# An Analysis of Elementary School Teacher Candidates' Conceptual Knowledge in Sets

Lütfi İNCİKABİ 1[*], Abdulkadir TUNA 2[**], A. Çağrı BİBER 3[***]

## Abstract

The purpose of this study was to evaluate mathematics teacher candidates' conception of sets based on definition of a set, representations of sets, relationship between these representations, showing elements of a set, and concept of subset. The methodology of the current study is case study. By taking opinions of the experts from the field of mathematics education, "Sets Knowledge Test" was developed by the researchers and applied to all participants. Among the results of the study, teacher candidates were found more successful in providing an example for sets than in defining sets. Another result of the study was that teacher candidates had difficulty in using rule method and that this difficulty resulted from teacher candidates' misconceptions of rule method as well as errors in mathematical operations.

**Keywords:** mathematics education, mathematics teacher candidates, sets, conceptual knowledge.

[*]. Yrd. Doç Dr., Kastamonu Üniversitesi, lincikabi@kastamonu.edu.tr
[**] Yrd. Doç Dr., Kastamonu Üniversitesi, atuna@kastamonu.edu.tr
[***] Yrd. Doç Dr., Kastamonu Üniversitesi, acbiber@kastamonu.edu.tr

**Extended Summary**

**Purpose of The Study**

The current study aimed to evaluate mathematics teacher candidates' conception of sets based on definition of a set, representations of sets, relationship among these representations, elements of a set, and the concept of subset. Toward this aim, the main research question was "to what extent can teacher candidates provide the relationships among the representations of sets, elements of a set and concept of subset?" and was detailed by the following sub-problems.

1) Do elementary school mathematics teacher candidates have the conception that elements of a set relate to a general property?

2) Do elementary school mathematics teacher candidates have an understanding of the relationship among the representations of sets, and do they know how to use these representations?

3) Do elementary school mathematics teacher candidates detect the interrelationship between being an element of a set and being subset of a set?

**Methodology**

Being qualitative in nature, this study is a case study. The sampling of the study consisted of a total of 72 third-grade college students who were studying in the department of elementary mathematics education at Kastamonu University during the spring semester of 2011-2012 academic year. Based of the comments and opinions of the six experts from the field of mathematics education, "Sets Knowledge Test" was developed by the researchers and applied to all participants.

**Findings of the study**

Among the results of the study, teacher candidates were found more successful in providing an example for sets than in defining sets. Another result of the study was that teacher candidates had difficulty in using the rule method whereas they were found successful in representing sets with the rosters and Venn diagrams. Teacher candidates' difficulty in representing with the rule method was mainly attributed to their misconceptions of the rule method as well as their errors in mathematical operations. Teacher candidates also presented difficulty in detecting elements in a given set on the contrary to their success in defining subsets.

**Discussions and Conclusion**

Among the limitations of the current study could be considered that the study included teacher candidates from one university and that the knowledge test on sets consisted of 9 questions aiming three dimensions of the concept of sets. Teacher candidates, while defining the concept of set, were often used the term "collection." The mathematical term of set does not cover the exact meaning of the term of "collection." For a given set, there is no such requirement as being collection of similar objects or having a relationship among the elements. The only requirement is that the elements are being well defined or known precisely. The study also shows that teacher candidates had difficulty in using the rule method whereas they were found successful in representing sets with the rosters and Venn diagrams. One explanation for this misconception might be that students usually focus on mathemati-

cal operation in the rule method by neglecting the elements satisfying the operation. They also had misconception that a given set can be represented by using all three methods. One reason of this misconception might be attributed to their past experiences since the mathematics textbooks usually provide set examples by using all methods without mentioning that the rule method is the only representation technique that can be used for any set. Teacher candidates also presented difficulty in detecting elements in a given set on the contrary to their success in defining subsets. The same result was found in Uğurel and Moralı's (2010) study. This misconception could be results from inattention or lack of knowledge about the meaning of the set concept.

## References

Baki, A. (1998). *Cebirle ilgili işlem yanilgilarinin değerlendirilmesi*. 3.Ulusal Fen Bilimleri Eğitimi Sempozyumu sunulmuş bildiri, Karadeniz Teknik Üniversitesi Fatih Eğitim Fakültesi, Trabzon.

Baki, A., & Mandacı Şahin, S. (2004). Bilgisayar destekli kavram haritası yöntemiyle öğretmen adaylarının matematiksel öğrenmelerinin değerlendirilmesi. *The Turkish Online Journal of Educational Technology, 3*(2), 91-104.

Bilgin, İ., & Geban, Ö. (2001). Benzeşim (analoji) yöntemi kullanarak lise 2. sinif öğrencilerinin kimyasal denge konusundaki kavram yanilgilarinin giderilmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 20*, 29-32.

Dönmez, A. (2002). Matematiğin öyküsü ve serüveni. *Dünya matematik tarihi ansiklopedisi, Matematik sözlüğü, Cilt 1*. İstanbul: Toplumsal Dönüşüm Yayınları.

Erbaş, K., & Ersoy, Y. (2002*). Dokuzuncu sınıf öğrencilerinin eşitliklerin çözümündeki başarıları ve olası kavram yanılgıları*. V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, ODTÜ, Ankara.

Eryılmaz, A., & Sürmeli, E. (2002). *Üç-aşamali sorularla öğrencilerin ısı ve sıcaklık konularındaki kavram yanılgılarının ölçülmesi*. V. Ulusal Fen ve Matematik Eğitimi Kongresi, ODTÜ, Ankara.

Fischbein, E. (1987). *Intuition in science and mathemalics*. Dordrecht, The Netherlands: Reidel.

Fischbein, E. (1993). The interaction between the formal and the algorithmic and the intuitive components in a mathematical activity. In R. Biehler, R. W. Scholz, R. Straser ve B. Winkelmann (Eds.), *Didactics of mathematics as a scientific discipline* (pp. 231-345). Dordrecht, The Netherlands: Kluwer.

Fischbein, E., & Baltsan M. (1999). The mathematical concept of set and the collection model. *Educational Studies in Mathematics, 37*, 1-22.

Gavalas, D. (2005). Conceptual mathematics: An application to education. *International Journal of Mathematical Education in Science and Technology, 36*(5), 497–516.

Hammer, D. (1996). More than misconceptions: Multiple perspectives on student knowledge and reasoning, and an appropriate role for education research. *American Journal of Physics, 64*(10), 1316-1325.

İpek, A., Albayrak, M., & Işık C. (2009). Sınıf öğretmeni adaylarının küme kavramıyla ilgili algıları. *Erzincan Eğitim Fakültesi Dergisi,11*(1).221-230.

Kadıoğlu, E., & Kamali, M. (2011). *Genel matematik*. Erzurum: Kültür Eğtim Vakfıb Yayınevi

Kathleen, M.S. (1994). *The development and validation of a categorization of misconceptions in the leaming of chemistry*. Doctoral Thesis, University of Massachusetts Lowell, USA.

Linchevski, L., & Vinner, Sh. (1988). The naive concept of sets in elementary teachers. *Proceedings of the 12th International Conference, Psychology of Mathematics Education*, *11*, 471-478.

Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.), London & Thousand Oaks, California: Sage.

Moralı, S., & Uğurel, I. (2010). Ortaöğretim öğrencilerinin kümeler konusundaki öğrenmelerinin değerlendirilmesi-I. *Akademik Bakış Dergisi, 22* (1), 1-25.

Olkun, S., & Toluk, Z. (2003). *İlköğretimde etkinlik temelli matematik öğretimi*. Anı Yayıncılık, Ankara.

Skemp, R.R., (1993). *The psychology of learning mathematics*. Penguin Books, England.

Smith, J. P., diSessa, A. A., & Roscheile, J. (1993). Misconceptions reconceived: A constructivist analysis of knov/ledge in transition. *The Journal of the Learning Sciences, 3*(2), 115-163.

Zembat, İ. Ö. (2008). Kavram Yanılgısı Nedir? In Ed. M. F. Özmantar, E. Bingölbali ve H.Akkoç, *Matematiksel kavram yanılgıları ve çözüm önerileri*, (s. 1-8), Ankara: Pegem Akademi Yayınevi, s. 1-8.