofer & Pintrich, 1997). Within this multidimensional framework, from one perspective regarding the certainty of knowledge, there is a belief towards the absolute truth of knowledge, while from another perspective, there is a belief that knowledge is tentative, developmental and contextual. Similarly, in the simplicity of knowledge, knowledge is composed of separate and simple parts as well as isolated facts, whereas it is also composed of interrelated and complex parts (Hofer & Pintrich, 1997). For the source of knowledge, knowledge can be external, and experts and authorities are the sources of knowledge, while knowledge can also be constructed contextually and through interactions with other people. In terms of justification, on the one side, reality is directly accepted without justification, while on the other side, justifications are critically evaluated (Hofer & Pintrich, 1997; Kuhn et al., 2000). Furthermore, epistemological beliefs held by teachers can influence their behaviours regarding educational practices. For example, a teacher having naive epistemological

beliefs will generally provide traditional instruction, whereas a teacher having more sophisticated epistemological beliefs will most likely perform more sophisticated teaching practices (Chan & Elliot, 2004; Tsai, 2002). In this study, we assume that there may be relationships between prospective teachers' epistemological beliefs and their writing-to-learn activities since these beliefs are strong determinants of a wide range of learning and teaching activities (Hofer & Pintrich, 1997).

Pedagogical Beliefs (Beliefs about Learning and Teaching)

Pedagogical beliefs, another belief type in education, are effective on individuals' decision-making processes. For example, individuals adopt a teaching approach in line with their beliefs about how they learn (Boz & Uzuntiryaki, 2006). Individuals' knowledge regarding how science has developed is related to both how they teach science and their beliefs regarding how students learn (Tsai, 2002). Teachers' beliefs regarding learning and teaching are propositions that they accept to be true, which ultimately shapes their opinions and behaviours. Prospective teachers' own practices and experiences in their learning environment have a significant role in the development of their beliefs (De Vries, Jansen & Van de Grift, 2013). It is known that students taught in a constructivist learning environment develop constructivist learning and teaching beliefs, whereas the ones taught in a traditional environment develop traditional learning and teaching beliefs (Boz & Uzuntiryaki, 2006). The present study examines how prospective teachers experienced learning and teaching throughout their education and how the beliefs towards learning and teaching shaped by such experiences affect the writing process about heat and temperature. Therefore, this study attempts to answer the following questions:

1. How do the epistemological and pedagogical beliefs of prospective teachers affect their writing processes?
2. What strategies do prospective teachers use during writing?
3. What do prospective teachers think about the benefits of writing?
4. What are the views of prospective teachers about implementing writing-to-learn activities in their professional lives?

METHOD

Research Design

Qualitative research is used to make detailed examination about complex and obscure cases (Creswell, 2008). Previous researchers of belief literature (e.g. Pajares, 1992) have also suggested that qualitative research methods should be used due to the difficult and complex nature of beliefs. Therefore, the qualitative research methodology, case study research design was used in the present study to analyse the relationship between belief systems and writing-to-learn.

Participants

The participants in this study comprised eight freshmen (four males and four females) from the Department of Elementary Science Education at a top ten public university in Turkey. The age of the participants ranged from 19 to 21. The participants entered the university by passing a nationwide multiple-choice examination comprising physics, chemistry, biology and mathematics.

The reason for selecting a group of first-year university students was to eliminate the effect of university education and experience on individuals. Maximum diversity sampling was used in choosing the sample by considering the achievement scores of the prospective teachers in the General Physics Laboratory class. Three volunteers from each of the low, medium and high achievers were chosen for the study; however, one participant did not take part in the interview process. The technical requirements necessary to demonstrate the use of ethical procedures in the research were fulfilled. All the participants gave their informed consent.

Data Collection Method

In this study, the data were collected via semi-structured interviews. To document what the participants experienced before, during and after the writing process in a more detailed manner, qualitative interviews were conducted. The semi-structured interview protocol developed by the researchers included 14 questions related to beliefs regarding writing-to-learn, epistemology and learning-teaching (Kingir, 2013; Tsai, 2002). The questions related to epistemology included: "What is knowledge?" "How do you attain knowledge and learn?" and "What is the source of knowledge?" The questions related to writing-to-learn were as follows: "Can you talk about what you experienced and felt when writing about heat and temperature?", "Are you, in your professional role, planning to assign your students writing tasks while teaching science?" "What types of writing activities are you planning to use and why?" and "For which purposes is writing used?" Finally, the questions related to beliefs regarding learning and teaching included: "How do you learn?" and "In what ways do you think you learn?" Each interview lasted for approximately 25–30 minutes. The participants' permission was obtained beforehand and the interviews were recorded with a voice recorder. Before the semi-structured interviews were conducted, the participants were exposed to a writing-to-learn activity regarding heat and temperature. The purpose of the writing activity was to allow prospective teachers to experience writing-to-learn and participate in the interviews by experiencing this activity. The concepts of heat and temperature were chosen because they are the basic concepts required for scientific learning. As stated earlier, Prain and Hand (1996) presented a set of features that distinguish writing-to-learn activities from traditional writing activities. In this regard, purpose, audience and type of writing are the main determinants of writing-to-learn. From this viewpoint, the features determined by Prain and Hand were considered and the prospective teachers were asked to write a maximum of two pages to teach the topics of heat and temperature to an audience. The

participants were informed that they could freely choose the audience (from among the secondary school students, their peers and other teachers) and the type of writing.

Data Analysis

The interviews were fully transcribed and the interview documents were analysed by the researchers by creating codes and themes. The themes in this study included factors affecting the writing process, strategies used in the writing process, contribution of writing and writing with regard to the profession. For reliability of the qualitative analysis, the agreement coefficient among the coders was used to minimise the researchers' prejudice and subjectivity (Creswell, 2008). Furthermore, direct quotations to support the codes and themes were also included. Creswell's view that the researcher conducts analyses through continuous and simultaneous connections between raw data and codes and categories was the basis of the present analysis. The coding in this study was examined by the researchers twice in a transformational manner. Three interview transcripts were randomly selected and independently coded by the researchers after which inter-rater agreement (88%) on the coding categories was obtained. The discrepancies were discussed and the remaining transcripts were coded by one of the researchers. Finally, the classical components of naturalistic inquiry (Lincoln & Guba, 1985), such as member check, external audit, thick description and peer debriefing, enabled the trustworthiness of our interpretations.

RESULTS

Explanations regarding each theme and code obtained from the data analysis are presented as follows.

Factors Affecting the Writing Process

Epistemologies, attitudes, pre-experience and beliefs regarding learning and teaching emerged as the main factors that affected the writing process. These factors also functioned as a filter for the prospective teachers when deciding the type of writing. Thus, these components were effective on the pre-writing process as well as the construction of writing.

Epistemological Beliefs

For prospective teachers, theoretical books, scientific journals, the Internet and experts were the main sources of knowledge. For instance, a prospective teacher who considered theoretical knowledge as the source of knowledge answered the question regarding the source of knowledge as, "Theoretical books, my practices and making connections between ideas". Regarding justification, the same prospective teacher stated that he understood the information after reading theoretical books and that he "generally reads too much theoretical knowledge". However, in this regard, Kuhn et al. (2000) stated that accepting knowledge and knowing something without questioning and evaluating the experts and the source of the knowledge is a naive belief in knowledge justification.

Some prospective teachers defended that knowledge is certain and it does not change. These participants included formulas to represent certain knowledge in their writing content. For example, one prospective teacher stated, "Now our topic is heat and temperature. If its formula is given and the factors that can change specific heat are determined, then it does not change in time, it is an objective term. It is not different for each person". When the writing task of this participant was examined, the content of the writing included (certain) knowledge and formulas such as $Q = m.c.\Delta t$. Again, another prospective teacher mentioned the following in terms of the nature of knowledge: "You can name anything as knowledge. Things I have learnt and will learn are also knowledge. Knowledge may be a set of terms". As for the truthfulness of knowledge, the same prospective teacher stated, "There is true knowledge in science. Before writing, I accessed on the Internet and justified that knowledge". This participant possessed a naive epistemological understanding, and thus the writing content included short and superficial explanations.

Beliefs about Learning and Teaching

Beliefs about learning and teaching have also shaped the type and construction of writing. For instance, the prospective teachers who believed that learning occurs via experiments, practices, dialogues, stories and figures reflected this understanding in their writing tasks. The prospective teachers also stated that they preferred to teach heat and temperature concepts to middle school students who were the audience in a manner that cognitively activated the students. For example, one prospective teacher taught heat and temperature by creating a story of an experiment conducted by two students and explained the reasons for choosing this approach as follows: "I chose the experiment because I believe that students can learn better. Experiments provide experience and tend to remind students about certain concepts more quickly" Another prospective teacher mentioned: "While I was preparing for the university entrance exam, I used to study with my father, which made me happy. For example, as he was talking about diffusion and when he was explaining deplasmolysis, he described a situation in which I was participating in a social activity and was poorly dressed. He said that you would probably feel bad after you entered the room. Similarly, when a substance moves from a region of high concentration to a region of low concentration, it shrinks. Such an explanation made me never forget about this concept" In short, one prospective teacher felt that it was more effective to talk about an experiment performed by two students, whereas the other believed that it was better to write the formulas and create a story about the topic in their writing tasks.

Attitude towards Writing

The attitudes of the prospective teachers towards writing were found to be influential on the determination of the type of writing. The prospective teachers who believed that writing was boring or difficult and who found writing ineffective in learning attempted to make writing-to-learn activities more enjoyable. For example, one prospective teacher stated that he does not learn via

writing, but does learn through dialogues or group work. This participant wrote a story that included dialogues to teach heat and temperature concepts. Another prospective teacher, who showed a negative attitude towards writing, stated the following: “I prefer oral communication rather than writing. I mean, eye contact or talking to the person or hand movements are more effective than writing”. The prospective teachers who favoured writing and considered that it was effective in learning mentioned that writing should be attractive; otherwise some students will not enjoy writing. For example, one prospective teacher stated, “I thought about methods to make it more enjoyable. I have liked writing since my childhood, but this doesn’t mean that every child likes it”.

Pre-experience

The majority of the prospective teachers referred to their previous experiences of writing. These participants stated that at the elementary and secondary level they experienced traditional writing activities such as writing what their teacher described, writing an important paragraph from a book, writing what they saw on the blackboard, summarising and writing a laboratory report. In their interviews, the prospective teachers mentioned that their pre-experience affected their attitudes towards writing. For example, with regard to the question about their previous writing experiences, one participant stated: “We had writing activities in biology class, and I didn’t like that. First, our teacher wrote on the blackboard for approximately 10 minutes and then made us write down the information in our notebooks for exactly 30 minutes”. Another prospective teacher mentioned, “In the experiments, I used to write in the same way. We performed an experiment using a transformer and I had to read a lot to complete it. I really read many books and I wrote down the important information”

Strategies Used in the Writing Process

The prospective teachers utilised a set of cognitive, meta-cognitive and affective strategies such as self-assessment, awareness, revising and empathising in the writing process.

Self-Assessment

The prospective teachers used self-assessment by reflecting on their previous learning approaches while writing. For instance, one prospective teacher stated, “Now, I realise that I have done too much rote learning. For example, this is photosynthesis, but why is it photosynthesis? What is the source of pressure? We have never learned that. I noticed this while writing”. During this process, some prospective teachers showed meta-cognitive awareness as well.

Considering the Audience

The prospective teachers stated that they considered the audience while writing. For instance, one prospective teacher noticed the points that she could not understand while revising, and hence made her writing clearer for the audience. Another prospective teacher showed meta-cognitive awareness by mentioning, “I

know what I think, I know what I know, but how can I write this so that the reader can understand me?’

Negotiation Process

Some prospective teachers continued to write until they had established a reasonable basis for being semantically satisfied. In short, they went through a negotiation process with what they wrote while writing. For instance, one prospective teacher stated that she repeatedly erased what she had written and explained the reason as follows: “If I did not understand what I wrote, how can they (the audience) understand my written product when they read it? First, I need to understand what I write and then I can describe the information to them (the audience)”.

Revising

Some prospective teachers mentioned that they clarified and revised their writing by considering several factors: language and expression and the fact that long and inverted sentences might cause the audience to understand the meaning negatively. For example, one participant expressed his feelings as follows: “Inverted sentences are a little bit more complicated. It is difficult for a child to understand a long sentence. I prefer to divide the sentence into two parts and write it in accordance with Turkish language structure”.

Empathising

The prospective teachers used affective strategies as well as cognitive and meta-cognitive strategies. One prospective teacher expressed that she considered the students as an audience, empathised with them and revised the writing accordingly. Another prospective teacher referred to the fact that thinking like a younger student made him use strategies that facilitated the students’ understanding even though it was a difficult method of teaching a subject. He stated, “You know, I tried to give names for everything in the formulas such as $Q = m.c.\Delta t$ stands for Macit (proper name in Turkish) and heat of solution stands for Emel (proper name in Turkish). I thought the students could understand the topics better this way”.

Contribution of Writing

The writing process provided the prospective teachers with benefits such as helping them conduct research, constructing knowledge, conceptual change and permanent learning.

Conducting Research

The prospective teachers stated that they performed research beforehand and started writing once they were sure that they understood the information. For instance, one prospective teacher mentioned, “I read a couple of things to understand the topic”.

Constructing Knowledge and Conceptual Change

The prospective teachers believed that writing is an effective method of structuring knowledge. For example, one prospective teacher emphasised the importance of strategies in structuring knowledge while writing as, "Writing is producing". Because of writing, the prospective teachers demonstrated a number of conceptual changes during the process of structuring knowledge. For instance, one prospective teacher explained changes in her conceptions by stating, "I was thinking that heat and temperature were the same concepts because no one had previously explained it to me and I did not perform any research on the topics. But when I searched them, I learned that heat is a type of energy and temperature is its measured state".

Permanency

Another benefit of writing mentioned by the prospective teachers is permanency of knowledge. For instance, one prospective teacher stated the effect of writing on the permanency of knowledge as follows: "We do not always remember what we have read from books, but when we write, we visualise and think about them".

Using Writing in Professional Life

The prospective teachers were asked questions regarding the use of writing in their professional lives. All the participants stated that they would use writing for purposes such as obtaining feedback, planning teaching and providing social development. Regarding feedback, one prospective teacher stated, "I think this would be a great way to obtain feedback. We can see what we conducted in a more concrete way". Another prospective teacher explained why she wanted to use writing activities in her professional life as, "When students study hard, they can remember easily. If they construct their own concepts, then they can learn better". Some of the prospective teachers stated that they would use writing to reveal students' pre-understandings and plan their teaching accordingly. For example, one prospective teacher emphasised the importance of obtaining the students' ideas as, "By this method, you can determine what to teach and what level it should be". Some prospective teachers mentioned that they would conduct writing activities for students' social development as well as learning. Finally, one prospective teacher emphasised the importance of writing for students who cannot express themselves orally and explained the effect of writing on self-expression by stating, "I believe that a student broadens his/her horizon through writing."

DISCUSSION

This study revealed that prospective teachers used various strategies such as self-assessment, revising and negotiating while writing for an audience. This finding is not surprising since writing-to-learn activities encourage students to use different learning strategies (Boscolo & Mason 2001; Gunel et al., 2009; Klein, 2000; Nückles, Hubner & Renkl, 2009). For this reason, the relation of

epistemological and pedagogical beliefs with writing-to-learn will be the focus of this discussion. When the findings related to epistemological beliefs are examined, it is shown that the prospective teachers' desire to access certain and truthful knowledge caused them to perform research before writing. Through such research that used books, the Internet and encyclopaedias, theoretical expressions helped shape the content of their writing about heat and temperature. For instance, the prospective teachers who believed that theoretical books were the sources of knowledge wrote theoretically, while those who supported the certainty of knowledge used formulas in their writing. This finding implies that naive epistemological beliefs are effective in conducting pre-research and building writing content. This finding also suggests that epistemology is a strong predictor of individuals' behaviours (Kılınç et al., 2013). In this regard, epistemology can function as a filter and frame for individuals in deciding what and how to write before writing. Rokeach (1968) emphasised that some stronger belief types are resistant to change and they function as filters and play a significant role in individuals' behaviours. In this study, it is possible to state that before the individuals began writing epistemology was a basic belief that significantly affected their writing tasks.

Besides epistemology, beliefs about learning and teaching also shaped the type and construction of writing. The prospective teachers who developed beliefs that they could learn through experiments, dialogues and scenarios adopted a teaching approach using such aspects during the writing task regarding heat and temperature. That is, the prospective teachers preferred to teach the way that they had learned. Furthermore, previous experiences, learning environments and people that they chose as role models might have been effective in the development of their beliefs regarding learning and teaching. For example, researchers such as Abelson (1979), Bandura (1986) and Nespor (1987) stated that experiences and cultural norms of individuals function as a source for belief development. The prospective teachers' attitudes towards writing were also effective in determining the type of writing. For example, the prospective teachers who believed that their writings should be interesting preferred to write in the form of a story. Meanwhile, half of the prospective teachers believed that talking and discussing were more effective than writing. When the cultural aspect of Turkish people is considered, it is shown that the oral culture developed before the written culture, and that stories, sagas and poems were milestones of oral culture (Özdemir, 2011). Thus, using stories or dialogues in writing-to-learn activities may stem from the effect of culture. However, some negative attitudes towards writing may also come from the cultural effect.

The prospective teachers transformed the knowledge by considering the audience, content and type of writing. They used a language that the audience could understand and preferred to present knowledge via linguistic transformation. Furthermore, they utilised some cognitive, meta-cognitive and affective strategies in their writing task and assessed their learning by asking themselves, 'How do I know what I know'? Yore (2000) stated that writing is a

rich context for learning as it includes a set of meta-cognitive activities. Meta-cognitive strategies keep the individuals active in their learning process (Gunel, 2009), and what is written and what is kept in mind are constantly compared and contrasted during writing. However, the ideas obtained through research from theoretical books may be transferred into writing. In this situation, it may be considered that the individual negotiation process is less than expected since the prospective teachers might have simply accepted the knowledge about heat and temperature as the truth. In short, the naive pedagogical beliefs of prospective teachers might have decreased their level of using various strategies. The prospective teachers stated that they would use writing activities in their professional lives to obtain feedback, learn, plan teaching and enhance social development. The reason for this might be the fact that the prospective teachers saw their own experience and writing as effective. Besides, it was the first time that the prospective teachers performed a writing-to-learn activity and the opportunity to view their pedagogical approach might have increased their desire to use this activity in the future. Furthermore, with regard to belief systems, teachers want to reflect on their university experience in their profession and this writing-to-learn experience might have triggered the desire to use this approach. As it has been shown, pre-experiences are the determinants of both beliefs and attitudes. In this study, the aforementioned experiences of the prospective teachers might have been an indicator of the traditional learning environment that they were previously exposed to in their education. Traditional writing activities practised in Turkey (i.e. writing what the teacher wrote on the blackboard and summarising the text from a book) may be an apparent indicator that the teacher was taught through a traditional approach. Due to traditional writing activities employed from elementary through high school, the prospective teachers might have developed naive epistemology, traditional beliefs about teaching and learning as well as negative attitudes towards writing. Taken as a whole, pre-experiences are the most important variables that influence writing-to-learn.

CONCLUSION and SUGGESTIONS

This study revealed that epistemological and pedagogical belief systems are influential factors on prospective teachers' writing processes and that epistemologies, beliefs regarding learning and teaching, attitudes, pre-experiences of prospective teachers and cultural factors shaped the type and content of the writing task. It also appeared to be difficult for the prospective teachers to conduct alternative writing activities at the desired level without developing their epistemological and pedagogical beliefs and attitudes towards writing-to-learn. For this reason, learning environments that support the development of prospective teachers' epistemological and pedagogical beliefs and attitudes towards writing-to-learn are highly recommended in this particular study. In such an environment, prospective teachers' practices, such as performing research and using scientific texts should be evaluated by asking the question, 'How are these sources used by the participants'? In this regard, individuals with a developed epistemological belief tend to criticise the

authorities and sources of knowledge after which they attempt to revise their writing and enrich their expressions or arguments. Therefore, we support the idea that writing should occur by criticising the opinions of authorities and by thinking in a more critical manner. For epistemological development, it is significant for students to encounter environments in which they can cast epistemological doubt on naive terms and beliefs and become exposed to conceptual change. In such environments, individuals discuss a different topic, term or case as a group and notice their own conceptions and beliefs. Furthermore, they experience disequilibrium by being exposed to environments in which they are dissatisfied with naive terms and beliefs. To re-establish equilibrium, they reflect on the changes regarding their own conceptions and beliefs (Bendixen, 2002). Furthermore, activities such as reading about the history and nature of science, taking relevant courses and following the lives and experiences of scientists, may enable individuals to gain awareness regarding the structure, function and nature of scientific knowledge. Learning environments that support argumentation, inquiry and science process skills, which scientists use in their research, can also enhance prospective teachers' epistemological development (Abd-El-Khalick & Lederman, 2000).

The development of beliefs regarding learning and teaching may increase the quality of writing-to-learn and the strategies used such as meta-cognitive strategies (e.g. evaluating, revising and evidence-based writing) embedded in argumentation and inquiry-based learning environments (Ferrari et al., 1998; Klein, 2000). Moreover, an individual constructing knowledge by questioning and criticising the presented knowledge and undergoing a process of negotiation (Ford, 2008) can shape their writing practice by collecting data from different sources and organising them in his/her mind. Based on the interviews in this study, it is understood that writing-to-learn is not used sufficiently in primary and secondary schools. To broaden the implementation of writing-to-learn activities in schools, books and course materials should include sections that make writing more enjoyable. As a result, both teachers and students can develop positive attitudes towards writing. The prospective teachers' reflection on their own teaching practices, via obtaining feedback from students, is one of the most significant parts of education. The contribution of writing to reflection is also crucial. Reflection is important for a teacher who makes his/her students write about what they understand. Indeed, Schön (1983) divided the reflection into two parts: reflection during the activity and reflection after the activity. Regarding the latter, the teacher thoroughly analyses the teaching processes and receives feedback. It is also important for the teacher to assess his/her students' opinions and to make plans accordingly in terms of both pedagogical and conceptual aspects (Ford, 2008). In this case, writing becomes a significant tool for both student learning and teacher planning.

Additionally, most of the prospective teachers considered the writing-to-learn activity as significant even though they experienced traditional writing activities in the past. This awareness and positive experience may contribute to the willingness of these prospective teachers to use writing in their profession. For

this reason, long-term studies using writing-to-learn activities conducted with prospective teachers can provide more experiences to them, which in turn can help them develop positive attitudes and beliefs regarding such activities. Finally, future research should be conducted to investigate the effect of certain components on writing and how individuals decide to write and shape their content before writing.

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GENİŞ ÖZET

Bilim insanları konuşma, okuma yazma ve dinleme gibi dilsel öğelerin fen öğretimi ile bütünleştirilmesinin önemine dikkat çekmektedir. Bu önem doğrultusunda yazmanın öğrenme ile ilişkisini dikkate alan Prain ve Hand (1996) fen konularında öğrenme amaçlı yazma taslağı geliştirmişlerdir. Bu taslağa göre fen sınıfları içerisinde yazma muhatabı, yazma amacı, yazma türü, konu ve yazma formatının değişkenliği bireylerin fen kavramlarını yapılandırmalarında etkilidir. Prain ve Hand'e göre yazma muhatabı (akran, daha genç dinleyiciler, öğretmenler vb.), yazma amacı (bilgi verme, hipotez kurma, araştırma vb.), yazma türü (mektup, poster, şiir vb.), konu (elektirik, ısı ve sıcaklık, genetik çeşitlik vb.) ve metin oluşturma yöntemi (bireysel ya da grup olarak, elle ya da bilgisayar ile) öğrenme amaçlı yazmayı etkileyen ve oluşturan temel bileşenlerdir. Yukarıda bahsedilen bileşenlerin kombinasyonları sonucu gerçekleştirilen yazma aktiviteleri fen kavramlarını anlamayı sağlamakta ve kavramsal değişime öncülük etmektedir (Kıngır, 2013). Örneğin bazı çalışmalarda (Günel, Hand ve Gündüz, 2006; Gunel, Hand ve McDermott, 2009; Kıngır, 2013) farklı formatta ve farklı muhataplar seçilerek oluşturulan yazma aktivitelerinde kullanılan dil ve öğrenme ilişkisi incelenirken, bazılarında (Demirbağ ve Günel, 2014, Hand ve Choi, 2010; McDermott ve Hand, 2013; Pantaleo, 2012) içerisine resim, grafik, diyagram gibi modsal betimlemelerin entegre edildiği yazma aktivitelerinin kavramsal anlama ve argüman kurma becerilerine etkisi incelenmiştir. Ayrıca yazmanın kavramsal anlama ve argüman kurma gibi bilişsel faktörlerle ilişkisini açıklayan çalışmaların yanında tutum (Gunel, Kabatas-Memis ve Büyükkasap, 2010) ve özdeğerlendirme (Ferrari, Bouffard ve Rainville, 1998; Hübner, Nückles ve Renkl, 2010) gibi duyuşsal ve motivasyonel faktörlere katkı sağladığını ortaya koyan çalışmalar da mevcuttur. Yapılan bu çalışmalar incelendiğinde öğrenme amaçlı yazma aktivitelerini gerçekleştiren bireylerin kazandığı bir takım bilişsel ve motivasyonel faktörler ön plandadır. Dolayısıyla bu çalışmalar öğrenme amaçlı yazma görevlerinin etkisi sonucu ortaya çıkan bileşenleri içermektedir. Bu tür çalışmalar önemli olmakla birlikte, "Bireylerin yazma öncesinde karar vermelerinde etkili olan faktörler nelerdir?" "Bu faktörler bireylerin yazma görevlerini nasıl etkilemektedir?" , "Bireyler öğrenme amaçlı yazma içeriği ve türüne nasıl karar vermektedir?" gibi soruların tartışılması öğrenme amaçlı yazmanın teorik alt yapısını güçlendirebilir. Bu varsayım ile öğretmenlerin pratiklerinde güçlü bir yordayıcı olan öğretmen inançlarının derinlemesine incelendiği ve öğrenme amaçlı yazma ile ilişkisinin kurulmaya çalışıldığı bu çalışma gerçekleştirilmiştir.

Çalışma nitel araştırma desenlerinden durum çalışması ile gerçekleştirilmiştir. Çalışmanın katılımcılarını ise üniversitedeki eğitim ve deneyimin bireyler üzerindeki etkisini azaltma amacıyla 1.sınıfta öğrenim gören 8 fen bilimleri öğretmen adayı oluşturmaktadır. Katılımcılar maksimum çeşitlilik örneklemesine göre belirlenmiştir. Araştırmanın uygulama sürecinde katılımcılar ısı ve sıcaklık konusunu temel alan öğrenme amaçlı yazma aktivitesi gerçekleştirmiştir. Öğrenme amaçlı yazma uygulamasından önce öğrencilere öğrenme amaçlı

yazma aktivitesini nasıl gerçekleştirecekleri ile ilgili bilgi verilmiştir. Bu bilgi doğrultusunda katılımcılardan ısı ve sıcaklık konusunu bir muhatap seçerek ve en az iki sayfa olmak koşuluyla istedikleri metin türünde anlatmaları istenmiştir.

Veri toplama aracı olarak ise öğretmen adaylarının gerçekleştirdikleri yazma aktivitesi ile inanç sistemlerini içeren görüşme soruları kullanılmıştır. Örneğin yazma aktiviteleri ile ilgili; Isı ve sıcaklıkla ilgili yazma ödevini yaparken yaşadıklarınızdan ve hissettiklerinizden bahseder misiniz? Öğretmen olduğunuzda konuları öğretirken öğrencilerinize yazma yaptırmayı düşünüyor musunuz?”, “Ne tür yazma yaptırmayı planlıyorsunuz?” Neden? “Sizce yazma hangi amaçlar için kullanılmaktadır?” İnançlarla ilgili olarak ise da “Bilgiyi nasıl öğrenirsiniz? Hangi yollarla bilgiyi öğrendiğinizi düşünmektensiniz?” tarzında sorularla görüşme gerçekleştirilmiştir.

Bulgular öğretmen adaylarının inanç sisteminin öğrenme amaçlı yazma aktivitelerini gerçekleştirmeden önceki araştırma sürecinde, yazma türünü ve içeriği seçme ile yazma esnasında kullandıkları stratejilerde etkili olduğunu göstermektedir. Örneğin inanç sisteminin bir alt parametresi olan epistemolojik inançların yazma içeriği ile ilişkisi incelendiğinde Bir öğretmen adayı “*Ya şimdi ısı-sıcaklığı konu alıyoruz. Bu formülü verilmişse, öz ısıyı değiştirebilecek faktörler belirlenmişse hani zamanla değişecek birşey değil, nesnel bir kavramdır, herkes tarafından değişecek birşey değildir*” şeklinde açıklamada bulunmuştur. Bu katılımcının yazma görevi incelendiğinde kesin türden bilgiler olarak ifade ettiği $Q=m.c.\Delta t$ gibi formüllerin kullanıldığı bir yazma içeriği görülmektedir. Bulgulara bakıldığında öğretmen adaylarının epistemolojik ve pedagojik inanç, tutum ve ön deneyimler gibi inanç sistemi ile ilişkili kavramların öğrenme amaçlı yazma eyleminde ön plana çıkması, bireylerin karar verme ve davranışlarını şekillendirmede etkili olan inanç sisteminin derin bir yordayıcı olması ile bağdaştırılabilir. Bu bağlamda öğretmen adaylarının inanç sistemlerindeki gelişimin öğrenme amaçlı yazma aktivitelerini kalitesini artırabileceği ön görülebilir. Örneğin, deney, hikaye ve diyalogun haricinde argümantasyon, araştırma ve sorgulamaya dayalı yaklaşımlar gibi öğrencilerin bilgiyi yapılandırdıkları öğrenme ve öğretme ortamlarında ki öğrenme amaçlı yazmada bireyler daha üst düzey stratejiler (örn. değerlendirme, revize etme, kanıt temelli yazma) kullanabilirler (Ferrari vd., 1998; Klein, 2000). Yine öğrenmenin bilgiyi sorgulayarak eleştirerek ve bir uzlaşma (Ford, 2008) sürecinden geçerek yapılandırdığını düşünen bir birey kitaptaki bir bilgiyi okuyarak yazmanın yanında farklı kaynaklardan da veriler toplayarak ve zihninde mantıklı bir temele oturarak yazma eylemini şekillendirebilir. Kısacası inanç sisteminin içerisinde yer alan her bir parametreye ilişkin (epistemolojik ve pedagojik inanç ön deneyimler vb.) gelişim öğrenme amaçlı yazma aktiviteleri ile ilgili süreç ve içeriğe olumlu şekilde yansiyabilir.