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COMPARISON OF KNOWLEDGE LEVELS OF MEIOSIS AND MITOSIS DIVISIONS IN SEVENTH GRADERS WITH MIXED METHODS

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Abstract:
The main aim of this study is to compare the information about meiosis and mitosis divisions of secondary school students with different methods. The mixed method was used in the research. In the mixed method, it is aimed to close the deficiencies in the solution of the research problems with both qualitative and quantitative data. Homogeneous samples were used in the study. In the 2018-2019 academic years, it was conducted with 7th grade students in a public school in Eastern Anatolia. A total of 132 students participated in the study, depending on the volunteerism principle. Matching test was used to collect quantitative data. Qualitative data were collected through a fully structured interview form. The collected data were analyzed with the help of Microsoft Excel program. Descriptive and content analyzes and techniques such as frequency and percentage values were used. According to the findings, the knowledge of meiosis and mitotic divisions was found to be good level. It was determined that most of the students had the right information about meiosis and mitosis and they knew the general characteristics of these divisions. According to these findings of the study, concordant results were obtained by using mixed method with different measuring methods. Suggestions are presented in parallel with these findings.

Keywords: science, meiosis and mitosis divisions, knowledge level, mixed method

1. Introduction

The science course is a science that allows us to understand nature and natural phenomena. In this science, the researcher tries to understand the natural world and its diversity by using the feelings of doubt and curiosity with its explorer and interrogator identity (Çaycı, 2007; Doğru and Kıyıcı, 2005).One of the basic aims of the science is to use the knowledge acquired by the individual (Zeidler, Sadler, Simmons and Howes, 2005). Individual should be able to use the knowledge gained in science subjects in

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daily life (Sadler and Ziedler, 2009). Thanks to this science, knowledge about the living universe, living things, physical and chemical events is learned. Another subject learned is cell division. These subjects, known as meiosis and mitosis divisions, are learned at seventh grade level in secondary school. The main purpose of these subjects is to get information about students' concepts and daily use (MoNE, 2018).

There are difficulties in education due to reasons such as abstracting and not reaching the science concepts. Very abstract concepts prevent students from learning this lesson in a meaningful way (Bora, Çakıroğlu and Tekkaya, 2006). The subject of cell divisions is also the subject of learning difficulties (Demirkuş, 2019). The most obvious reason for this is the adaptation of the words of foreign origin to the Turkish language (Demirkuş, Ertas and Gulen, 2018). Although there are difficulties in teach these subjects (Atılboz, 2004), new approaches and methods should be applied in teaching subjects. For example, it is thought that it will be possible to eliminate the possible difficulties with the material and to get knowledge (Sinan and Karadeniz, 2010).

Knowledge can be defined as a whole of learned facts about any subject. As a matter of fact, human beings learn something from birth (Güven, 2014). The area of knowledge is quite high. Technology, science and education are just some of these areas (Brillouin, 2013). The main purpose of the knowledge acquired in science education is to provide the satisfaction of the individual and to use this information. As a matter of fact, the information obtained about cell divisions should be close to daily life and should be available (Baran, Doğan and Yalçın, 2002; Demiral and Türkmenoğlu, 2018). Meiosis and mitosis and related concepts should be learned in a meaningful way (Daşdemir and Doymuş, 2012). The aim is not to memorize the information is to think of learning (Aydin and Balim, 2013).

Students will have to think about the meiosis and mitosis divisions and try to use them in their daily lives. Mitosis in general; it allows proliferation in single-celled organisms, growth and repair in multicellular organisms. At the end of the mitosis division, the number of chromosomes remained constant and consisted of 2 new cells. The resulting cells are inherently identical. This division occurs in the body cells (MoNE, 2018; Özdemir, 2006). Meiosis only occurs in the genitals. By dividing meiosis of the main reproductive cells, the number of chromosomes consists of four new cells that are halved. The cells formed are different from each other in hereditary way (Akyürek and Afacan, 2012; MoNE, 2018). Both quantitative and qualitative methods are used to determine students' knowledge about meiosis and mitosis. In addition, a mixed method is formed by the application of these two methods together.

The mixed method is to collect and integrate both qualitative and quantitative data to understand the research problem (Creswell, 2017). The aim of this method is to close the missing aspects of qualitative and quantitative methods while seeking a solution to the research problem. These results are obtained more objectively (Creswell and Plano Clark, 2011). In addition, quantitative results are supported with answers to questions such as how and why the qualitative results are supported with statistical data (Yıldırım and Şimşek, 2013). The most important situation here is the adaptation of the data obtained by both methods. As a matter of fact, a definitive judgment is reached

through this harmony. When the literature is examined, it can be said that the mixed method studies are increasing (Bellibaş and Gedik, 2014; Demirci, 2017; Evren Yapıcıoğlu and Kaptan, 2018; Kalman and Summak, 2016; Kocaman-Karoğlu, 2015). But the results of these studies should be examined. In addition, students are known to suffer from various cell divisions (Tekkaya, Çapa and Yılmaz, 2000; Tekkaya, Özkan and Sungur, 2001). What are the levels of knowledge of students about cell divisions? Are similar results achieved when different methods are used? Are these results consistent with each other? The answer to such questions was sought. Therefore, it is important to determine the knowledge level of the students about meiosis and mitosis in the research by means of a mixed method and to obtain the data which are integrated by comparing the qualitative-quantitative data.

1.1 Purpose of the research

The main aim of this research is to compare the information about meiosis and mitosis divisions of secondary school students with different methods. In this context, the answers to the following questions were sought.

1) What is the level of knowledge of secondary school seventh grade students' about meiosis and mitosis divisions?
2) What is the similarity level of secondary school seventh grade students' level of knowledge about meiosis and mitosis divisions?

2. Method

The mixed method was used in the research. In the mixed method, it is aimed to close the deficiencies in the solution of research problems with both qualitative and quantitative data (Büyüköztürk, 2009; Çepni, 2010; Yıldırım and Şimşek, 2013). Qualitative data were collected together with quantitative data.

2.1 Participants

Homogeneous (analogous) samples were used in the study. The aim in the analogous sample is to determine the status of groups of similar characteristics in a subject in order to collect the data effectively (Creswell, 2013). As a matter of fact, the research was conducted with 7th grade students in a public school in Eastern Anatolia Region during the 2018-2019 academic years. A total of 132 students participated in the study, depending on the volunteerism principle. While all students participated in the matching test used in the study, 100 students participated in the fully structured interview form. 27 students were not allowed to leave the form blank and 5 students could not read the forms. The socio-economic status of the participants was similar. The families of the majority of the participants are engaged in farming. Farming means a small number of agriculture and animal care. They also conducted research on mitosis and meiosis divisions at the beginning of the 2018-2019 academic years. This topic has been discussed and learned in class.

2.2 Data collection tools

Matching test was used to collect quantitative data. This test measures students' concepts of mitosis and meiosis and their correct mapping of properties and relationships. Qualitative data were collected through a fully structured interview form. In the fully structured interview form, the following questions were used.

1) Why is mitosis division important for living things?
2) Why is meiosis division important for living beings?

2.3 Analysis of data

The data of the measurement tools used in the study were analyzed with the help of Microsoft Excel program. Descriptive and content analyzes and techniques such as frequency and percentage values were used.

In each pairing test, each line was evaluated as 1 point. In total 16 matches are required. These notes were then converted into a hundred percent note system.

The data of the fully structured interview form were analyzed both in terms of descriptive and content in order to determine information about mitosis and meiosis divisions. The data obtained by the two analysis methods are presented in the findings section.

The score range of the matching test was evaluated according to the criteria given in Table 1.

Table 1: Interpretation value range of scores

Order	Value	Range for matching test
1	Very bad	00.01 - 20
2	Bad	20.01 - 40
3	Middle	40.01 - 60
4	Good	60.01 - 80
5	Very good	80.01 - 100

As seen in Table 3, five equal intervals were determined for more precise interpretation. According to this, it is very bad, bad, middle, good and very good value for true-false test. Kandemir (2015) has similar criteria to this table in his study.

2.4 Reliability and Validity

Within the scope of the reliability studies, the status of the sample group was explained in detail, the existing roles were explained, the conceptual framework and data collection and analysis were presented. In addition, these data were supported by descriptive analysis and content analysis (Glesne, 2013). The fully structured interview form used is based on expert opinion. The analyzed received help from their teachers. For the coding and scoring, reliability was calculated using the formula of Miles and Huberman (1994). According to this calculation, 95% confidence coding was performed throughout the study. In fact, according to Miles and Huberman (1994) 80% and above has been accepted as reliable (Arik and Yilmaz, 2017). In the descriptive and content

analysis of validity of the research, direct quotations were given and the accuracy of the research results was shown (Merriam, 2013). The codes used in the content analysis and the interpretations were done in depth. The names of the participants are coded. In addition, subject gains were taken into consideration in terms of the scope validity of the matching test. Validity values such as structure and appearance are obtained by taking expert opinion (Yıldırım and Şimşek, 2013).

3. Results

The data collected with both qualitative and quantitative measurement tools are presented below. As a result of the evaluation of the matching test used in the study, the values given in Table 2 are obtained.

Table 2: Matching test statistical values

Test	N	Standard deviation	Average	Comment
Matching test	132	24.12	63.26	Good

Table 2 shows the mean and standard deviation of the scores of the students who took part in the matching test. In addition, these average scores are "*good*" level within the scope of the criteria in Table 1. According to this, the mean score of the participants was 63.26 and the standard deviation was 24.12.

The data obtained as a result of the fully structured interview form analysis used in the research are presented below. The most commonly used expression as a result of the descriptive analysis is given in Table 3.

Table 3: Most repetitive expressions

Order	Expressions (N: 100)	Frequency (f)	Percent (%)
1	Mitosis provides reproduction in single cells	60	60
2	Meiosis provides reproduction in multiple cells	51	51
3	Mitosis makes repair	37	37
4	Mitosis provides growth and development	31	31
5	Meiosis provides hereditary diversity	28	28

As shown in Table 3, the first three of the most repetitive statements "mitosis provides reproduction in single cells", "meiosis provides reproduction in multiple cells" and "mitosis makes repair". In general, it is observed that the majority of participants use correct expressions about meiosis and mitosis. As a matter of fact, it is seen that 60% of the respondents said that mitosis divides single-celled animals, 37% of them provide mitosis and 31% of them show mitosis growth and development. These statements are generally used by different participants. Similarly, it was seen that 51% of the participants stated that meiosis divergence in multicellular organisms and that 28% of the meiosis division provided hereditary diversity. The sum of these two data is above average. Based on these data, it is seen that the majority of the participants have sufficient knowledge about meiosis and mitosis divisions. It is understood that most of

the new participants have at least one or more accurate knowledge about meiosis and mitosis divisions.

In addition to the descriptive analysis, the themes and categories obtained in the content analysis are presented below.

3.1 Recognition of meiosis and mitosis divisions

Under this theme, the quotations of the participants were analyzed with the two categories mentioned below.

A. Meiosis division

The statements used by the participants in this category are quoted below (Quotes are selected at random):

> *"As meiosis divides in parts, it occurs in different gene structures (Cells). Hereditary diversity is achieved." (P5)*
>
> *"Meiosis provides a continuation of a generation. Provides hereditary diversity. In short, the continuity of generation." (P13)*
>
> *"As a result of meiosis, four new cells are formed. (P57)*
>
> *"It is important to keep a constant value of the number of chromosomes. Because it usually provides reproduction." (P77)*
>
> *"There is a need for meiosis in order for human beings to breed and continue their generation. Thanks to meiotic cleavage, diversity of species is ensured and thus everyone is different" (P88)*
>
> *"The part change is visible. It provides reproduction in multicellular organisms." (P123)*

As it is understood from the above quotations, it has been stated that "*growth occurs*" with the formation of "*new cells*" that provide "*continuity of the generation*" of meiosis. In addition, it is stated that different individuals are formed by providing the "*hereditary diversity*" within the "*species*" by the "*exchange*" of parts in the meiosis division. It can be said that the participants know the general characteristics of meiosis.

B. Mitosis division

The statements used by the participants in this category are quoted below (Quotations randomly selected):

> *"Without mitosis, single-celled organisms would not have the ability to reproduce. Multicellular organisms cannot develop. For example, when our arm was injured, the wound would never be healed." (P9)*

"Mitosis results in two cells. Mitosis improves proliferation in single cells, healing wounds in multiple cells." (P21)

"Repair when injury occurs." (P47)

"For some living things, reproduction provides repair and growth in some living things. So it is important". (P65)

"Mitosis division is all over our lives. For example, it allows our wounds to heal. It is very important in our growth and development". (P100)

"In order for multicellular organisms to survive, it is important for single-celled organisms to sustain their lineage" (111)

As it is understood from the quotations, it is stated that mitosis division provides "*reproduction*" in "*single-celled*" organisms, "*growth and development*" in "*multicellular*" organisms. It has also been reported that mitosis divides makes "*repair*" the wounds. It can be said that participants from these quotations know the general characteristics of mitosis.

Apart from the above quotations, it can be said that very few participants mixed the properties of meiosis and mitosis. Apart from these two interesting quotations are presented below.

"Meiosis is mating". (P61)

"Meiosis and mitosis are for animals". (P118)

As it is understood from these quotations, although there are very few, there are some misconceptions about meiosis and mitosis. In general, when all the citations are examined, it was determined that the majority of the participants had the true information about meiosis and mitosis divisions. It was also determined that the participants knew the general characteristics of meiosis and mitosis.

4. Discussion

The average of the scores obtained from the matching test shows that the information about meiosis and mitosis divisions is at a good level considering the criteria in Table 1. According to this, the students are well aware of the concepts, concepts and mappings of meiosis and mitosis. The first three of the most repetitive statements based on the descriptive analysis of the results of the fully structured interview form; mitosis provides reproduction in single cells, meiosis is the expression that makes reproduction in multi-celled and mitosis makes repair. These expressions show that the students know the basic purpose of mitosis and meiosis. As a result of content analysis, it was

determined that most of the students had the right information about meiosis and mitosis divisions. It was also determined that the participants knew the general characteristics of meiosis and mitosis. According to these findings, it can be said that both qualitative and quantitative data show the same results. Compatible results were obtained by using mixed method with different measuring methods.

Similar to the results of the study, Özdemir (2006) found that both qualitative and quantitative methods were used in the structuring of knowledge. Kalman and Summak (2016) had positive results in experimental study with teachers using the mixed method. Also, Kocaman-Karoğlu (2015) according to his work in scientific research is increasing the rate of use of mixed methods. It is present in studies that do not show similarity with the results of the research. Evren Yapıcıoğlu and Kaptan (2018) found that some of the qualitative and quantitative data were not compatible with each other. Although Bellibaş and Gedik (2014) and Demirci (2017) used mixed methods in their studies, they found discrepancies between qualitative and quantitative data. In addition to these studies, Bakırcı, Artun, Şahin and Sağdıç (2018) have determined that students can use the information they have learned in their daily life problems. Wersig (1993) also stated that it is important to pay attention to the teaching of familiar and common concepts. As a matter of fact, meiosis and mitosis divisions are both related to daily life and should be considered. In addition to the above studies, there are various problems in students' cell divisions (Emre and Bahşi, 2006; Tekkaya, Çapa and Yılmaz, 2000; Tekkaya, Özkan and Sungur, 2001). Although this study is rare, attention should be paid to the teaching of cell division issues.

4.1 Conclusions and recommendations

The knowledge of students about meiosis and mitosis divisions was found to be good level. It is suggested that the level of knowledge in a subject can be determined using the matching test.

It was determined that most of the students had the right information about meiosis and mitosis and they knew the general characteristics of these divisions. Furthermore, it was determined that they knew the basic purpose of mitosis and meiosis. Using a fully structured interview form, it is possible to determine what a student knows about a subject. This is recommended for similar studies.

According to the results of this study, mixed results were obtained by using mixed method with different measuring methods a mixed method is recommended for studies that need to show the same result with different aspects of a subject.

References

Akyürek, E., & Afacan, Ö. (2012).Determining the 8th grade students' misconceptions in the unit of "cell division" by using roundhouse diagramming. *International Journal of Educational Programs and Teaching Studies, 2*(3), 47-58.

Arık, S., & Yılmaz, M. (2017).Attitudes of science teachers towards environmental problems and their metaphorical perceptions for environmental pollution. *Kastamonu Education Journal, 25*(3), 1147-1164.

Atılboz, N., G. (2004). Level of understanding of mitosis and meiosis subjects of high school students in 1st grade and their concepts. *Gazi Education Faculty Journal, 24* (3), 147-157.

Aydın, G., & Balım, A. (2013). Science and technology course plans and activities based on conceptual change strategies. *Journal of Research in Education and Teaching, 2*(1), 327-337.

Bakırcı, H., Artun, H., Şahin, S. & Sağdıç, M. (2018). Investigation of opinions of seventh grade students about socio-scientific issues by means of science teaching based on common knowledge construction model. *Journal of Qualitative Research in Education, 6*(2), 207-237. DOI:10.14689/issn.2148 - 2624.1.6c2s10m

Baran, Ş., Doğan, S., & Yalçın, M. (2002). The levels of university biology students making connection between the knowledge gained during their educations and daily life. *Journal of Erzincan Faculty of Education*, 4(1), 89-96.

Bellibaş, M. Ş., & Gedik, Ş. (2014). Comparison of public and private school principals' instructional leadership skills: mixed-method approach. *Educational Administration: Theory and Practice, 20*(4), 453-482.

Bora, N. D., Çakıroğlu, J., & Tekkaya, C. (2006).Teaching the nervous system with roundhouse diagram. *Education and Science, 31*(141), 32-39

Brillouin, L. (2013). *Science and information theory: Second edition*. New York: Academic press.

Büyüköztürk, Ş. (2009). *Manual of data analysis for social sciences*. Ankara: Pegem Academy.

Çaycı, B. (2007). Investigation of the effect of concept change texts on concept learning. *Gazi University Journal of Gazi Faculty of Education, 27* (1), 87-102.

Çepni, S. (2010). *Introduction to research and project work*. Trabzon: Celepler Printing.

Creswell, J., & Plano Clark, V. L. (2011).*Designing and conducting mixed method research* (2nd ed). Thousand Oaks, CA: Sage.

Creswell, J.W. (2013). *Qualitative research methods (Trans. Ed.: Whole, M., & Demir, S.B.).* Ankara: Political Publications Distribution.

Creswell, J.W. (2017). *Introduction to mixed method research (Trans. Ed.: Sözbilir, M)* Ankara: Pegem Akademi Publications.

Daşdemir, İ., Doymuş, K. (2012). The effect of using animation in science and technology course on students' academic achievements, information retention and scientific process skills. *Pegem Journal of Education and Training, 2* (3), 33-42.

Demiral, Ü., & Türkmenoğlu, H. (2018). The relationship of preserves science teachers' decision making strategies and content knowledge in socio-scientific issues. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 31* (1), 309-340. DOI: 10.19171/uefad.450141

Demiral, Ü., & Türkmenoğlu, H. (2018). The relationship of preserves science teachers' decision making strategies and content knowledge in socio-scientific issues. *Journal of Education Faculty, 31* (1), 309-340

Demirci, F. (2017). *Science teachers' self-efficacy beliefs about astronomy subjects teaching: a mixed method research.* Unpublished Master Thesis, University of Ordu, Institute for Graduate Studies in Science and Technology, Ordu

Demirkis, N., Ertas, A., & Gülen, S. (2018), Microbiological concepts to teach the development of the course material course. *Kirsehir Education Faculty Journal*, 19(3), 2561-2572. DOI: 10.29299 / kefad.2018.19.03.021

Demirkuş, N. (2019). *Important concepts in biology*. http://www.biyolojiegitim.yyu.edu.tr/ders/kav.htmAccessed on 12.02.2019

Doğru, M., & Kıyıcı, F.B. (ed) (2005). *Obligation of science education. teaching science and technology in primary education*. Ankara: Anı Publishing.

Emre, İ., & Bahşi, M. (2006).Science student teachers' conceptions about cell division. *Eastern Anatolia Region Surveys*. 4(3), 70-73.

Evren Yapıcıoğlu, A., & Kaptan, F. (2018). Contribution of socio-political status-based teaching approach to development of argumentation skills: A Mixed-Method Study. *Ondokuzmayis University Journal of Education. 37*(1), p39-61.

Glesne, C. (2013). *Introduction to qualitative research (Trans. Ed.: Ersoy, A., & Yalcinoglu, P.).* Ankara: Anı Publishing.

Güven, İ. (2014). Examination of information literacy and media literacy levels of science and technology teacher candidates. *Turkish Studies - International Periodical for the Languages, Literature and History of Turkish or Turkic,* 9(2), 787-800

Kalman, M., & Summak, M. (2016). A mixed methods study on developing teachers' psychological capital. *Gaziantep University Journal of Social Sciences, 15*(1), 27-58. DOI: 10.21547/jss.256733

Kandemir, M. A. (2015). Examining reflective thinking tendency levels of primary school mathematics and classroom teacher candidates according to some variables. *Education Sciences, 10* (4), 253-275.

Kocaman-Karoğlu, A. (2015). Mixed method research analysis in the field of instructional technology: 2005-2015.*AhiEvranÜnv. Journal of Kırşehir Education Faculty*, 16 (2), 353-369.

Merriam, S. B. (2013). *A guide for qualitative research design and implementation (Trans. Ed .: Turan, S.).* Ankara: Nobel Publishing.

Miles, B. M., & Huberman, A. M. (1994).*Qualitative data analysis (2nd ed.*). London: Sage Publication.

Ministry of National Education (MoNE), (2018). *Elementary and Secondary School 3, 4, 5, 6, 7 and 8 grades science curriculum*. Ankara: MoNE publications

Özdemir, Ö. (2006). *The effect of instruction 'the life event which enables continuity of species (reproduction)' subject through worksheets on primary school eighth grade students' achievement and retention*. Unpublished Master Thesis, Dokuz Eylul University Institute of Educational Sciences. Izmir

Sinan, O., & Karadeniz, Ö. (2010). A sample event for the teaching of mitosis division. *Elementary Education Online, 9*(3), 1-7

Tekkaya, C., Çapa, Y., Yılmaz, Ö. (2000). Biology teacher candidates' conceptions in general biology. *Journal of Hacettepe University Faculty of Education, 18*, 140-147.

Tekkaya, C., Özkan, Ö. & Sungur, S. (2001). Biology concepts perceived as difficult by Turkish high school students. *Journal of Hacettepe University Faculty of Education, 21*, 145-150.

Wersig, G. (1993). Information science: The study of postmodern knowledge usage. *Information Processing & Management, 29*(2), 229-239.

Yıldırım, A. & Şimşek, H. (2013). *Qualitative research methods in the social sciences.* Ankara: Seçkin Publishing.

Zeidler, D. L. & Nichols, B. H. (2009). Socioscientific issues: Theory and practice. *Journal of Elementary Science Education, 21*(2), 49-58.

Zeidler, D. L., Sadler, T. D., Simmons, M. L. &Howes, E. V., (2005). Beyond STS: A research-based framework for socioscientific issues education. Science Education, 89(3), 357-377.