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The effect of open inquiry learning on gifted students' conceptual understanding

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Abstract

In science education, one of the most important approaches for educating inquiry-seeking individuals is inquiry-based learning. Science education programmes have been using the inquiry-based learning approach. Inquiry-based learning creates a learning environment that provides students with opportunities for researching scientific tasks and structuring meaningful information. Within this scope, this study aims to investigate the academic achievements of gifted students studying at Science and Art centres (SACs) in 'separating mixtures' in science courses through the open inquiry learning approach. The study was conducted on eight students in a metropolitan SAC, which is in the western part of Turkey. Four context-based, open-ended questions regarding the 'understanding of mixture separation methods' and questions to determine the students' ideas before and after the instruction were used as data collection tools. The categories consisted of two sections: scientifically correct and scientifically incorrect. The results showed that the students' scientifically correct response rates in separating mixtures increased with open inquiry learning. In addition, it is seen that the students evaluated the activity as 'creativity-stimulating' and learning through discovering as 'remarkable and fun'. Based on the results, it is recommended to use an open inquiry learning approach in science classes to increase students' academic achievement and interest in the course. In addition, this study contributes to the science education of students in SACs, to literature and to new studies to be conducted on this issue.

Keywords: Inquiry learning, gifted students, separating mixtures, conceptual understanding.

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1. Introduction

To keep up with the rapidly changing and developing world, individuals should possess problem-solving, researching, questioning, reasoning, and critical and creative thinking skills. Thus, the main objective of our education system should be to provide students with the skills of obtaining information rather than memorising. In today's world where new knowledge is quickly acquired and spread, science education aims to educate students who have investigation and questioning skills (Finlayson et al., 2015; NRC, 1997, 2000). Inquiry-based learning is one of the most important approaches for educating inquiry-seeking individuals in science education. Science education curriculums (e.g. Milli Egitim Bakanligi, 2013, 2018; NCCBE, 2004; NGSS, 2013) use the inquiry-based learning approach. Inquiry-based learning provides students with a learning environment which includes opportunities for fulfilling scientific tasks and structuring meaningful information (Tuan, Chin, Tsai & Cheng, 2005). There are many definitions regarding 'inquiry' in the literature. According to Windschitl's (2002) study, it is defined as a series of intellectual activities, building and testing hypotheses, and modelling practical problem-solving. According to Crawford's (2007) and NRC's (1996) studies, it is described as the processes used by students and scientists to investigate the natural world in accordance with the nature of science.

Inquiry-based learning may consist of three different levels: structured inquiry, guided inquiry and open inquiry (NRC, 2000). In the structured inquiry, all stages of instruction are determined by the teacher, and the students are guided by the teacher to achieve results. In the guided inquiry, the students constitute the teaching and the teacher guides the process. In the open inquiry, students determine the research hypothesis and teaching process (Celik, Senocak, Bayrakceken, Taskesenligil & Doymus, 2005). Open inquiry, in which the student is responsible for the whole process, is the level of questioning where the learner is most mentally active (Colburn, 2000). Some researchers state that open inquiry improves students' research and higher-order thinking skills, and the nature of science (Berg, Bergendahl, Lundberg & Tibell, 2003; Chinn & Malthora, 2002; Krystyniak & Heikkinen, 2007). According to VanTassel-Baska and Stambaugh (2006), the most important differences that distinguish gifted students from others are faster learning capacity (Colangelo, Assouline & Gross, 2004), the ability to find and solve problems easier (Sternberg, 1985), and the ability to use abstract ideas skilfully and make connections easily (Gallagher & Gallegher, 1994). Considering these characteristics, it is thought that open inquiry learning may be suitable for gifted students.

When the literature works related to the inquiry-based learning are examined, it is seen that there are several studies regarding the achievement (Akpullukcu, 2011; Arslan, 2007; Bagcaz, 2009; Marx et al., 2004; Sensoy, 2009; Tatar, 2006; Wallace, Tsoi, Calkin & Darley, 2003), attitude (Akpullukcu, 2011; Kucuker, 2008; McDonald, 2004; Tatar, 2006), science processing skills (Erdogan, 2005; Simsek & Kabapinar, 2010; Sullivan, 2008; Tatar, 2006; Wu & Hsieh, 2006; Wu & Krajcik, 2006), motivation (Mcphedran, 2006), critical thinking skills (Evren, 2012; McDonald, 2004), reasoning and discussion skills (Gillies, Nichols, Burgh & Haynes, 2013), and understanding concepts related to the nature of science (Khishfe & Abd-El-Khalick, 2002) of elementary and high school students in inquiry-based science activities. However, there are no studies investigating the effect of open inquiry learning approach on gifted students' conceptual understanding. Within this scope, it is important to demonstrate the effect of open inquiry learning approach on gifted students' conceptual understanding in science courses. In addition, it is thought that the new information regarding the effect of open inquiry learning on conceptual understanding of gifted students will contribute significantly to the related literature (Al Hashimi, Mahdi, Al Muwali & Zaki 2019; Unver & Cakir Ilhan, 2019).

2. Methodology

2.1. Research design

The case study design, one of the qualitative research methods, was used in this study. It is a design that examines an existing situation in depth by using multiple data collection tools without any intervention (Yin, 1984). In this study, the case study design is thought to be the most appropriate method, since the students' opinions regarding the instruction of open inquiry learning are aimed to be examined in detail.

2.2. Study group

The study group consisted of eight students in the Individual Skill Difference Avoid 2 group studying at a Science and Art Centre (SAC) located in the metropolitan area of the western part of Turkey during the 2019–2020 academic year. The reason for the small size of the study group in the study is because of the case study, which is a more detailed and in-depth research method (Yildirim & Simsek, 2008). Since one of the researchers was a teacher of the students whose opinions were taken, the interviews was conducted in an authentic environment. The students had received no prior instruction about 'separating mixtures', and they received it for the first time at the SAC. An open inquiry instruction was given to the students on a different topic before the open inquiry instruction on 'separating mixtures', and thus the students were informed about this approach.

2.3. Data collection tools

In order to determine the effect of open inquiry learning in a science course, pre- and post-application of four context-based, open-ended questions, including 'understanding of separating mixture methods' and questions aiming to determine the students' ideas about the method after the instruction, were used as the data collection tools. The questions were formed by the researchers and necessary corrections were made by obtaining the opinions of two different experts in the field.

2.4. Data analysis

Descriptive analysis, one of the qualitative data analyses, was used to analyse the data. It is defined as the processing of data and the identification and interpretation of findings based on a predetermined framework (Yildirim & Simsek, 2008). First, the students' answers were coded with the letter 'S' and the number given to the students. While analysing the answers of the students, the researchers read the answers of each student separately and identified two categories. These categories were: 'scientifically correct' and 'scientifically incorrect'. After the students' answers were identified as scientifically correct or incorrect, the development of students' conceptual understanding was determined by considering the explanations. In the process of creating categories, inter-rater reliability was examined and it was found as 0.95 (Miles & Huberman, 1994, p. 64). To ensure the reliability of the data analysis, the researchers evaluated a part of the data and re-evaluated the same part after a week.

The category of scientifically correct: The answers given by the students regarding the mixtures are fully compatible with the scientific facts and do not contain any false expressions. An example of an answer in this category is as follows: '*S1: When a box is filled with water and some balls are thrown in it, the plastic balls float and the glass balls sink*'.

The category of scientifically incorrect: The answers in this category contain false statements that students give about the mixtures. An example of an answer in this category is as follows: 'S*4: Defne can separate glass balls and plastic balls by weight. Glass balls are heavier*'.

2.5. The instruction process

Prior to the instructions, a four-hour activity was organised on a different topic to adapt the students to open inquiry learning. Initially, a pre-test consisting of comprehension questions of the concept was applied. The students were not informed about the topic on which the activities were conducted. Different mixtures and materials that were used for separation were written on the board. The students were given a sheet of A4 paper and asked to think and write about the probable subject. After completing the process of writing the subject, the students were asked 'Why did I write these materials?' and 'What do I want you to do?' Following the answers, it was stated that the students were expected to design experiments related to the materials written on the board and to express these designs with writing and drawings on the A4 paper. After completing the writing and drawings, the materials written on the board were brought to the classroom and the students were asked to carry out the experiments they imagined. Then, they were asked to share their experimental results with their friends. At the end of the activity, the comprehension questions of the concept that were applied before the activity were re-applied as the post-test (Soylucicek, 2019; UZ, 2018).

3. Findings

The findings obtained from the analysis of the understanding questions of separating mixtures are given in this section. The first question included '*Defne's glass and plastic balls are scattered in a toy box. Defne does not want to separate the balls one by one. How can Defne separate glass and plastic balls more easily?'*

Table 1. Findings from the analysis of the first question

Response types	Pre-test *f*	Post-test *f*
A. Scientifically correct answers	–	8 O(1,2,3,4,5,6,7,8)
B. Scientifically incorrect answers	8 O(1,2,3,4,5,6,7,8)	–
Total	8	8

In the first question, the students were expected to recognise the density difference method among the separation methods of solid–solid heterogeneous mixtures. After examining Table 1, there was no scientifically correct answer from the students in the pre-test. All students gave answers in the category of scientifically incorrect before instructions. However, seven students gave scientifically correct answers and one student gave a scientifically incorrect answer in the post-test.

Table 2 presents the findings regarding the second question about understanding the methods of separating mixtures: 'How do you think they can separate the salt in the salt lake?'

Table 2. Findings from the analysis of the second question

Response types	Pre-test *f*	Post-test *f*
A. Scientifically correct answers	4O (2,5,7,8)	8 O(1,2,3,4,5,6,7,8)
B. Scientifically incorrect answers	4O (1,3,4,6)	–
Total	8	8

In the second question, the students were expected to recognise the evaporation method among the separation methods of liquid–solid homogeneous mixtures (solution). After examining Table 2, four students gave scientifically correct answers, while the other four students gave scientifically incorrect answers. However, all students gave scientifically correct answers in the post-test.

Table 3 presents the findings regarding the third question about understanding the methods of separating mixtures: '*Ayse put water and olive oil in the glass. After seeing that the two liquids do not mix, she wants to separate them again. How do you think they should be separated?*'

Table 3. Findings from the analysis of the third question

Response Types	Pre-test *f*	Post-test *f*
A. Scientifically correct answers	1 O(7)	8 O(1,2,3,4,5,6,7,8)
B. Scientifically incorrect answers	7 O(1,2,3,4,5,6,8)	–
Total	8	8

In the third question, the students were expected to recognise the separating funnel method among the separation methods of heterogeneous liquid–liquid mixtures. After examining Table 3, it was seen that one student gave a scientifically correct answer, while seven students gave scientifically incorrect answers in the pre-test. However, all students gave scientifically correct answers in the post-test.

Table 4 presents the findings regarding the question of '*Defne's glass and plastic balls are scattered in a toy box. Defne does not want to separate the balls one by one. How can Defne separate glass and plastic balls more easily? Can you draw it?*'

Table 4. Findings from the analysis of the fourth question

Response types	Pre-test *f*	Post-test *f*
A. Scientifically correct answers	1 O(7)	8 O(1,2,3,4,5,6,7,8)
B. Scientifically incorrect answers	7 O(1,2,3,4,5,6,8)	–
Total	8	8

In the fourth question, the students were expected to separate the density difference between glass and plastic ball mixtures, one of the samples of heterogeneous solid–solid mixtures. In Table 4, it can be seen that two students were scientifically correct, while six students were scientifically incorrect in the pre-drawing. In the post-drawing, all students carried out scientifically correct drawings.

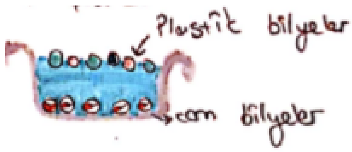

Figure 1. S1 drawing after the instruction

Figure 2. S5 drawing after the instruction

The findings of the question asked to determine the students' ideas about the instruction are given as follows:

'What do you think about the instruction about the separation of mixtures?'

In the interviews, it was seen that the students had fun with open inquiry learning and their creativity increased. Some of the answers given by the students are as follows:

S3: '*I think it was fun and increased my creativity*.'

S1: *'I like this kind of activities. But the teacher could also explain. If you did it to free us and understand what we could do, I would prefer it.'*

S6: *'Our teacher gave us certain materials and became silent. We discovered it by thinking. It was more fun.'*

4. Conclusions and discussions

In conclusion, it was determined that the gifted students' scientific response rate regarding the methods of separating mixtures increased with open inquiry learning. Open inquiry-based instruction on separating mixtures had an effect on the conceptual understanding of gifted students. While in students who did not have scientific ideas about these concepts before the instruction, it was seen that there was an increase in scientific responses after the instruction. It can be said that this teaching approach is effective in conceptual understanding of gifted students. In addition, students evaluated the activities as 'creativity enhancing', and learning by discovering as 'remarkable and fun'. This result is consistent with the studies conducted in the literature (Duban, 2008; Erdogan, 2005; Ortakuz, 2006; Tatar & Kuru, 2006). For example, Stohr-Hunt (1996) examined the relationship between the frequency of inquiry activities and students' science achievement in a study conducted with eight grade students. Science achievements of students who do these activities every day or once a week are higher than those who do these activities once or less than a month. Research has shown that these activities are highly effective in science achievement. In another study, Akkus, Gunel and Hand (2007) compared the traditional approach with the inquiry-based approach and found that the quality of the instruction had a significant effect on the student's post-test scores. It was also stated that a qualified inquiry-based approach had a significant effect on students' achievement. In their study, Sadeh and Zion (2009) stated that the two different activity models applied in the biology course created similar differences in terms of developing students' basic inquiry skills. They expressed that the 'methodological understanding' of the group of students using open inquiry increased significantly. In addition, students evaluated the activity as 'enhancing their creativity, and learning by discovering is remarkable and fun'. This result is compatible with Akpullukcu's (2011) finding that students enjoy learning by taking responsibility and creating their own learning products in inquiry-based learning environments, and Duran's (2015) finding that the lessons are fun and more enjoyable with inquiry-based learning activities.

5. Recommendations

Taking these results into consideration, the following suggestions can be made. Further studies may be conducted on different subjects that will be taught to gifted students by using the open inquiry approach. In addition, studies in which the gifted students will design different projects for longer periods may be carried out. Within the scope of the prospective studies, the effects of the open inquiry approach on the conceptual understanding of gifted students may be revealed in more detail.

References

Akkus R., Gunel, M. & Hand, B. (2007). Comparing an inquiry-based approach known as the science writing heuristic to traditional science teaching practices: are there differences? *International Journal of Science Education, 29*(14), 1745–1765.

Akpullukcu, S. (2011). *Fen ve teknoloji dersinde arastırmaya dayali ogrenme ortaminin ogrencilerin akademik basari, hatirda tutma duzeyi ve tutumlarina etkisi [The effect of inquiry based learning environment in science and technology course on the students' academic achivements, attitudes and retention level]* (Master's thesis). DokuzEylul University, Izmir, Turkey.

Al Hashimi, S., Mahdi, N., Al Muwali, A. & Zaki, Y. (2019). Proposing a framework for evaluating digital creativity in social media and multimedia-based art and design education. *Global Journal of Arts Education, 9*(2), 48–62. doi:10.18844/gjae.v9i2.4238

Arslan, A. (2007). *Fen egitiminde arastirmaya dayali ogretim yonteminin kavramsal ogrenmeye etkisi [The effect of inquiry-based teaching in the education of science on the conceptual learning]* (Master's thesis). Marmara University, Istanbul, Turkey.

Bagcaz, E. (2009). *Ogretim yonteminin ogrencilerin akademik basarisi ve fen ve teknoloji dersine yonelik tutumuna etkisi [The effect of inquiry teaching method on students' academic success and on attitude for the science and technology lesson]* (Master's thesis). Sakarya University, Sakarya, Turkey.

Berg, C. A. R., Bergendahl, C. V. B., Lundberg, B. & Tibell, L. (2003). Benefiting from an open-ended experiment? A comparison of attitudes to, and outcomes of, an expository versus an open-inquiry version of the same experiment. *International Journal of Science Education, 25*(3), 351–372.

Celik, S., Senocak, E., Bayrakceken, S., Taskesenligil, Y. & Doymus, K. (2005). Aktif ogrenme stratejileri uzerine bir derleme calismasi [A review on active learning strategies]. *Kazim Karabekir Egitim Fakultesi Dergisi, 11*, 155–185.

Chinn, C. A. & Malhotra, B. A. (2002). Epistemologically authentic inquiry in schools: a theoretical framework for evaluating inquiry tasks. *Science Education, 86*(2), 175–218.

Colangelo, N., Assouline, S.G. & Gross, M. U. M. (2004). *A nation deceived: how schools hold back America's brightest students (V.II.).* Iowa City, IA: University of Iowa.

Colburn, A. (2000). An inquiry primer. *Science Scope, 23*, 139–140.

Crawford, A. B. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching, 44*(4), 613–642.

Duban, N. (2008). *Ilkogretim Fen ve Teknoloji Dersinin sorgulamaya dayali ogrenme yaklasimina gore islenmesi: bir eylem arastirmasi [Conducting science and technology course through inquiry based learning approach in primary education: an action research]* (PhD Thesis). Anadolu University, Eskisehir, Turkey.

Duran, M. (2015). Development process of guidance materials based on inquiry based learning approaches and student opinions. *International Online Journal of Educational Sciences, 7*(3), 179–200.

Erdogan, M. N. (2005). *Ilkogretim 7. sinif ogrencilerinin atomun yapisi konusundaki basarilarina, kavramsal degisimlerine, bilimsel surec becerilerine ve fenne karsi tutumlarina sorgulayici arastirma yonteminin etkisi [The effects of Inquiry method on middle school (level 7) students' achievement, conceptual change, scientific process skills and attitude toward science about the atomic structure]*. Master's thesis, Gazi University, Ankara, Turkey.

Evren, B. (2012). *Fen ve teknoloji ogretiminde sorgulayici ogrenme yaklasiminin ogrencilerin sahip olduklari elestirel dusunme egilim duzeylerine ve fen ve teknoloji dersine yonelik tutumlarina etkisi [The effect of inquiry learning approach on elementary students' critical thinking dispositions and attitudes towards science and technology course]*. Adnan Menderes University, Aydin, Turkey.

Finlayson, O., McLoughlin, E., Coyle, E., McCabe, D., Lovatt, J. & van-Kampen, P. (2015). *SAILS inquiry and assessment units.* Dublin, Ireland. Retrieved from http://results.sails-project.eu/sites/default/files /outcomes/SAILS_units_volume-1.pdf.

Gillies, R. M., Nichols, K., Burgh, G. & Haynes, M. (2013). Primary students' scientific reasoning and discourse during cooperative inquiry-based science activities, *International Journal of Educational Research, 14*, 127–140.

Khishfe, R. & Abd-El-Khalick, F. (2002). Influence of explicit and reflective versus implicit inquiry-oriented instruction on sixth graders' views of nature of science. *Journal of Research in Science Teaching, 39(7),* 551–578.

Krystyniak, R. A. & Heikkinen, H. W. (2007). Analysis of verbal interactions during an extended, open-inquiry general chemistry laboratory investigation. *Journal of Research in Science Teaching, 44*(8), 1160–1186.

Kucuker, S. (2008). *Bilgisayar destekli sorgulayici-arastirma (inquiry) yonteminin ogrencilerin kimyasal reaksiyonlar konusundaki kavramsal degisimlerine etkisi [The effects of technology integrated inquiry-based instruction students' conceptual change toward chemistry course about chemical reactions]*. Ankara, Turkey*:* Gazi Universitesi Egitim Bilimleri Enstitusu.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., Fishman, B., Soloway, E., Geier, R. & Tal, R. T. (2004). Inquiry-based science in the middle grades: assessment of learning in urban systemic reform. *Journal of Research in Science Teaching, 41*(10), 1063–1080.

McDonald, D. M. (2004). *Teaching for spesific understanding (microform): a study of the effects of two methods* (Doctoral dissertation). National Library of Canada, Ottawa, ON.

Mcphedran, J. L. (2006). *An investigation of inquiry based teaching ve its influence on boy's motivation in science*. (Unpublished master's thesis). University of Toronto, Toronto, ON.

Milli Egitim Bakanligi, (2013). *Ilkogretim kurumlari (Ilkokullar ve Ortaokullar) Fen bilimleri dersi (3, 4, 5, 6, 7 ve 8. siniflar) ogretim programi.* Ankara, Turkey: MEB Yayinevi.

Milli Egitim Bakanligi. (2018). *Fen bilimleri dersi ogretim programi (Ilkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Siniflar).* Ankara, Turkey: Millî Egitim Bakanligi Temel Egitim Genel Mudurlugu.

NCCBE, (2004). *The finnish national core curriculum for basic education*. Helsinki, Finland: Finnish National Board of Education. Retrieved from http://www.oph.fi/english/curricula_and_qualifications/basic_education.

NGSS. (2013). *The next generation science standards*. Washington, DC: The National Academy of Sciences. Retrieved from: http://www.nextgenscience.org/sites/default/files/NGSS%20DCI%20Combined%2011.6.13.pdf.

NRC. (1996). *National science education standards.* Washington DC: National Academy Press.

NRC. (1997). *Science teaching reconsidered: a handbook*. Washington, DC: National Academies Press.

NRC. (2000). *Inquiry and the national science education standards.* Washington, DC: National Academy Press.

Ortakuz, Y. (2006). *Arastirmaya dayali ogrenmenin ogrencilerin fen-teknoloji-toplum-cevre iliskisini kurmaya etkisi [The effect of inquiry-based learning on students' establishing relations among science-technology-society environment]* (Master's thesis). Marmara University, Istanbul, Turkey.

Sadeh, I. & Zion, M. (2009). The development of dynamic inquiry performances within an open inquiry setting: a comparison to guided inquiry setting. *Journal of Research in Science Teaching, 46*(10), 1137–1160.

Sensoy, O. (2009). *Fen egitiminde yapilandirici yaklasima dayali arastirma sorusturma tabanli ogretimin ogretmen adaylarinin problem cozme becerileri, oz yeterlik duzeyleri ve basarilarina etkisi* [*The effect of inquiry-based science instruction according to the constructivist approach on preservice teachers' problem solving skills, self-efficacy and achievements]*. PhD thesis, Gazi University, Ankara, Turkey.

Simsek, P. & Kabapinar, F. (2010). The effects of inquiry-based learning on elementary students' conceptual understanding of matter, scientific process skills and science attitudes. *Procedia-Social and Behavioral Sciences, 2*(2), 1190–1194.

Soylucicek, S. (2019). Looking through the sphere; illustration in virtual reality. *Global Journal of Arts Education, 9*(1), 22–28. doi:10.18844/gjae.v9i2.3953

Sternberg, R. J. (1985). Implicit theories of intelligence, creativity, and wisdom. *Journal of Personality and Social Psychology, 49*(3), 607.

Stohr-Hunt, P. M. (1996). An analysis of frequency of hands-on experience and science achievement. *Journal of Research in Science Teaching, 33,* 101–109.

Sullivan, F. R. (2008). Robotics and science literacy: thinking skills, science process skills and systems understanding. *Journal of Research in Science Teaching, 45*(3), 373–394.

Tatar, N. (2006). *Ilkogretim fen egitiminde arastirmaya dayali ogrenme yaklasiminin bilimsel surec becerilerine, akademik basariya ve tutuma etkisi. [The effect of inquiry-based learning approaches in the education of science in primary school on the science process skills, academic achivement and attitude].* Master's thesis, Gazi University, Ankara, Turkey.

Tatar, N. & Kuru, M. (2006). Fen egitiminde arastirmaya dayali ogrenme yaklasiminin akademik basariya etkisi. *Hacettepe Universitesi Egitim Fakultesi Dergisi* [The effect of inquiry-based learning approach in science education on academic achivement]. *Hacettepe Universitesi Egitim Fakultesi Dergisi, 31*, 147–158.

Tuan, H. L., Chin, C. C., Tsai, C. C. & Cheng, S. F. (2005). Investigating the effectiveness of inquiry instruction on the motivation of different learning styles students. *International Journal of Science and Mathematics Education, 3*(4), 541–566.

Unver, Z. & Cakir Ilhan, A. (2019). The assessment of the reasons for choosing their professions of state opera and ballet orchestra artists. *Global Journal of Arts Education, 9*(1), 1–8. doi:10.18844/gjae.v9i2.4033

UZ, N. (2018). Importance of drawing education in plastic arts and an example of method for developing creativity. *Global Journal of Arts Education, 8*(3), 91–102. doi:10.18844/gjae.v8i3.3880

VanTassel-Baska, J. & Stambaugh, T. (2006). *Comprehensive curriculum for gifted learners* (3rd ed.). Boston, MA: Pearson, Allyn, & Bacon.

Wallace, S. C., Tsoi Y. M., Calkin J. & Darley M. (2003). Learning from inquiry-based laboratories in nonmajor biology: an interpretive study of the relationships among inquiry experience, epistemologies and conceptual growth. *Journal of Research in Science Teaching, 40*(10), 986–1024.

Windschitl, M. (2002). Inquiry projects in science teacher education: what can investigative experiences reveal about teacher thinking and eventual classroom practice*? Science Teacher Education, 87*, 112–143.

Wu, H. K. & Hsieh, C. E. (2006). Developing sixth graders' inquiry skills to construct explanations in inquiry based learning environments. *International Journal of Science Education, 28*(11), 1289–1313.

Wu, H. K. & Krajcik, J. S. (2006). Inscriptional practices in two inquiry-based classrooms: a case study of seventh graders' use of data tables and graphs. *Journal of Research in Science Teaching, 43*(1), 63–95.

Yildirim, A. & Simsek, H. (2008). *Sosyal bilimlerde nitel arastirma yontemleri [Qualitative research methods in the social sciences]* (6th ed.). Ankara, Turkey: Seckin Publicaitons.

Yin, R. (1984). *Case study research: design and methods* (3rd ed). Thousand Oaks, CA: Sage Publications.