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A meta analytical review of the relationship between personal epistemology and self-regulated learning

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ABSTRACT Recently, researchers have begun associating personal epistemology with self-regulated learning. Therefore, in the literature there is a need to examine what degree the studies have supported the relationship between the two. The purpose of this meta-analysis is two folds: a) to compute the mean effect size for the relations between personal epistemology and self-regulated learning and b) to examine the influence of moderator variables including age, gender, culture, and subject area on the mean effect size. It analyzes the result of forty-five studies conducted various countries and disciplines. A small but significant mean effect size emerged (r=.24 [SE=.012] under fixed effects model, and r=.22 [SE=.026] under random effects model). Although the effect of age on the relationship is not statistically significant, moderator analyses revealed statistically significant effects of the culture, gender, and subject area inferred from the reviewed studies on the relationship. The results highlight the need for further research into how gender, culture and subject area influence students' personal epistemology and self-regulated learning

Keywords *Culture, Gender, Meta-analysis, Personal epistemology, Self-regulated learning.*

Epistemolojik inançlar ve öz-düzenleyici öğrenme: Bir meta-analitik inceleme

ÖZ Son yıllarda araştırmacılar epistemolojik inançları öz-düzenleyici öğrenme stratejileri ile ilişkilendirmeye başlamıştır. Dolayısıyla epistemolojik inançlar ile öz-düzenleyici öğrenme stratejileri arasındaki ilişkinin alan yazında yapılan çalışmalarla nasıl desteklendiğine dair bir derleme (meta-analiz) çalışmasına ihtiyaç vardır. Bu meta-analiz çalışmasının iki amacı vardır: a) epistemolojik inançlar ile öz-düzenleyici stratejiler arasındaki ilişki için ortalama etki büyüklüğü hesaplamak ve b) hesaplanan etki büyüklüğüne yaş, cinsiyet, kültür ve konu alanı gibi moderatör değişkenlerin etkisini incelemektir. Bu amaçla farklı ülkelerde ve konu alanlarında yapılmış olan toplam 45 çalışma (40 makale) incelenmiştir. Analiz sonucunda küçük fakat anlamlı bir ortalama etki büyüklüğü hesaplanmıştır (sabit etki modeli altında, r=.24 [SE=.012] ve rasgele etki modeli altında r=.22 [SE=.026]). İki değişken arasındaki ilişki farklı okul seviyesinde yapılan çalışmalar arasında değişmemesine rağmen, hesaplanan etki büyüklüğünün kültür, cinsiyet ve konu alanı değişkenlerine göre anlamlı düzeyde farklılık gösterdiği bulunmuştur. Elde edilen sonuçlar cinsiyetin, kültürün ve konu alanının epistemolojik inançlar ile öz-düzenleyici stratejiler arasındaki ilişkiyi nasıl etkilediğini açıklayan teorik modellere ve çalışmalara ihtiyaç olduğunu göstermiştir.

Anahtar Kelimeler *Kültür, Cinsiyet, Meta-analiz, Epistemolojik inançlar, Öz-düzenleyici stratejiler.*

INTRODUCTION

Over last decades' views on how learning occurs have shifted from simple conditioning to complex networks of interacting factors. Nowadays, many educators view education as a hot rather than a cold process which learners construct their own ways and with their prior experiences, and theories that shape how knowledge is formed (Phillips, 1995; Sinatra, 2005: Zimmerman, 2008). As a consequence of this transition, two particular constructs, personal epistemology and self-regulated learning, have drawn the attention of many researchers.

Personal epistemology and self-regulated learning play important roles in learning. Personal epistemologies refer to students' views on knowledge and knowing (Hofer & Pintrich, 1997). There is growing evidence that personal epistemology affects students' motivation (Buehl, & Alexander, 2005), implicit theories (Chen, 2012), text comprehension (Bråten, Ferguson, Strømsø, & Anmarkrud, 2013) and self-regulation (Braten & Stromso, 2005). In the review of personal epistemology and multiple-text comprehension, Ferguson (2015) supported the notion that students' ideas about knowledge and knowing are linked with their multiple-text comprehension, and should be included in any model of text comprehension. Self-regulated learning is defined as a process in which individual students actively monitor and control their own motivation, cognition, and behavior toward the successful completion of academic tasks (Pintrich, 2002; Zimmerman, 2008). Self-regulated learners are those "who monitor their own process towards self-set goals and are therefore able to reflect on the effectiveness of their learning approaches, tent to view the learning tasks as intrinsically interesting and worthwhile while having high levels of self-efficacy, and engage in and persist with learning behaviors that maximize the degree to which learning occurs" (Crede & Phillips, 2011, p. 337). Thus, research on personal epistemology and self-regulation can help us understand the complex structure of learning.

Recently, researchers have begun associating personal epistemology with self-regulated learning. Some researchers (e.g., Hofer & Pintrich, 1997) stated that personal epistemology served as goals that guide self-regulated learning. Other researchers (Bromme, Pieschl, Stahl, 2010; Muis, 2007) pointed out that personal epistemology is likely to shape learner's perceptions of tasks and therefore how the tasks are approached. Although the theoretical models exist to explain how personal epistemology associates with self-regulated learning, it is important to know how empirical studies support the relationship between personal epistemology and self-regulated learning. A meta-analysis is a statistical summary of relavant literature taht reveals how strong the correlation is by computing the mean effect size of the relationship under investaigation (Sen & Akbas, 2016). Therefore, we believe that taking a closer look at the strength of the relationship between personal epistemology and self-regulated learning may better guide the future studies. Moreover, a meta-analysis can enable us to explain the variation by including the moderator effects, such as, culture, sex, age, and subject area that underpin the theories of personal epistemology and self-regulated learning (e. g., Hofer, 2008; Zimmerman, 2008). For example, Hofer (2008) states that research in the relationship between personal epistemology and self-regulated learning may not neatly replicate in other cultures. Including the studies conducted in different cultures, the meta-analysis results can enable us to determine the level of difference among the cultures. Furthermore, a recent discussion in personal epistemology research whether personal epistemology is the domain- or general-specific (Muis, Bendixen, & Haerle, 2006; Topcu, 2013). Therefore, it may be helpful to examine its domain-specificity by comparing reported effect sizes in the different domains. In the literature, no meta-analytic study dealing with personal epistemology and self-regulated learning has been reported up to date. The present study addresses this gap.

Personal epistemology expresses individuals' ideas about how knowledge is generated, evaluated and costructed. Research into personal epistemology began with Perry's (1970) longitual study with college students. Since Perry's work, many attempts have been done to organize personal epistemology research. The complexity of personal epistemology research led to many different perspectives on how to organize the research. These models can be put into two groups as (a) the developmental nature of epistemic thinking (Kuhn, 1991; Perry, 1970), and (b) multi-dimensional structure of personal epistemology (Greene, Azevedo and Torney-Purta, 2008; Hammer & Elby, 2002; Hofer & Pintrich, 1997; Schommer, 1990).

In the developmental nature of epistemic thinking models, personal epistemology is viewed as worldviews (e.g., dualist, relativist). This perspective suggests that personal epistemology is a cognitive construct that progresses along a predictable developmental path, driven by a process of cognitive

equilibrium (Feucht & Bendixen, 2010; Hofer & Pintrich, 1997). In this perspective, personal epistemology develops through three or more general stages (e.g., absolutist, subjectivist, evaluativist; Schraw, Brownlee, & Berthelsen, 2010). Perry (1970), for example, characterized students' theories about the nature of knowledge with nine positions clustered in four categories: dualism, multiplicity, relativism, and commitment. In this perspective, common views are that naïve individuals tend to see knowledge as static and an accumulation of separate facts. If any change in one's personal epistemology occurs- it has to move from naïve views through more sophisticated views.

Models in the multi-dimensional structure of personal epistemology view personal epistemology as a construct that consists of different dimensions, rather than unitary. In this perspective, individuals may have different beliefs about the different facets of knowledge and knowing. Schommer (1990), for example, conceptualized individuals' personal epistemology as a system of several independent beliefs about learning and knowledge in five belief dimensions: (a) the structure of knowledge that knowledge is organized ranging from simple to complex, (b) the stability of knowledge, ranging from absolute to tentative, (c) the source of knowledge that knowledge is handed down by authority to reasoning and observation, (d) the ability to learn, ranging from fixed at birth to improvable learning, and (e) the speed of learning, ranging from quick to not-at-all learning. In another model of the multi-dimensional structure of personal epistemology, Hofer and Pintrich (1997) conceptualized personal epistemology as epistemic theories in four identifiable dimensions as the certainty of knowledge, the simplicity of knowledge, the justification of knowledge and the source of knowledge. Research has reported that students' ideas about knowledge and knowing are important to understand how learning occurs. For example, beliefs in the speed of learning related to students' problem solving in well-structured content (Schraw, Dunkle, & Bendixen, 1995). Also, students who believe that knowledge is fluid are more likely to change their conceptions about scientific phenomena (Nussbaum, 2011). Naive students are less willing to use and evaluate evidence on justifying knowledge claims, and rely on the authority (Sandoval & Cam, 2011).

Like personal epistemology, many models have been made to organize self-regulated learning research (e.g., Pintrich, 2002; Winne & Hadwin, 1998; Zimmerman, 2000). Although terminology varies from one model to another, models of self-regulated learning typically have four phases or processes: (a) forethought (Zimmerman, 2000), the definition of the task (Winne & Hadwin, 1998), and the goal orientation (Pintrich, 2002), (b) monitoring, (c) control, and (d) reaction and reflection (Muis, 2007). In the first phase, the learner may set up goals for learning tasks. In the second phase, metacognitive awareness of various aspects of the learning process is activated. In the third phase, controlling processes and regulating learning are activated. In the fourth phase, the learner may show various types of reflections and reactions about the learning event (Muis, 2007).

Winne and Hadwin (1998), for example, conceptualized self-regulated learning in four phases: task definition, goal setting and planning, enactment, and adaptation to metacognition. Winne and Hadwin defined each of four phases based on the interaction of the student's conditions, operations, products, evaluations, and standards (COPES). The task definition is the phase which the student produces perceptions of what the task is. The second phase, the goal-setting and planning, is which she or he produces goals for the task based on the task definition. It is third phase, the enactment phase, which the student go through the plan of study and tactics created in the goal-setting phase. In the last phase, the adaptation, the student may reflect and adapt the learning based on experience of the task. Research has documented the importance of students' self-regulated learning on their learning in general and consequently their academic achievement (Bandura, 1997; Pintrich & De Groot, 1990). Student with high self-regulated learning have demonstrated higher levels of involvement, effort, and consistency on academic tasks than those who were low self-regulated learning, and as a result of it, a higher level of achievement on their subject areas (Eilam, Zeidner & Aharon, 2009; Zimmerman & Pons, 1986).

Personal epistemology can influence students' thinking and learning in many ways including directing their perception and attention to particular features of information, guiding the processing, and the use of information (Pintrich, 2002). Personal epistemology serves as inputs to metacognitive processes and as standards in the task definition phase of self-regulation (Muis, 2007). Moreover, Hofer (2004) conceptualizes personal epistemology as a part of metacognition which is a required condition for self-regulated learning. She assumes that, for example, whether naïve or sophisticated belief about the source and justification of knowledge requires different learning strategies. On the one hand, a naive learner relies on only one source such as textbooks; a sophisticated learner tends to look for different sources,

monitor to epistemic claims, weighting evidence, and evaluate authorities, on the other hand. In the same view, she exemplifies that holding a naïve belief about the certainty and simplicity of knowledge leads the learner to look for simple answer for the given task: however, a sophisticated learner engages in deep learning process and critical thinking to complete the given task.

Some researchers have proposed theoretical models to explain the relationship between personal epistemology and self-regulated learning. Muis (2007), for example, conceptualized a framework to describe how personal epistemology can facilitate or limit facets of self-regulates learning. Based on a combination of various models of self-regulated learning, she purposes four phases for self-regulated learning: (a) cognition that refers to knowledge activation and knowledge tactics and strategies, (b) motivation and affect that refer to achievement goals and self-efficacy, (c) behavior that refers to effort and time, and (d) content that includes resources and social content. Based on the facets of self-regulated learning, she specifies four positions for the relation between personal epistemology and self-regulated learning: (a) personal epistemology is one component of the cognitive and affective conditions on task definition, (b) personal epistemology influences goals standards students set, (c) personal epistemology translate into epistemic standards that serve as inputs to metacognition, and (d) self-regulated learning may play a role in the development of personal epistemology. She posits that as the reciprocal relationship is in the nature of the model, any information from any phase or component can provide information back into other components. Researchers has reported that students' beliefs about knowledge and knowing are related to their self-regulated learning. More sophisticated personal epistemology was related to stronger adaptation to task complexity and students with sophisticated personal epistemology shown stronger relations between their judgments and task complexity (Bromme et al., 2010). In addition, student beliefs with more sophisticated personal epistemology reported to have higher indicators of deep processing learning strategies (Bromme et al., 2010).

Researchers have been interested in the role of individuals' beliefs in their learning processes. Studies focusing on personal epistemology and self-regulated learning have assumed that both are closely linked to each other (Hofer, 2004; Pintrich, 2002). These studies have consistently demonstrated statistically significant relationships between the students' personal epistemologies and self-regulated learning. In the present study, we wanted to examine the relationship between the personal epistemologies and self-regulated learning from the primary school level through college level, and how this relationship is differentiated by moderator variables (e.g., culture, age, subject area, and sex). A meta-analytic review of studies concerning personal epistemology and self-regulated learning help us know the overall effect size the studies have reported.

Potential moderator effects

We have identified several potential moderator variables that the previous studies have reported, relating to the relationship of personal epistemology and self-regulated learning.

Age. Younger students may have difficulties in applying cognitive and metacognitive strategies (Zimmerman, 2000). Paris and Winograd (1999) asserted that the development of children's metacognition continues during schooling from 5 to 16 years. Zimmerman and Martinez-Pons (1986), for instance, found that 11th graders reported a higher level of mathematical and verbal self-efficacy than 5th graders. Also, Hofer (2008) stated that individuals' beliefs about knowledge develop with age and education. Thus, variation in personal epistemology may be a function of age (Buehl, 2008). For example, Driver et al. (1996) studied scientific views of students aged 9, 12, and 16 and found that younger students reported naïve beliefs than did older students.

Culture. Studies identified that the structure of Asian students' beliefs is different from the students sampled from the U.S. (Hofer, 2008). As cultural norms play a crucial role on an individual's construction of his/her own personal epistemology, studies that sampled participants in different countries may report the different level of relationship (Hofer, 2008). Moreover, different educational systems affect the personal epistemology and self-regulated learning, and consequently the relationship between the two. For instance, Purdie, Hattie, and Douglas (1996) found that Australian students reported greater use of self-regulated learning strategies than Japanese students.

Sex. Sex appears to play a role in personal epistemology and self-regulated learning. For instance, Neber and Schommer-Aikins (2002) found that highly gifted girls' science-related motivational beliefs were less positive than those of boys. Similarly, Elder (2002) found that girls showed more sophisticated beliefs in the source of knowledge than did boys.

Subject area. Students may hold different personal epistemologies about hard versus soft sciences (Buehl & Alexander, 2005). For example, Hofer (2000) found that students viewed scientific knowledge to be more certain than knowledge in the discipline of psychology. Students' learning strategies may differ from one course to another (Pintrich, 1995). Wolters and Pintrich (1998) found that 7th and 8th grade students reported greater use of cognitive strategies in social studies than in mathematics.

Research questions

Considering the moderator effects described above, two guiding research questions were posed to analyze the relationship between personal epistemology and self-regulated learning:

What is the overall effect size of the studies that have been conducted to determine the level of relationship between personal epistemology and self-regulated learning?

How do moderator variables including sex, country, subject area, and grade affect the level of relationship?

METHODOLOGY

List of Variables

Personal epistemology and self-regulated learning strategies are the variables in this study. We used any study dealing with personal epistemology from both developmental and multi-dimensional perspectives. For self-regulation learning strategies, the literature provides a large number of strategies, ranging from simple reading to more advanced strategies including synthesizing knowledge. To be consistent with the previous meta-analytic studies in self-regulated learning (e.g., Dignath and Buttner, 2008; Dignath, Buttner & Langfelt, 2008), we focus on the following self-regulated learning strategies:

Motivational strategies. These strategies refer to motivational aspect of using cognitive and metacognitive strategies including goal orientation, task value, control beliefs, self-efficacy, and test anxiety (Dignath et al., 2008; Pintrich, 1995).

Cognitive strategies. Cognitive strategies are defined as the treatment of the learned information. Cognitive strategies including elaboration, rehearsal, and organization are domain and task specific (Pintrich et al., 1991).

Metacognitive strategies. These are strategies a higher level than the cognitive strategies. Meta-cognitive strategies refer to cognition about cognition. These strategies include self-reflection, planning, and monitoring (Winne & Hadwin, 1998).

Management Strategies. Management strategies are used to enhance the learning environment and to create the optimal learning conditions. These strategies include help-seeking, collaborative learning, and effort management (Pintrich et al., 1991).

Data Collection

We identified potential data sources via keyword searches of the PsychINFO, Eric, Dissertation Abstracts databases, Google Scholar and examinations of the reference lists of studies. Sixteen words describing personal epistemology and self-regulated learning were used: *personal epistemology, epistemic belief, epistemological beliefs, beliefs, meta-cognition, learning strategies, self-regulation, self-monitoring, help-seeking, goal orientation, self-efficacy, cognition, task value, peer learning, effort management, and test anxiety.*

Coding procedure. We coded each data source using standardized coding sheets. This information includes: correlations between personal epistemology and self-regulated learning, and sub-scales, reliability values of the instruments, the type of subject area (e.g., Chemistry), and sample characteristics including sex, country, and age. To address the coding reliability, several steps were followed as highlighted by Lipsey and Wilson (2001). The first author of the study coded all studies. After some time passed, the first author coded all studies again. Results from these condings were compared item by item (Lipsey & Wilson, 2001). Second, an independent expert coded some sample of data (Yeaton Wortman, 1993). Intercoder reliability was %95. Disgreements were solved by discussion.

Selection criteria. We used several criteria to include potential studies in this meta-analytic study.

Purpose of the study. We included studies that focused on the relationship between personal epistemology and self-regulated learning, and, if that relationship is shown to exist, what influence the relationship had on achievement. We excluded interventional studies that were outside the scope of the study. Studies that focused on only one dimension of personal epistemology and self-regulated learning were included.

Reporting. Studies were included if the inter-correlation among subscales could be computed. Any study was excluded if the inter-correlation among subscales cannot be calculated into Pearson correlation. We also excluded studies that did not report any subscale or reported only statistically significant correlation, not all correlations.
Publication type. Since it is difficult to obtain unpublished papers, only studies published in English in peer-reviewed journals and as ERIC document (conference papers) were included in the study.
Time scope. Studies that were conducted between 1997 and 2013 years were included in the study.

Data Analysis Methods

Computing effect size. Personal epistemology and self-regulated learning is a multivariable construct, which was in most cases measured by several constructs. In terms of personal epistemology, studies employed different theoretical models whose dimensions do not overlap each other. To be able to investigate the relation between personal epistemology and self-regulated learning, we followed these steps: First, Pearson r-values were transferred to Fisher's z score. Then, for each self-regulated learning strategy, we computed the average value of the Fisher's z score (Corey, Dunlap, & Burke, 1998). That yielded an average z score of the correlation between the self-regulated learning strategy and personal epistemology. Next, Fisher's z scores were transferred back to Pearson r. Finally, self-regulated learning strategies were grouped according to the recorded dimension. As for the reliabilities, if the studies that did not report overall reliabilities of measurements, we computed it, as described by Willson (1982), by using reliabilities of each subscale and inter-correlation between each subscale in unweighted case of the number of item.

To compute effect size, we used Pearson correlation within variables. In case the studies do not report overall Pearson correlation, we calculated the average correlations following the steps described above, if inter-correlation among the subscales of variables was reported. We calculated the effect size for the studies that regressed variables, as described by Libsey and Wilson (2001). To make corrected effect size, we included the reliabilities of variables into the calculation. If a study did not report its measurements' reliability values, we used the mean value of reliabilities computed by other studies, which reported reliabilities as described by Hunter and Schmidt (2004). When aggregating the effect sizes across the studies, we weighed the effect sizes of the studies by the number of participants, as the effect sizes from studies with different sample sizes do not estimate the level of relationship with the same precision (Dignath & Buettner, 2008). All computation was done by using Excel 2010 data sheet that allowed us to compute the effect sizes by using formulas as described by Libsey and Wilson (2001).
Fixed-and random-effects models. In literature, meta-analysis studies use fixed or random effects models. Fixed effects model refers to the assumption that sampling error is due solely to differences among participants in the study on the one hand (Cooper, 2010). On the other hand, random effects model views "studies as containing other random influences, including differences in teachers, facilities, community economics, and so on" (Cooper, Robinson, & Patall, 2006, p.16). Rather than choosing a single effect model, we chose to apply both effects models to our analysis. We conducted all analyses twice, under fixed and random effects models once. By doing so, we could examine the effects of different models on the outcomes of the analysis and make our interpretation on the effect of moderator variables in the effect size distribution (Cooper et al., 2006).
We used multiple ANOVAs to examine the interaction of categorical moderator variables (e.g., grade level) on the relationship, and regression analysis for continuous moderator variables. We put studies into groups as the following criteria:
Age. Most studies did not report age means. Thus, we categorized studies by the level that studies targeted such as, university, high school (9th to 12th grade), and elementary (1st to 8th grade).
Culture. We used the country of origin of the study as indicator of the culture. Since studies were conducted in different countries, we categorized the studies into two groups: (a) Western culture (countries in Europe, Australia, and North America) and Eastern Culture (countries in Asia).
Sex. We used the percentage of the female participants in the study. By doing so, we obtained a continuous variable.
Subject area. Biglan (1973) classified academic disciplines into two groups as hard science and soft science. Based on Biglan's (1973) classification of academic disciplines, we categorized students' majors into three groups as: (a) hard sciences including physics, science, and math etc., (b) soft sciences

including education, psychology, history etc., and (c) mixed sciences indicating participants' majors in both hard and soft sciences. We categorized studies at high school and elementary levels into the mixed sciences unless the study focused on the particular subject area. Some studies focused on elementary students' scientific beliefs or science-related strategies (e.g., Chen, 2012). We put these studies into the hard science group, not mixed group.

RESULTS

General Characteristics of the Studies Included in the Meta-analysis

A total of forty-five studies from forty articles, which met the eligibility criteria, were included in the meta-analysis. These sampled studies were drawn from a variety of student populations from elementary level through college level. The samples were drawn from 15 countries: The United States, Canada, Norway, Hong Kong, Taiwan, Germany, Turkey, China, Fiji, Italia, Belgium, India, Indonesia, Iran, and Greece. Of these studies, %47.6 in North America, %16.6 in Europe, and 35.7 in Asia, and %2.3 in Australia were conducted. The mean age of participants was 17.9 years. Fifty-nine percent of the participants was female.

One hundred and thirty effect sizes arose from these 45 studies resulting from 40 articles. Dignath et al. (2008) discussed that an effect size value that differs greatly from the distribution of all effect sizes may be misleading the results in the research area and it influences the meta-analytic analysis in a spurious way. Lipsey and Wilson (2001) recommended excluding such an extreme effect size in the analysis if it differs from the mean effect size more than three standard deviations. We looked at the funnel plot of the effect sizes and located an extreme effect size (with an E.S. value of .66). We excluded this effect size (with a value of .66) from the analysis. Figure 1 represents the funnel plot of the effect size illustrating the distribution of the effect sizes before the elimination.

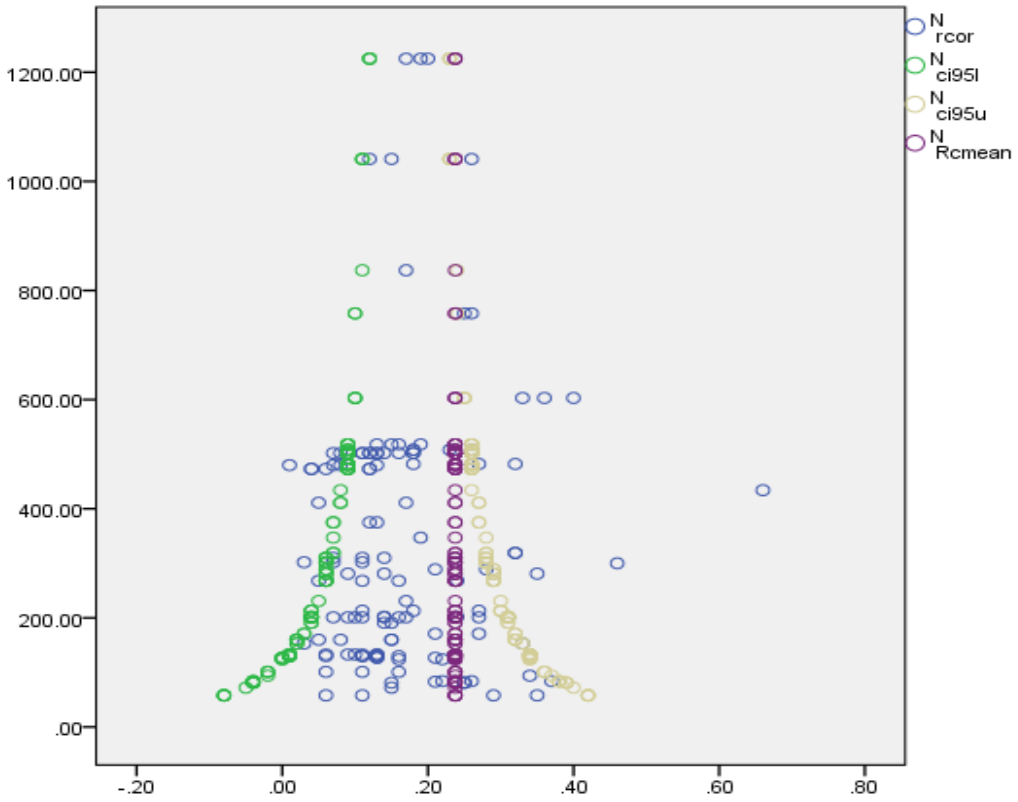

Figure 1

The funnel plot of the effect sizes. X-axis represents the value of effect size and y-axis represents the number of the participant.

After eliminating the extreme effect size, the overall distribution comprised 129 effect sizes. Of these effect sizes, 22 cognitive strategies effect sizes, 17 meta-cognitive strategies effect sizes, 12 management

strategies effect sizes were reported (See Table 1). Most effect sizes focused on the relation between personal epistemology and motivation strategies. Fourteen studies reported the overall effect size.

Table 1
Summary of Study and Effect Size Characteristics

Self-regulated learning strategies	n=129 (effect size)	N= 45 (studies)
Cognitive strategies	22	13
Meta-cognitive strategies	17	15
Motivational strategies	64	24
Management strategies	12	7
Overall strategies	14	14
Sample size	M= 342.70 (S.D.=250.53)	

Mean effect sizes were computed, underlying the assumption of fixed and random effects models. In the fixed effects model, the weighted overall effect size, "r" was .24 with a standard error .012. In the random effects model, the weighted overall effect size, "r" was .22 with a standard error .026. In the random effects model the standard error value was higher, which led the confidence intervals to be wider. Since the confidence intervals for fixed and random effects models do not include zero (Dignath et al., 2008), the mean effect sizes are statistically significant (See Table 2). In addition, we conducted the Q homogeneity test to compare the observed variance to that expected from sampling error (Cooper, 2010). We found a statistically significant difference, which indicates the heterogeneity of the effect sizes (Q (128) =635.7, p<.01). Furthermore, the I^2 value was 80% that showed the considerable heterogeneity, which might be evidence for the presence of the effects of the moderator variables in effect sizes (Borenstein, Hedges, Higgins & Rothstein, 2009).

Table 2
Mean Effect Sizes

	Mean E.S.(S.E.)	-95% CI	+95% CI
Fixed effects model	.24 (.012)	.21	.27
Random effects model	.22 (.026)	.17	.27
Random effects var. com. (v)			.016

Relationship between Moderator Variables and Effect Sizes

The influence of the aforementioned moderator variables (age, culture, subject area, and sex) on the effect size variability is presented.

Age. Age was identified as a moderator effect that may influence the level of relationship between variables. Since most studies were clustered in college level and that were not continuous within themselves by age, we categorized the sampled studies into levels as university, high school, and elementary; so that we were able to include studies that did not report the mean value of the participants' ages (See Table 3).

Table 3
Summary of Study and Effect Size Characteristics by Age

Age (grade level)	n=129 (effect size)	N= 45 (study)	Mean sample size
University	85	31	M= 311.5 (SD=193.0)
High School (9th to12th)	20	7	M= 418.5 (SD=350.6)
Elementary (1st to 8th)	24	7	M=361.5 (SD=249.8)

We computed mean effect sizes for each group, underlying the assumption of fixed effects model and random effects model as described by Lipsey and Wilson (2001). A categorized inspection of the school level data revealed a weighted overall mean effect size of 0.23 for elementary school (ranging from -.02 to .47), 0.22 for high school (ranging from -.04 to .50), and 0.24 for university level (ranging from .06 to .40) under fixed effects model (See Table 4). Under random effects model, we found the weighted mean effect size as .22 for elementary level, .20 for high school level, and .22 for university level. In both instances, the absolute value of the difference between the correlations was quite small.

Table 4
Summary of Mean Es in Fixed-Random Effects Models by Age

	Fixed effects model			Random effects model		
Age	E.S.(S.E.)	-95% CI	+95% CI	E.S.(S.E.)	-95% CI	+95% CI
University	.24 (.008)	.23	.26	.22 (.016)	.19	.25
High School	.22 (.013)	.19	.24	.20 (.033)	.14	.27
Elementary	.23 (.013)	.21	.26	.22 (.031)	.16	.28
Q-between (Qb)	3.32(p>.05)			.20 (p>.05)		

We compared the effect sizes for the different categories as described by Lipsey and Wilson (2001). In fixed effects model, comparing the effect sizes for the different outcome categories revealed no statistically significant differences between all categories (Q_b = 3.32, p>.05). Likewise, we found that there is no statistically difference between all categories in random effects model (Q_b =.20, p>.05). Non-significant value of Q_b under fixed and random effects models indicates that as a moderator factor, participants' age does not explain the variation of the effect sizes, except the effects beyond that associated with the sampling error.

Culture. We chose the country where the study was conducted as the indicator of its culture. Next, we categorized the studies into two groups as (a) Western culture including studies that have been conducted in the North America, Australia, and Europe, and (b) Eastern culture including studies that have been conducted in Asia. The studies analyzed in this paper were conducted in 15 different countries. The cultural variations between each country would not be easy to identify and document. Hence, we categorized the countries as being a more representative of the Western culture versus being a more representative of the Eastern culture. As Table 5 shows, twice the more studies were conducted in the Western culture than the studies conducted in the Eastern culture.

Table 5
Summary of Study and Effect Size Characteristics by Culture

Culture	n=129 (effect size)	N= 45 (studies)	Mean sample size
Western	91	30	M= 314.7 (SD=188.0)
Eastern	38	15	M= 385.8 (SD=350.9)

We calculated the mean effect sizes for each culture group, underlying the assumption of fixed and random effects models (See Table 6). Under fixed effects model, the weighted overall mean effect sizes are 0.25 for the Western culture (ranging from -.04 to .50), and 0.22 for the Eastern culture (ranging from -.02 to .46). Under random effects model, we found the weighted mean effect size as 0.23 for the Western culture, and 0.19 for the Eastern culture. In both instances the absolute value of the difference between the correlations was quite small.

Table 6
Summary of Mean Es in Fixed and Random Effects Models by Culture

	Fixed effects model			Random effects model		
Culture	E.S.(S.E.)	-95% CI	+95% CI	E.S.(S.E.)	-95% CI	+95% CI
Western	.25 (.008)	.23	.27	.23 (.016)	.20	.26
Eastern	.22 (.009)	.20	.24	.19 (.023)	.14	.24
Qb	5.58(p<.01)			1.24 (p>.05)		

We compared the effect sizes for the different categories. In fixed effects model, comparing the effect sizes for the different outcome categories revealed a statistically significant difference between the categories (Q_b = 5.58, p<.05). However, we found that there is no statistically significance difference between the categories in random effects model (Q_b =1.24, p>.05). A statistically significant value of Q_b under fixed effects model indicates that the culture is a significant contributor to the variation in the effect size. However, under random effects model, the culture does not explain the variation in the effect sizes. Cooper (2010) argued that if the analysis is significant under fixed effects model but not under random effects model, this indicates that "the findings relates only to what past studies have found but not necessarily to the likely results of a broader universe of similar studies" (p.201). The present study's findings suggest that "culture" explains the variation in the effect sizes for the past studies. However,

the same claim-- that the culture explains the variations in the effect sizes-- is not valid for the studies that are not included in the present study.

Subject area. The sampled studies were conducted in various subject areas including physics, business, education, psychology, history, and math. To able to investigate the effect of the subject area on the effect sizes, we categorized the effect sizes into three groups as (if the target sample coming from or the study focused on the particular subject area) a) hard sciences that used to define academic areas perceived as being more scientific or accurate (e. g. physics), b) soft sciences that used to define social science academic areas (e. g. education), and c) mixed that included participants from hard and soft science areas. And we put the studies at elementary and high school levels into the mixed group unless the study focused on any particular subject area. As seen in Table 7, most of the studies analyzed in this paper have been conducted in the hard sciences.

Table 7
Summary of Study and Effect Size Characteristics by Subject Area

Subject area	n=129 (effect size)	N= 45 (studies)	Mean sample size
Hard sciences	57	20	M= 271.2 (SD=54.1)
Soft sciences	29	11	M= 312.4 (SD=175.7)
Mixed sciences	43	14	M=415.6 (SD=451.5)

We computed the mean effect sizes for each "subject area" group under fixed- and random effects models (See Table 8). Under fixed effects model, the weighted overall mean effect sizes are 0.19 for hard sciences (ranging from -.02 to .47), .32 for soft sciences (ranging from -.04 to .46), and .26 for the mixed science category (ranging from .05 to .50). Under random effects model, we found the weighted mean effect size as 0.19 for hard sciences, 0.26 for soft sciences, and 0.22 for the mixed science category.

Table 8
Summary of Mean Es in Fixed and Random Effects Models by Subject Area

	Fixed effects model			Random effects model		
Subject area	E.S.(S.E.)	-95% CI	+95% CI	E.S.(S.E.)	-95% CI	+95% CI
Hard sciences	.19 (.008)	.17	.21	.19 (.020)	.15	.23
Soft sciences	.32 (.014)	.29	.35	.26 (.030)	.20	.32
Mixed sciences	.26 (.010)	.24	.28	.22 (.023)	.17	.27
Qb	74.8(p<.01)			6.19 (p<.05)		

We compared the effect sizes for the different categories. In fixed effects model, comparing the effect sizes for the different outcome categories revealed statistically significant differences between the categories (Q_b (2) = 74.8, p<.01). Also, we found that there is a statistically significant difference between the categories in random effects model (Q_b (2) =6.19, p<.05). A statistically significant value of Q_b under fixed- and random effects models reveals that the subject area can account for the variation in the effect sizes. Again, in both instances the absolute value of the difference between the correlations was quite small.

Sex. To able to investigate the influence of students' sex on the effect size distribution, we used the percentage of female students in the study, which yielded a continuous variable of the female. To estimate the influence of students' sex on the effect size variance, we applied a series of meta-analytic approaches under fixed and random effects models. First, we adopted the general approach described by Cheung (2008) in Mplus 6, which is an innovative way to integrate fixed, random, and mixed effects models of meta-analysis to SEM. Although this approach worked well with the available data under fixed effects model, it did not fit with the available data in random effects model. Therefore, in random effects model we used the traditional weighted regression method described by Lipsey and Wilson (2001) to estimate the parameters.

Lipsey and Wilson (2001) suggested that the standard error (SE) value should be adjusted and then the correct assessment of statistical significance should be tested in the regression analysis for the meta-analytic purposes. We computed the corrected SE values for fixed and random effects models, and found z-test values as 17.9 and 14.9, respectively (See Table 9).

The traditional regression analysis revealed that in fixed effects model the percentage of female students is statistically significantly related to the effect size distribution (R^2= .08, t (female) = 17.9., p <.01).

The standardized coefficient (β =-0.28) indicates that approximately 8% of the variance of the effect size can be explained by the percentage of female participants in the studies. The direction of the relationship is negative, which means that the more female participants in the sample, the lower is the effect size obtained. The traditional regression analysis resulted identical with the SEM analysis.

Table 9
Results of the Traditional Meta-Analytic Regression Analysis by Sex

	Fixed effects model			Random effects model		
	β	SE (β	β(stand.)	β	SE β	β (stand.)
Sex	-0.51 (-.50)	.03** (.01)	-0.286*(-0.28*)	-0.20	.014**	-0.233*

Note: Numbers in parenthesis show the parameters obtained from SEM approach.
*: p <.01 **: Corrected SE values.

In random effects model, the relation between the percentage of female students and the effect size is statistically significant but the strength of the relation is low (β =-0.23). This value indicates that approximately 5% of the variance of the effect size can be explained by the percentage of female participants in the studies (R^2= .05, t (female) = 14.9, p<.01). The adjustment on the variance in random effects model can account for obtaining a small beta coefficient. Again, the direction of the relation between the percentage of the female participants and the effect size is negative.

CONCLUSION and IMPLICATIONS

The present meta-analytic study investigated 45 studies for the relationship between personal epistemology and self-regulated learning strategies from elementary level through college level. The results of the present study are discussed below.

The findings of this meta-analytic study have important implications not only for research on the relationship between personal epistemology and self-regulated learning, but also on the general literature regarding the determinants of and predictors of these on college academic performance. The result of this meta-analysis shows that personal epistemology is positively related to self-regulated learning strategies. The analysis is based on 129 effect sizes from 45 studies and revealed a weighted average effect size of .24 under fixed effects model and .22 under random effects model. This meta-analytic study suggests that the relationship between personal epistemology and self-regulated learning strategies is moderate. Moreover, 5% (R^2=.05) of the variation in self-regulated learning strategies can be explained by personal epistemology.

The previous studies in personal epistemology and self-regulated learning reported that age is a function of development in personal epistemology and self-regulated learning strategies (Buehl, 2008; Hofer & Pintrich, 1997; Driver et al., 1996). The results of this meta-analytic study suggest that even when students get mature, motivation and behaviors of self-regulated learning that are constructed by their personal epistemology remain the same. Additionally, we found that the relationship between personal epistemology and self-regulated learning is statistically different across the cultures under fixed effects model. Yet, that relationship is not statistically significant under random effects model. This result suggests that culture explains the variation that the past studies have reported so far in the relationship between personal epistemology and self-regulated learning; yet, this variation cannot be generalizable to future studies. Overall, the results of the meta-analytic study suggest that greater levels of the Western students' self-regulated learning strategies are explained by their personal epistemologies than those in the Eastern culture countries. This difference across cultures can be explained by the reported strategies that students used. The stereotypical view among the students in Eastern culture countries is that knowledge is something handed down by someone in authority (Purdie et al., 1996). The students in the Eastern culture countries reported that they were more likely to use rote learning strategies (Yumusak, Sungur, & Cakiroglu, 2007). Also they were less likely to seek help from others than students in Western culture countries (Yumusak et al., 2007). The students in the Eastern culture countries were less likely to use management strategies, like collaboration (Dahlin & Watkins, 2000). This may lower the relationship between the personal epistemology and self-regulated learning. Another explanation for the observed variation across the cultures is the instruments that were used. The instruments to measure students' personal epistemology and self-regulation learning were developed first in the U.S. and then translated into other languages and used in other countries (Hofer, 2008). In future studies it is suggested

that researchers in other countries should use instruments developed by the native speaker researchers of the target country.

The meta-analytic review revealed that the relationship between personal epistemology and self-regulated learning strategies is statistically significant across subject areas under fixed and random effects models. This result suggests that the subject area explains the variation in effect sizes of the relationship between personal epistemology and self-regulated learning strategies. The results showed that in soft sciences personal epistemologies predict students' self-regulated learning strategies more than they predict in the hard sciences. This difference in the mean averaged effect size across the subject areas can be explained by the difference in the content of the subject areas. Hard sciences are viewed more paradigmatic than soft sciences since "the content and methodologies employed are more idiosyncratic" (Muis, Bendixen, & Haerle, 2006, p.10). This difference between the hard versus soft sciences may lead students to view the knowledge in the hard sciences more certain, and dependent on the theoretical explanations and rules than the knowledge they view in the soft sciences (Buehl & Alexander, 2005; Hofer, 2000). Consequently, students in the hard sciences may employ more structured and rote learning strategies than in soft science.

The role of the students' sex on personal epistemology and self-regulated learning has been studied in multiple lines of works (Hofer, 2000; Baxter Magolda, 1992). Some studies have found that the students' sex plays an important role to shape their personal epistemologies and self-regulated learning strategies (e.g., Hofer, 2000) whereas some others did not report any variation in terms of students' sex (e.g., Buehl et al., 2002). The negative relationship between the percentage of female students and the effect size can be explained by the expectations from females. Following Perry's (1970) early research with almost all-male student sample in personal epistemology, Belenky and her colleagues (1997) worked on all-female student sample in their research and proposed an epistemology they labeled "women's ways of knowing (WWK)." The substantive studies on WWK reported that girls were more likely to report a connected approach (paying more attention to understand the object of attention) to knowing. In these studies, boys reported "a separate approach" (an approach that views "knowing" different from "the known" by putting their own feelings and values aside, and adopting a neutral perspective) (Clinchy, 2002; Galotti, Drebus, & Reimer, 1999). In addition to this difference in ways of knowing, in social environments girls are more often expected to obey the social rules than boys. In turn, this might discourage girls to have sufficient practice and encourage them to regulate their behaviors and emotions (Davis, 1995).

Some implications for educational research can be drawn from the results of this study. Studies examined in this study have mostly utilized the multidimensional construct of personal epistemology proposed by Schommer (26 out of 45 studies). Schommer's framework draws upon the personal epistemology as a system of interdependent general beliefs about knowledge and learning. However, the results of this study provide evidence that the relationship personal epistemology and self-regulation is domain-specific. In their model of epistemic cognition, Greene and his colleagues (2008) claimed that justification of knowledge can vary across at the domain levels. The results of this study support Greene and his colleagues' model of epistemic cognition. Therefore, the results of this study suggest that the domain-specificity at high school or college levels should be taken into consideration in future studies on personal epistemology, and Greene and his colleague's framework of epistemic cognition may be considered as the leading framework.

Additionally, Greene and his colleagues (2008) argued that justification of knowledge should be considered as multi-dimensional, including justification by authority and personal justification. On the one hand, in their study examining epistemic cognition during the reading of multiple conflicting document, Ferguson, Bråten, and Strømsø (2012) added a third task-based dimension, justification by multiple sources, which refers to the beliefs that justification is corroborated by several sources of information into epistemic cognition model. On the other hand, in her model explaining the relationship between personal epistemology and self-regulated learning, Muis (2007) conceptualized personal epistemology as a part of the task definition phase in self-regulation. Such a task-based dimension of personal epistemology can serve a bridge between personal epistemology and learning task. Therefore, in the task-based studies regarding personal epistemology, it seems adding a task-based dimension of personal epistemology may be beneficial to better understand the function of personal epistemology in the learning task.

Addition to this, Ferguson and her colleagues (2013) developed the Justification for Knowing Questionnaire (JFK-Q), which was used to map the three justification dimensions. The JFK-Q has been used in several recent studies. For example, Ferguson and Braten (2013) validated the three dimensional structure of JFK-Q to map students' justification of knowledge. With utilizing the JFK-Q, Bråten and his colleagues (2014) studied indirect and direct relations amongst dimensions of the justification for knowing in science, motivation for science reading comprehension, and science achievement. Bråten and his colleagues reported the three justification dimensions that Ferguson et al. (2012) discussed were related to students' motivation and achievement in science. More specifically, justification by authority and justification by multiple sources were positively related to self-efficacy (β=0.20 and β =0.25, respectively) and task value (β =0.17 and β =0.43, respectively). Personal justification were negatively associated with self-efficacy (β=-0.22) and task value (β=-0.20). They reported that all three dimensions of justification of knowledge explained 14 and 23% of the variance in self-efficacy and task value, respectively; which is higher than the effect size we found in this study. The contextual variation, of course, can be a reason for this difference. However, it may provide evidence that the JFQ-K better capture students' personal epistemology in a specific task because it includes a task-based dimension of justification of knowledge. Therefore, there is a need to further examine the relation between personal epistemology and self-regulated learning with the task-specific instruments such as JFK-Q.

Limitation of the Findings

This meta-analytic study has certain limitations. First, we included only published studies in English in peer-reviewed journals. Published studies are more likely to report statistically significant results, which may indicate a publication bias (Cooper, 2010). Including the non-significant results, which are usually not published, might lower the averaged effect size. Therefore, we encourage scholars to submit well-done studies for publication, even when results are not statistically significant.

Second, during the analysis, we found that the studies on personal epistemology and self-regulated learning strategies have most often used university level students (85 of 129 effect sizes and 31 of 45 studies). Very little research on personal epistemology and self-regulated learning includes elementary (seven of 45 studies) and high school students (seven of 45 studies). As a limitation relating to the effect of students' age on the relationship, this should be taken into consideration. More studies with younger students are recommended.

Whether personal epistemology and self-regulated learning are domain general or domain specific is a recent discussion (Muis et al., 2006). There is evidence that students may have different beliefs and/or strategies across the disciplines (Hofer, 2000; Buehl et al., 2002). The results of this meta-analytic study support the notion that the motivation and behavioral aspects of self-regulated learning that are constructed by the students' personal epistemologies vary across the hard versus soft sciences. It should be noted that because we grouped the studies as hard, soft, and mixed sciences, any attempt to generalize this study's findings, and conclusions to all science disciplines in hard sciences or soft sciences should be approached with caution. The relationship between personal epistemology and self-regulated learning may vary across disciplines in hard science or soft science. There is evidence that high school students viewed knowledge in physics more certain and unchanging than knowledge in biology (Tsai, 2006). Furthermore, some argue that students' personal epistemologies are task and context dependent (Elby & Hammer, 2010; Sandoval, 2009). Therefore, future studies on personal epistemology and self-regulated learning should focus on the task or discipline specific nature of personal epistemology and self-regulated learning.

Lastly, in this study, we analyzed 129 effect sizes in which they were nested in 45 studies. Because the average number of effect sizes per study is 2.87, fixed effects model has some dependencies because of being in the same study. As a limitation of this study, in the analysis, we made the assumption that these dependencies would not significantly influence the variation with only 2 or 3 effect sizes for per study. Although Cheung (2013) suggests a methodology for multiple effects per study, it has not been validated and requires knowledge of the correlation between effect sizes within the study that is simply not known.

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APPENDIX A

Sampled Studies Used in Meta-analysis

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TÜRKÇE GENİŞLETİLMİŞ ÖZET

Epistemolojik inançlar ve *öz-düzenleyici öğrenme* öğrencilerin öğrenmelerinde önemli rol oynar. Birinci terim, epistemolojik inançlar, öğrencilerin bilgi ve bilme hakkındaki fikirlerini ifade eder. İkinci terim, öz-düzenleyici öğrenme, ise öğrencilerin aktif ve yapıcı olarak kendi öğrenmelerini izlemelerini ve öğrenme etkinliğini başarı bir şekilde tamamlamak için motivasyonlarını ve davranışlarını kontrol etmesi sürecidir. Son yıllarda eğitim alanında yapılan çalışmalar, öğrencilerin epistemolojik inançları ile öz-düzenleyici öğrenme stratejileri arasında yakın bir ilişki olduğunu göstermektedir. Muis' ye (2007) göre bireyin sahip olduğu epistemolojik inançlar bireyin hedeflerini, öğrenme amaçlarını ve öğrenmede kullandıkları bilişsel stratejilerini etkilemektedir. Bu ilişkinin çalışmalarda ne kadar desteklediğinin ve güçlü olduğunun belirlenmesi yapılacak çalışmalara yol gösterebilir. Ayrıca alan yazında kültür, cinsiyet, yaş ve konu alanı gibi epistemolojik inançlar ve öz-düzenleyici öğrenme stratejilerini etkileyen olası faktörlerin bu ilişkiye etkisinin incelenmesi bu ilişkinin doğasını anlamamıza yardımcı olabilir. Bu yüzden bu çalışmanın amacı, meta-analiz yöntemi kullanarak epistemolojik inançlar ile öz-düzenleyici öğrenme stratejileri arasındaki ilişkinin etki büyüklüğünü (effect size) belirlemek ve kültür, cinsiyet, yaş ve konu alanı değişkenlerinin etki büyüklüğüne etkisini incelemektir.

Yöntem

Bu meta-analiz çalışmasında, alan yazında epistemolojik inançlar ile öz-düzenleyici öğrenmeyi inceleyen tüm nicel çalışmalar anahtar kelimeler kullanılarak PsychINFO, Eric, Google scholar veri tabanlarında taranmıştır. Epistemolojik inançların, motivasyonel, bilişsel, üstbilişsel ve kaynak yönetimi stratejileri gibi öz-düzenleyici stratejilerle ilişkisini inceleyen bildiri, makale ve tezler incelenmiştir. Seçim kriterleri olarak 2013 yılına kadar yapılmış olan çalışmalar dâhil edilmiştir. Etki büyüklüğünü hesaplamak için sabit-etki (fixed-effect) ve rastgele-etkiler (random-effect) modelleri kullanılmıştır. Etki büyüklüğü hesaplanırken değişkenler arasında rapor edilmiş olan Pearson korelasyon katsayısı kullanılmıştır. Meta-analiz yapılmadan önce ön koşul olan Q Homojenlik testi yapılmıştır. Yapılan Q homojenlik testine göre sonuçlarına göre anlamlı farklılık bulunmuştur (Q = 152, 09), p (Q) <. 01). Bu sonuç etki büyüklükleri arasında örnekleme hatasında farklı olarak moderatör değişkenlerin etkisinden dolayı farklılık olduğunu göstermektedir. Moderatör değişkenlerin etkisini incelemek için elde edilen etki büyüklükleri yaş için, ilköğretim, lise ve üniversite olmak üzere üç gruba, kültür için doğu ve batı olmak üzere iki gruba ve konu alanı için, sayısal, sözel ve karma olmak üzere üç gruba ayrılmıştır. Cinsiyet değişkeninin etki büyüklüğüne etkisini incelemek için her bir çalışmadaki kız öğrenci oranı kullanılmıştır. Moderatör değişkenlerin etki büyüklüğüne etkisinin incelenmesi amacıyla gruplar için ANOVA ve sürekli değişkenler içinse regresyon yöntemi kullanılmıştır.

Tartışma ve Sonuç

Alan yazın taraması sonucunda 15 ülkeden toplam 40 çalışma bulunmuş ve bu çalışmalarda toplam 129 etki büyüklüğü hesaplanmıştır. Ortalama etki büyüklüğü (*r*) ise sabit-etki modelinde .24 ve rastgele-etkiler modelinde ise .22 olarak bulunmuştur. Yaş değişkeni gruplarında ortalama etki büyüklüğü ilköğretim grubunda sabit-etki modelinde .23 ve rastgele-etkiler modelinde .22, lise grubunda sabit-etki modelinde .22 ve rastgele-etkiler modelde .20 ve üniversite grubunda sabit-etki modelinde .24 ve rastgele-etkiler modelinde .22 olarak bulunmuştur. ANOVA sonuçları, gruplar arasında etki-büyüklüğünde anlamlı bir farklılık olmadığını göstermiştir (Q_b (1) = 3.32, p>.05). Kültür değişkeni gruplarında ortalama etki büyüklüğü batı kültürü grubunda sabit-etki modelinde .25 ve rastgele-etkiler modelinde .23 ve doğu kültürü grubunda sabit-etki modelinde .22 ve rastgele-etkiler modelde .19 olarak bulunmuştur. ANOVA sonucuna göre gruplar arasında etki-büyüklüğünde sabit-etki modelinde anlamlı bir farklılık göstermiş (Q_b (1) = 5.58, p<.05) fakat rastgele-etkiler modelinde ise anlamlı farklılık olmadığı bulunmuştur (Q_b (1) = 1.24, p>.05). Konu alanı gruplarında ortalama etki büyüklüğü sözel konu alanında sabit-etki modelinde .32 ve rastgele-etkiler modelinde .26, sayısal konu alanında her iki modelde de .19 ve karma konu alanında sabit-etki modelinde .26 ve rastgele-etkiler modelde .22 olarak bulunmuştur. ANOVA sonucuna göre gruplar arasında etki-büyüklüğünde sabit-etki (Q_b (2) = 74.8, p <.01) ve rastgele-etkiler (Q_b (2) = 6.19, p <.05) modellerinde anlamlı bir farklılık göstermiştir. Regresyon analizinde kız öğrenci oranı ile etki büyüklüğü arasında negatif bir ilişki bulunmuştur (sabit-etki modeli için β =-.28, p < .01 ve rastgele-etkiler modeli için β =-.23, p < .01).

Bu çalışmada hesaplanan etki büyüklüğü, epistemolojik inançların öz-düzenleyici stratejilerle orta düzeyde pozitif bir ilişkili olduğunu göstermektedir. Bu yüzden öğrencilerin epistemolojik inançlarını geliştirilmesi öz-düzenleyici öğrenme becerilerinin de gelişmesine yardımcı olacaktır. Yapılan ANOVA analizleri sonucunda epistemolojik inançlar ile öz-düzenleyici öğrenme stratejileri arasındaki ilişkinin yaş ile değişme göstermediği fakat konu alanı ve kültürün bu ilişki üzerine etkisi olduğu bulunmuştur. Etki büyüklüğü batı kültüründe ve sözel konu alanında daha büyüktür. Bu sonuç, öğrencilerin doğu kültüründe ve sayısal alanlarda daha fazla ezberleyici öğrenme stratejilerini kullanmasıyla açıklanabilir. Bu çalışmada incelenen ve anlamlı etkisi bulunan kültür, konu alanı ve cinsiyet değişkenlerinin epistemolojik inançlar ve öz-düzenleyici öğrenme ile ilgili teorik modellerde göz önüne alınması gerekir.

Bununla birlikte, bu çalışmanın sonuçları, epistemolojik inanç ile öz-düzenleyici stratejiler arasındaki ilişkinin konu alanına özgü olduğunun kanıtlarını ortaya koymaktadır. Greene ve meslektaşları (2008), epistemolojik biliş modellerinde, bilginin gerekçelendirilmesinin etki alanı düzeylerinde farklılık gösterebileceğini iddia ettiler. Bu çalışmanın sonuçları Greene ve meslektaşlarının epistemolojik biliş modelini desteklemektedir. Bu nedenle, bu çalışmanın sonuçları, lise ya da kolej düzeyindeki etki alanına özgüllüğün gelecekteki kişisel epistemoloji çalışmalarında dikkate alınması gerektiğini ve Greene ile meslektaşlarının epistemolojik biliş çerçevesinin önde gelen bir çerçeve olarak düşünülebileceğini düşündürmektedir.