An Investigation of Students' Meaningful Causal Thinking Abilities in Terms of Academic Achievement, Reading Comprehension and Gender

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Abstract

The main purpose of this study is to investigate whether students' meaningful causal thinking abilities vary with their academic achievement levels, reading comprehension abilities, and gender. The sample of the study consisted of 124 ninth grade students attending a secondary school in Adana City Seyhan District during 2008-2009 academic year. The Meaningful Causal Thinking Evaluation Test, the Biology Academic Achievement Test, and the Reading Comprehension Test (IOWA) were used to collect the data. The study documents significant relationships between meaningful causal thinking and academic achievement, and between meaningful causal thinking and reading comprehension. On the other hand, no significant difference is found between male and female students' meaningful causal thinking abilities. It is concluded that students' academic achievement levels and reading comprehension scores are significant predictors of their meaningful causal thinking ability, but their gender is not. An individual carries all these characteristics in the same cognitive structure and probably uses them in coordination when he/she needs. Therefore, educational activities can be designed based on the relationship between meaningful causal thinking and academic achievement, and between meaningful causal thinking and reading comprehension.

Key Words

Meaningful Causal Thinking, Academic Achievement, Reading Comprehension, Gender, Biology Lesson.

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Individual that thinks effectively and has awareness of his thinking process always searches for a meaning throughout his life. During this search, he questions the events surrounding him and his behaviors. He tends to set up his life around meaningful things and lives according to internalized meanings (Berkant, 2007).

Many thinking activities exist in thinking processes such as causal thinking, critical thinking, logical thinking, intuitive thinking, analytic thinking, scientific thinking, and etc. These thinking activities emerge as a result of innate biological characteristics supported and improved by teaching activities. Therefore, teaching activities should be designed in a way that support students to interpret and especially give personal meanings to the events and facts during the development of their thinking abilities. Common experiences are provided for all students in a learning environment. However, each student has different perceptions about this learning environment and knowledge units, and derives different *meanings* from these perceptions, because they differ from each other in terms of socio-cultural backgrounds, cognitive, affective and psychomotor readiness, and brain functions (Berkant, 2007).

Causal thinking processes, including meaning dimension, that are experienced by students may be affected by various factors. Following this argument, students' meaningful causal thinking processes may be related to their academic achievements, reading comprehensions, and gender. This study may provide a different perspective on learning processes by investigating whether such relations exist.

Meaningful Causal Thinking

Assigning meaning to information is essential for our learning process. During this process, we resist to learn information that is not compatible with our meaning structures. Besides, we strongly need to comprehend our experiences. According to Mezirow, we try to have functional viewpoints within the boundaries of our meaning structures (Fear et al., 2003).

Kegan reports that, meaning occurs in a zone between the fact and the individual's reaction to this fact. Kegan defines this zone as *the zone of mediation*. The zone of mediation is a place where a fact occurs and has a meaning for the individual. *Being an individual* and *assigning a meaning* are the same things. When we fail to assign meanings, we cannot have experiences, ideas, and perceptions (Ignelzi, 2000).

In this context, *meaning* is the basic concept of human psychology. Living process is involved in a *meaning construction* (Bruner, 1990). Meaning is a phenomenological output, where the potential meaning of external world is transformed into personal meaning or awareness as a result of the meaningful learning process (Ausubel, 1963).

There is a strong relationship between the meaningfulness and causality. Meaningfulness stems from the similarities between the structural qualities. *Causal relationships* are also structural qualities. *Meaning* is based on inferences about unobservable components from observable components of structural qualities on the basis of causal relationships (Denkel, 1996).

Although philosophers have expressed different views about causality, they agree on its basic that the existence of a thing stems from another thing. In this context, Lucretius declared "de nihilo nihil" (nothing can be born of nothing) as a proposition (Kundi, 2006).

Cause and effect relationship is also defined as *causality. Cause* is a necessary and sufficient condition that leads another thing to happen (Cevizci, 2000). Causality is a philosophical category that describes obligatory relationships between phenomena, where one phenomenon (cause) determines another (effect) (Rosenthal, & Yudin, 1997). According to Timuçin (1998), causality is a principle that conjectures that same things cause same results under the same conditions.

According to Aristotle, results occur in the presence of causes and if we understand why something is present and cannot occur in another way, we really comprehend it (Hançerlioğlu, 1978). Hume accepts causality as a perception rather than a relationship between two things (McCleary, 1998). From this perspective, our psychic lives may be accepted as the sources of causality. On the contrary, Kant claimed that causal relations are not originated from our psychic lives, but from our understanding capacity (Özlem, 1996).

According to Piaget (1974), causality is related to how an object affects other objects and the people observing it while moving. Therefore, causality is closely related to the perception of people observing the object. This perception includes expectations from the interactions between the objects based on our experiences.

The perceptions and awareness of causal events are the premises of causal thinking process. Causal thinking is one of the ways that may be

chosen or used during the thinking process. Thus, the individual that considers causal relationships is a *thinking person* before a *causal thinking person* because, like a causal thinking person, a thinking person also prefers problematic situations, considers rationalism important, and believes in the effectiveness of reasoning (Doğanay, 2002).

According to Pena, Sossa, and Gutierrez (2008), the factors underlying causal thinking depend on the general definition of thinking. Causal thinking involves the ability of relating the cause to the effect (Zohar, & Tamir, 1991). Causal thinking is defined in the context of the relationship between cause and effect (Achugar, & Schleppegrell, 2005). Causal thinking as a cognitive process may be viewed as a searching process for probable cause and effect relationships between all the information units or components in nature.

Human's causal thinking ability develops fast between the ages of 3.5 and 4 years (Hong, Chijun, Xuemei, Shan, & Chongde, 2004). Natural sciences present findings proving the presence of activities in some areas of brain during the causal thinking. These findings support the social sciences data claiming the presence of causal thinking in human nature (Fugelsang, Roser, Corballis, Gazzaniga, & Dunbar, 2005).

Causal thinking process varies depending on the human's age. The sample of this study consists of ninth grade students and because of their ages, they are in adolescence period. According to Piaget's theory of cognitive development, an adolescent attending a secondary school is in the formal operational period. In this period, adolescents can answer the questions by using adjacent causes; are skeptical about the nature of events and facts; and search for the main causes (Erden, & Akman, 1997; Gander, & Gardiner, 2001; Temel, & Aksoy, 2001).

Causal thinking is an operation that is used for assigning meaning to the nature. It gets harder to internalize the causal relationship unless we search for a meaning in this relationship. Thus, the definition of causal thinking should not be limited to a shallow searching process for cause and effect. *Adding a meaning dimension to causal thinking process is based on constructing our inferences by relating our perceptions of causal relationships to our existing cognitive structure, and transforming these inferences into usable abilities for different situations by internalizing them. Therefore,* we *may acquire meaningful causal thinking ability by assigning meanings to causal relationships.*

The difference between causal thinking and meaningful causal thinking is similar to the difference between rote learning and meaningful learning. The individual that acquires knowledge by *rote learning* can remember the concepts or events whenever they are asked. However, if asked to solve a problem by using this knowledge, he cannot succeed in applying this knowledge to the new situations. On the other hand, an individual that acquires knowledge by meaningful learning can remember the concepts and events, uses that knowledge to find various solutions in the problem solving process, and learns related concepts (Mayer, 2002).

In this context, *meaningful causal thinking* may be defined as a cognitive process in which an individual internalizes the observed and perceived causal relationships in the events or facts occurring in his body or environment by assigning meanings to them based on his experiences in life. Students may live a *three-dimensional meaningful causal thinking process* when the meaning dimension is adapted to causal thinking process and the teaching activities are designed according to this process (Figure 1). Three-dimensional meaningful causal thinking process may be defined as cause and effect relationships between the meanings of knowledge units that are involved in the same topic *(Y: 1st dimension: Vertical causal thinking)*; between the meanings of knowledge units in a topic and the meanings of knowledge units that are involved in former and following topics *(X: 2nd dimension: Horizontal causal thinking)*; between the meanings of knowledge units that are involved in all the topics and between all the topics and their examples from everyday life *(Z: 3rd dimension: Diagonal / Deep causal thinking)* (Berkant, 2007).

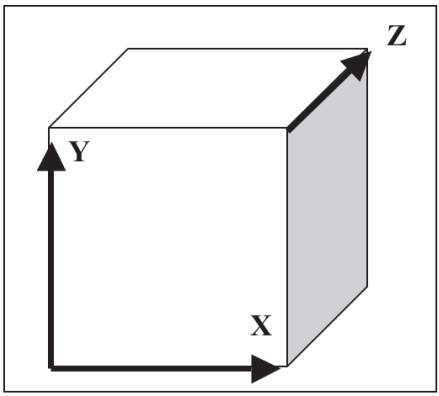

Figure1. *Three-dimensional Meaningful Causal Thinking Process (Berkant, 2007)*

Y (1st dimension: Vertical causal thinking): Causal thinking process between the meanings of knowledge units that are involved in the same topic.

X (2nd dimension: Horizontal causal thinking): Causal thinking process between the meanings of knowledge units in a topic and the meanings of knowledge units that are involved in former and following topics.

Z (3rd dimension: Diagonal / Deep causal thinking): Causal thinking process between the meanings of knowledge units that are involved in all the topics and between all the topics and their examples from everyday life.

As shown in Figure 1, relating the knowledge units that are involved in different topics to each other according to cause and effect relationships meaningfully is important for students' learning.

Meaningful Causal Thinking in Biology Lessons

The object, content, teaching-learning, and measuring-evaluation components of biology lessons should be examined in the context of meaningfulness, which enables students to give meanings to the biological facts or events that occur in their bodies and environments.

The following dimensions should be taken into consideration in a biology lesson to support meaningful causal thinking (Berkant, 2007):

1. Concepts: A biology lesson that is developed based on causal relationships may be designed in the context of the cause and effect relationships between the basic concepts of the topics.

2. The principles and the principle of causality: Learning the concepts by relating/connecting them based on meaningfulness is more effective for meaningful learning than learning the concepts separately. Concepts may be related by using them in the principle statements. These statements may be expressed in a way to declare *causality.*

3. Causal thinking: If students establish causal connections between the concepts, principles, and biological events/facts, they may gain awareness for the presence of causality between the information components. Thus, they may think causally and search for direct or indirect causal connections between all the information components during later learning experiences.

4. Meaning: Chin and Brown (2000) report that deep thinking process requires relating the components to each other, relating the newly acquired knowledge to existing knowledge, and relating the concepts to daily life. Making inferences by relating the existing cognitional schemas to the awareness of causal relationship and applying these inferences to practical abilities by internalizing them may help students give meaning to causal relationships.

5. Meaningful causal thinking: A cognitive process in which an individual internalizes the observed and perceived causal relationships in the events or facts in his body or environment by assigning meanings to them via his life.

It is expected that when students achieve the goals that are targeted in a biology class, their thinking abilities and academic achievements may increase (Berkant, 2007; Binzat, 2000; Koç, 2002; B. Özkan, 2001; Ö. Özkan, 2001; Pepper, 1999; Saygın, 2003). Thus, one of the dimensions of this study is the relationship between the students' meaningful causal thinking and their academic achievements.

Reading and writing abilities not only and simply help people read and write, but also support them to think, understand, and be aware (Earle, 2005). According to constructivism, reading is a process in which the meaning is constructed by active connections that are established between the text and the individual's experiences and brain (Yore, Shymansky, Henriques, Chidsey, & Lewis, 1997). Reading comprehension ability is also related to other abilities and behaviors (Jager, 2002; Kuzu, 2004). Thus, it is important to examine the relationship, if any, between the meaningful causal thinking and reading comprehension.

Gender has been studied as an independent variable by researchers in various studies. There are a number of studies in prior literature with different findings about the relationship between gender and thinking process or thinking abilities. Lauer (2007) finds no differences between men's and women's thinking abilities, and Al-Rumaidhi (2008) finds no differences between men's and women's moral thinking processes. According to Lowrie and Diezmann (2007), there is no significant relationship between spatial thinking and gender, but men are more capable of reading graphics and maps than women. Roots (2005) reports that women are more successful about recalling emotional experiences and knowledge from long term memory compared to men because they

use a wider area of their brain in their emotional experiences. Brizendine (2006) states that during the menstrual period, various hormones (i.e., estrogen and progesterone) are secreted and increase women's critical thinking abilities during this period. Because men do not have such a period, women's critical thinking abilities are concluded to be higher than men -at least during this period-. In this context, investigating the relationship, if any, between gender and meaningful causal thinking is of considerable scientific importance.

Studies in the relevant literature have left *meaningful causal thinking* and the variables affecting the meaningful causal thinking unexamined. Thus, this study investigates students' meaningful causal thinking abilities based on academic achievement, reading comprehension, and gender. In this context, the objective of this study is to investigate whether students' meaningful causal thinking abilities vary with their academic achievement levels, reading comprehensions, and gender. In the context of this purpose, following questions are addressed: Is there a meaningful relationship between students' meaningful causal thinking abilities and their academic achievement levels in biology? Is there a meaningful relationship between students' meaningful causal thinking abilities and their academic achievement levels in biology when their reading comprehension scores are controlled for? Is there a meaningful relationship between students' meaningful causal thinking abilities and their reading comprehension abilities? Do students' meaningful causal thinking abilities vary with gender? Do academic achievement in biology, reading comprehension, and gender predict students' meaningful causal thinking abilities?

Method

This study was conducted in the context of the ecology unit of a biology lesson. This is because biology lessons in ecology unit comprise various topics including causal relationships that require the use of meaningful causal thinking abilities.

Population and Sample

The population of this study consists of students attending ninth grade classes in public schools in Adana City Seyhan District during 2008-2009 academic year. To determine the sample of the study, one of these

schools was chosen by random sampling. The sample of this study includes 124 students attending four different sections of ninth grades in this school. In the sample, 86 (69.3%) students are females, and 38 (30.7%) are males. The ages of the students range from 15 to 17 years old. The mean age of the students is 15.94 years.

Data Collection Tools

The Meaningful Causal Thinking Evaluation Test (MECTET), the Biology Academic Achievement Test and the Reading Comprehension Test are used to collect data.

The Meaningful Causal Thinking Evaluation Test (MECTET): The MECTET is used to determine the level of the students' meaningful causal thinking abilities. The MECTET is developed by Berkant (2007) and based on the causal thinking abilities discussed in the paper titled "Assessing Students' Difficulties in Causal Reasoning in Biology-A Diagnostic Instrument" (Zohar, & Tamir, 1991). These abilities are explained below:

1. The ability to organize events according to the temporal sequence in which they have occurred.

2. The ability to distinguish between cause-and-effect relationships and other proximate events.

3. The ability to understand that temporal sequence does not necessarily imply a causal connection.

4. The ability to understand that an event can have more than one valid causes.

Berkant (2007) adds three more abilities to the list as**:**

5. The ability to distinguish between structural causality and functional causality.

6. The ability to correctly match the examples from daily life events with biological events.

7. The ability to correctly match the causes and effects of biological events with the events from former topics.

The MECTET is based on the ecology unit and consists of 13 questions. A rubric and an answer key are used to score the MECTET. The categories of rubric vary between 0-2 and 0-8 according to the questions.

A sample of 64 students is used for the development study of the MECTET. The students' answers are scored by three experts via the rubric. The Pearson correlations between the scores that are assigned by experts are presented below as reliability coefficients (Berkant, 2007):

There are significant positive correlations between expert-1 and expert-2 (r=0.97, p<.001), between expert-1 and expert-3 (r=0.95, p<.001), and between expert-2 and expert-3 (r=0.95, p<.001).

Cronbach alpha coefficient was found to be .98 while the MECTET was being developed. The correlation coefficients and Cronbach alpha were accepted as the indicators of reliability of the MECTET (Berkant, 2007).

Besides the findings presented above, the reliability coefficients are re-calculated by using the MECTET on the present sample. The answers from 124 students are scored by three experts via the rubric. The findings are presented below as reliability coefficients:

There are significant positive correlations between expert-1 and expert-2 (r=0.96, p<.001), between expert-1 and expert-3 (r=0.98, p<.001), and between expert-2 and expert-3 (r=0.97, p<.001). Cronbach alpha coefficient of MECTET is re-calculated and found to be .99. These findings indicate that the MECTET is sufficiently reliable to be used in this study.

The Biology Academic Achievement Test: This multiple-choice test including 28 items is developed by Berkant (2007) to determine the level of students' academic achievements in the ecology unit of a biology lesson. The difficulty of the test (P) is determined as .62, so the difficulty level may be considered average. The KR-20 coefficient is found to be .75. This coefficient shows that the test is sufficiently reliable to be used in this study.

The Reading Comprehension Test (IOWA): This multiple-choice test including 50 items is used to measure the students' reading comprehension abilities. This test was developed in 1972 by Roger Farr (Avcıoğlu, 1993). The adaptation study of this test to the Turkish culture was done by Avcıoğlu (1993). Avcıoğlu found the KR-20 reliability coefficient to be .83. The KR-20 coefficient is re-calculated in the present study and found to be .72, suggesting that the test is reliable enough to be used in this study.

Procedure

Data are collected from the sample by using the MECTET, Biology Academic Achievement Test, and Reading Comprehension Test. These tests were administered with the required explanations about the study after the students had studied the ecology topics with their teacher. Data are analyzed by using Bivariate and Partial Correlations, Multiple Linear Regression, and Independent Sample t Test methods via SPSS 11.5.

Results

The Findings about the Relation between the Students' Meaningful Causal Thinking Abilities and Academic Achievements

There is significant positive correlation between the students' meaningful causal thinking abilities and academic achievements (r=0.65, p< .001).

The Findings about the Relation between the Students' Meaningful Causal Thinking Abilities and Their Academic Achievements when Reading Comprehension Scores are Controlled for

There is significant positive correlation between the students' meaningful causal thinking abilities and academic achievements when reading comprehension scores are controlled for (r=0.62, p< .001).

The Findings about the Correlation between the Students' Meaningful Causal Thinking Abilities and Reading Comprehension Abilities

A significant positive correlation is found between the students' meaningful causal thinking abilities and reading comprehension abilities (r=0.40, p< .001).

The Findings about the Differences between Genders in terms of the Students' Meaningful Causal Thinking Abilities

No significant difference is found between male and female students' meaningful causal thinking abilities [t(122) = -0.29, p>.05].

The Findings about the Prediction of Meaningful Causal Thinking Ability Based on Students' Academic Achievements in Biology, Reading Comprehension Abilities and Gender

The academic achievement, reading comprehension and gender variables are significantly predicting the meaningful causal thinking ability (R= .70, R^2= .49, p<.001). These three variables explain 49% of the total variation in meaningful causal thinking ability scores. The t-Test analyses reveal that academic achievement and reading comprehension variables are significant predictors of meaningful causal thinking. On the other hand, gender is not a significant predictor of meaningful causal thinking.

The following regression equality is based on the regression analysis findings:

MEANINGFUL CAUSAL THINKING= -10.70 + 0.67 *ACHIEVEMENT* +0.35 *READING COMPREHENSION* + 0.28 *GENDER*

Discussion

In the present study, a significant positive correlation between students' causal thinking abilities and academic achievements is documented. Prior literature reports that incorporating thinking activities into learning environments increases academic achievement (Berkant, 2007; Binzat, 2000; Koç, 2002; B. Özkan, 2001; Ö. Özkan, 2001; Pepper, 1999; Saygın, 2003). Besides, it is also reported that instruction based on meaningful causal thinking increases academic achievement (Berkant, 2007). Consistent with this, Myers, O'Brien, Balota, and Toyofuku report that establishing causal connections about an event facilitates learning (Reed, 2004). In this perspective, it may be argued that providing students with learning environments based on the meaningful causal thinking activities results in higher academic achievement.

Since reading comprehension ability is expected to affect both meaningful causal thinking and academic achievement, reading comprehension is controlled for to examine the relationship between meaningful causal thinking and academic achievement. It is found that the correlation between meaningful causal thinking and academic achievement (r=0.65) declines when reading comprehension scores are controlled for (r=0.62). The difference between the two correlation coefficients may be explained by the effect of reading comprehension ability on meaningful causal thinking and academic achievement.

About the relationship between reading comprehension and academic achievement, Egelioğlu documents that students cannot learn beyond their knowledge level when their reading comprehension abilities are not sufficient (Erginer, 1999). Consistent with these findings, a number of prior studies document the effect of reading comprehension ability on academic achievement (Demirel et al., 2005); high correlation between reading comprehension ability and academic achievement when students use language effectively (Tekin, 1980); and significant relationship between reading achievement and success in life (Çınar, 2004).

Reading and writing abilities that are gained in preschool or primary school not only simply mean reading and writing, but also help us think, understand, and be aware (Earle, 2005). According to constructivist theory, reading comprehension ability is a process during which an individual establishes active relationships between the text, his experiences, and his mind (Yore et al., 1997). This ability is not only related to reading per se, but also to other thinking abilities and behavior acquisition (Jager, 2002; Kuzu, 2004). Some studies document the effect of reading comprehension ability on the ability of finding cause and effect relationships in a text (Belet, & Yaşar, 2007). The finding that there is a significant positive correlation between meaningful causal thinking and reading comprehension supports the arguments set forth by prior studies.

Considering studies that examine the structural and functional differences between male and female brains (Brizendine, 2006; Demirsoy, 1997) and point out to differences between male and female brains (Graber, 2000; Tarhan, 2005), it may be argued that such differences are expected to be reflected on thinking processes. In this study it is found that gender does not have a significant effect on students' meaningful thinking abilities. Studies that examine the differences between men and women reach various conclusions. Some findings are consistent with those of this study. Er (2008) documents that gender is not a significant factor in students' ability to form causal chains. Tay (2007) proposes that there is no significant difference between male and female students' achievement scores related to causality concept. Moreover, Lauer (2007) argues that there are no differences between men's and women's thinking abilities, and Al-Rumaidhi (2008) finds no differences between men's and women's moral thinking processes. According to Lowrie and Diezmann (2007), there is no significant relationship between spatial thinking and gender.

In order of importance, academic achievement and reading comprehension are found to be significant predictors of meaningful causal thinking abilities, but gender is not in the present study. This finding is consistent with other findings and discussions mentioned above. It is worth noting that the effects of three variables (academic achievement, reading comprehension, and gender) are tested simultaneously in data analyses. This is because an individual carries all these characteristics in the same cognitive structure and probably uses them in coordination when he needs. Therefore, educational activities can be designed based on the relationship between meaningful causal thinking and academic achievement, and between meaningful causal thinking and reading comprehension.

On the basis of the results, following proposals are put forward: The result related to the significant positive relationship between meaningful causal thinking and academic achievement suggests that classes and activities may be based on meaningful causal thinking in order to increase the students' success. Beside, the result related to the significant positive relationship between meaningful causal thinking and reading comprehension suggests that activities that increase students' reading comprehension abilities may be presented during lessons. In a follow-up study, an experimental setting may be designed to examine the output from teaching methods that are based on meaningful causal thinking. Future studies can also investigate the relationship between meaningful causal thinking ability and other thinking abilities (i.e., creative and critical thinking).

References/Kaynakça

Achugar, M., & Schleppegrell, M. J. (2005). Beyond connectors: The construction of cause in history textbooks. *Linguistics and Education*, *16*(3), 298-318.

Al-Rumaidhi, K. M. M. S. (2008). Moral reasoning among Kuwaiti adolescents. *Social Behavior & Personality: An International Journal*, *36*(1), 115-121.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning - An introduction to school learning.* New York, NY: Grune&Stratton.

Avcıoğlu, H. (1993). *Iowa sessiz okuma testi düzey 1 formu'nun uyarlama, geçerlik-güvenirlik çalışması*. Yayımlanmamış yüksek lisans tezi, Ankara Üniversitesi, Sosyal Bilimler Enstitüsü, Ankara.

Belet, D. Ş. ve Yaşar, Ş. (2007). Öğrenme stratejilerinin okuduğunu anlama ve yazma becerileri ile Türkçe dersine ilişkin tutumlara etkisi. *Eğitimde Kuram ve Uygulama*, *3*(1), 69-86.

Berkant, H. G. (2007). *Dokuzuncu sınıf biyoloji dersinde yapıcı öğrenme temelli hazırlanan anlamlı nedensel düşünmeye dayalı öğretimin öğrencilerin anlamlı nedensel düşünmelerine, akademik başarılarına, kalıcılığa ve günlük yaşam davranışlarına etkisi (The effect of constructivist learning based meaningful causal thinking instruction in ninth grade biology lesson on students' meaningful causal thinking, academic achievements, retention and everyday lives behaviors).* Yayımlanmamış doktora tezi, Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü, Adana.

Binzat, O. K. (2000). *The effects of concept mapping and some other variables on learning of human excretory system.* Unpublished master's thesis, The Middle East Technical University, The Department of Secondary Science and Mathematics Education, Ankara.

Brizendine, L. (2006). *Kadın beyni* (çev. Z. H. Ateş). İstanbul: Kelebek Yayınevi.

Bruner, J. (1990). *Acts of meaning.* USA, Cambridge, MA: Harvard University Press.

Cevizci, A. (2000). *Felsefe terimleri sözlüğü*. İstanbul: Paradigma.

Chin, C., & Brown, D. E. (2000). Learning in science: A comparison of deep and surface approaches. *Journal of Research in Science Teaching*, *37*(2), 109-138.

Çınar, İ. (2004). Birleştirilmiş sınıflı ilköğretim okullarında ilkokuma yazma öğretimine ilişkin bir araştırma. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, *5*(7), 31-45.

Demirel, Ö., Arslan, A., Epçaçan, C., Diker, Y., Coşkuer, D. P. ve Seçkin, H. (2005, Eylül). Okuduğunu anlama becerilerine ilişkin standartlara ulaşmada etkin öğrenmenin erişiye ve tutuma etkisi. *XIV. Ulusal Eğitim Bilimleri Kongresi (28-30 Eylül 2005, Denizli) kongre kitabı* içinde (C. II, s. 17-19). Denizli: Pamukkale Üniversitesi Matbaası.

Demirsoy, A. (1997). *Yaşamın temel kuralları* (Cilt I-Kısım II). Ankara: Meteksan.

Denkel, A. (1996). *Anlam ve nedensellik.* İstanbul: Kabalcı.

Doğanay, A. (2002). Yaratıcı öğrenme. A. Şimşek (Ed.), *Sınıfta demokrasi* içinde (s. 171-210). Ankara: Eğitim-Sen Yayınları.

Earle, W. (2005). *Literacy or literacies?* Retrieved July 22, 2007, from http://www.instituteofideas.com/transcripts/edforumliteracy.pdf

Er, Y. (2008). *Osmanlı beyliğinin kuruluşu konusu çerçevesinde öğrenci, tarih öğretmeni ve tarihçilerin tarihte nedensellik anlayışlarının incelenmesi*. Yayımlanmamış yüksek lisans tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Erden, M. ve Akman, Y. (1997). *Eğitim psikolojisi (Gelişim-öğrenme-öğretme)*. Ankara: Arkadaş.

Erginer, E. (1999). İlköğretim 3., 4. ve 5. sınıf öğrencilerinin okuduğunu anlama becerilerinin değerlendirilmesi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *6(Özel sayı)*, 1-11.

Fear, F. A., Doberneck, D. M., Robinson, C. F., Fear, K. L., Barr, R. B., Van Den Berg, H. et al. (2003). *Meaning* making and "the *learning* paradigm": A provocative idea in practice. *Innovative Higher Education*, *27*(3), 151-168.

Fugelsang, J. A., Roser, M. E., Corballis, P. M., Gazzaniga, M. S., & Dunbar, K. N. (2005). Brain mechanisms underlying perceptual mechanisms. *Cognitive Brain Research*, *24*, 41-47.

Gander, M. J. ve Gardiner, H. W. (2001). *Çocuk ve ergen gelişimi* (çev. B. Onur, N. Çelen ve A. Dönmez). Ankara: İmge.

Graber, G. H. (2000). *Kadın psikolojisi* (çev. K. Şipal). İstanbul: Cem Yayınevi.

Hançerlioğlu, O. (1978). Nedensellik. *Felsefe ansiklopedisi: Kavramlar ve akımlar* içinde (Cilt 4). İstanbul: Remzi.

Hong, L., Chijun, Z., Xuemei, G., Shan, G., & Chongde, L. (2004). The influence of complexity and reasoning direction on children's causal reasoning. *Cognitive Development*, *20*(1), 87-101.

Ignelzi, M. (2000). Meaning-making in the learning and teaching process. *New Directions for Teaching and Learning*, *82*, 5-14.

Jager, B. de (2002). *Teaching reading comprehension: The effects of direct instruction and cognitive apprenticeship on comprehension skills and metacognition.* Unpublished doctoral dissertation, University of Groningen, Netherlands. Retrieved July 12, 2007, from http://irs.ub.rug.nl/ppn/238538419

Koç, G. (2002). *Yapılandırmacı öğrenme yaklaşımının duyuşsal ve bilişsel öğrenme ürünlerine etkisi.* Yayımlanmamış doktora tezi, Hacettepe Üniversitesi, Sosyal Bilimler Enstitüsü, Ankara.

Kundi, M. (2006). Causality and the interpretation of epidemiologic evidence. *Environmental Health Perspectives*, *114*(7), 969-974.

Kuzu, T. S. (2004). Etkileşimsel modele uygun okuma öğretiminin Türkçe bilgilendirici metinleri anlama düzeyine etkisi. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, *37*(1), 55-77.

Lauer, H. (2007). The logical limitations to misunderstanding. *Legon Journal of The Humanities*, *18*, 107-118.

Lowrie, T., & Diezmann, C. M. (2007). Solving graphics problems: Student performance in junior grades. *Journal of Educational Research*, *100*(6), 369-378.

Mayer, R. E. (2002). Rote versus meaningful learning. *Theory into Practice*, *41*(4), 226-232.

McCleary, R. (1998). *Philosophy of science-causality.* Retrieved December 12, 2007, from http://www.mrrc.bio.uci.edu/se10/causality.htm

Özkan, B. (2001). *Yapılandırmacı öğrenme ortamlarında özgün etkinlik ve materyal kullanımının etkililiği.* Yayımlanmamış doktora tezi, Hacettepe Üniversitesi, Sosyal Bilimler Enstitüsü, Ankara.

Özkan, Ö. (2001). *Remediation of seventh grade students' misconceptions related to ecological concepts through conceptual change approach.* Unpublished master's thesis, The Middle East Technical University, Ankara.

Özlem, D. (1996). *Felsefe ve doğa bilimleri*. İstanbul: İnkılâp.

Pena, A., Sossa, H., & Gutierrez, A. (2008). Causal knowledge and reasoning by cognitive maps: Pursuing a holistic approach. *Expert Systems with Applications*, *35*(1-2), 2-18.

Pepper, W. L., Jr. (1999). *The effect of using graphic organizers in the teaching of standard biology*. ProQuest Digital Dissertations (Publication No. AAT 9949977).

Piaget, J. (1974). *Understanding causality.* New York, NY: W.W. Norton&Company.

Reed, S. K. (2004). *Cognition-theory and applications*. USA, Belmont, CA: Wadsworth.

Roots, K. (2005). Men, women process memories differently. *Science & Spirit*, *16*(2), 23.

Rosenthal, M. ve Yudin, P. (1997). *Felsefe sözlüğü* (çev. A. Çalışlar). İstanbul: Sosyal.

Saygın, Ö. (2003). *Lise I biyoloji dersi hücre konusunun öğretiminde yapılandırmacı yaklaşımın etkisi*. Yayımlanmamış yüksek lisans tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Tarhan, N. (2005). *Kadın psikolojisi*. İstanbul: Nesil Yayınları.

Tay, B. (2007) *Sosyal bilgiler öğretimi kapsamında ilköğretim öğrencilerinde nedensellik kavramının gelişimi*. Yayımlanmamış doktora tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Tekin, H. (1980). *Okullarımızdaki Türkçe öğretimi.* Ankara: Gül Yayınları.

Temel, Z. F. ve Aksoy, A. B. (2001). *Ergen ve gelişimi - Yetişkinliğe ilk adım.* Ankara: Nobel.

Timuçin, A. (1998). *Felsefe sözlüğü* (Genişletilmiş 2. baskı). İstanbul: İnsancıl.

Yore, L. D., Shymansky, J. A., Henriques, L., Chidsey, J. L., & Lewis, J. O. (1997). *Reading-to- learn and writing-to-learn science activities for the elementary school classroom*. Retreived July 22, 2007, from http://www2.etown.edu/bap/Resources/readtolearn.pdf

Zohar, A., & Tamir, P. (1991). Assessing students' difficulties in causal reasoning in biology-a diagnostic instrument. *Journal of Biological Education*, *25*(4), 302-307.