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Biology Education Research in Turkey: Trends from 1989 to 2015

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ABSTRACT

This study was conducted to reveal out which biology subjects were preferred the most in Turkey in postgraduate theses; and to make comparisons of the university biology education, the types of publications, the research methods and investigated subjects. It was also aimed to find out the intensity of biology subjects dealt with in primary school and secondary school curriculum with regards to course hours on the basis of both the grades and the biology subjects. The qualitative research method was used in this study. The content analysis was used in data analysis. The result of study showed that; before 2000, MS theses were mostly done and PhD theses were fewer. Secondary school level was mostly preferred as for the research group and the “Quantitative” method was mostly preferred as for the research method. In addition, it was revealed out that; the environment, cell and variety of the living beings were among the topics that were studied the most in researches while the tissues, evolution, systems and energy were studied the least.

Keywords: Biology, education, content analysis, curriculum

INTRODUCTION

Interests, objectives, attitudes, concerns and motivation have great role in academic success and learning. These factors are directly interrelated and they have a significant impact on the behaviors of the individuals. In science education, there is a relation between the success of individuals and their interest in this area. The interest in science has a positive impact on the individual's success in this area (Hong, Shim and Chang, 1998; Prokop, Prokop and Tunnicliffe, 2007; Usak et al., 2009). Many students find science boring and difficult. However, this is not true for all branches of science areas. Particularly female students are known to have more interest in biology compared to others. Actually, the interest shown in biology is more than the others in general (Uitto, Juuti, Lavonen and Meisalo, 2006; Prokop, Prokop and Tunnicliffe, 2007). Biology has a unique place in that, it includes both laboratory and field studies (Prokop, Prokop and Tunnicliffe, 2007). Research methods utilized by the scientists are commonly utilized in biology researches. Observation, comparison, experimental studies and models can be listed among these (Krell and Krüger, 2015). Besides teaching the scientific issues, the science curriculum shall encourage the student to think like



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a scientist (Roberts 2001). In science education and in other science areas (Prokop, Tuncer and Chuda, 2007; Harurluoğlu and Kaya, 2009), the teacher and the activities they perform in the class has the greatest role in bringing the students to the desired level and raising them as qualified individuals. This is because, the teacher is the one who knows how the students learn and what is the best way of learning (Prokop, Tuncer and Chuda, 2007). All the same; the methods utilized by the teacher in class, his/her ability to organize the activities and ever improve himself/herself also have a significant role in achieving the attainment of the lesson (Kaya and Gürbüz, 2002; Altunoğlu and Atav, 2005). Particularly in recent years, natural sciences have developed significantly as distinct from social sciences. This has brought about technological advancement and new information and thus, the need to teach the new information to the individuals through science education has arisen (Reiss, 2006). Teachers have the greatest role in achieving the objectives of this information and in the operation of the system. This is because, teachers are the ones who play an active role in bringing the students to the desired level and enabling the objectives to be completely achieved (Altunoğlu and Atav, 2005; Yılmaz and Çimen, 2008; Delibaş and Babadoğan, 2009). Education is expected to be given to individuals in classroom environment and through the activities utilized by the teacher (Uitto, Juuti, Lavonen and Meisalo, 2006). In order to achieve this, the teachers need to possess the essential pedagogical content knowledge and skills and there must be sufficient level of materials and activities for utilization (Kahyaoğlu and Yavuzer, 2004; Saka and Akdeniz, 2006). Classroom materials help the teachers to enable materialization of the issues and to contribute to the students' understanding of the lesson. Necessary methods and equipment shall be made available to teachers (Akaydın, Güler and Mülâyim, 2000; Köseoğlu and Soran, 2005). Particularly in science education, providing the students with sufficient level of experimental activities and practice would enable the students to be trained as a scientist and contribute much to the interest and success in science (Zhai, Jocz and Tan, 2014). This contribution shall not be limited to education but shall also enable the individuals to gain success in their future business lives (Reiss, 2006).

Literature review

Review studies made in science education provide great benefits for researchers. These studies both give ideas to researchers about the tendencies in science education and they guide them for their future researches (Tsai and Wen, 2005; Lee, Wu and Tsai, 2009). This is not only useful for the researchers but also for the persons and entities that have role in decision-making processes of the education system and it will help them improve the quality of education (Chang, Chang and Tseng, 2010). When previous studies are viewed within the scope of the research, it is observed that there are comprehensive researches on the area of science education; researches on science published on various journals between 1998 and 2002 (Tsai and Wen, 2005), researches on science education published on various journals between 2003 and 2007 (Lee, Wu and Tsai, 2009), between 2008 and 2012 (Lin, Lin and Tsai, 2014), 633 researches on biology education published on journals in Turkey on national and international journals (Gül and Sözbilir, 2015), 46 researches on physics education published between 2004 and 2011 (Önder et al., 2013), 53 researches on the environmental issues at primary education level, performed between 1997 and 2007 (Erdoğan, Marcinkowski and Ok, 2009), 314 researches on science education performed between 2005 and 2006 (Erdem, 2011) and Physics (66), Chemistry (49) and Biology (108) theses published on the areas of science education between 1990 and 2009 (Doğru, Gençosman, Ataalkın and Şeker, 2012). These researches show that; most of the researches consist of experimental studies; the amount of case, theoretical and review studies is few; mainly the environmental and ecological issues are handled in biology studies; the issues of learning, teaching and

attitudes are among the ones that are mostly studied; “program”, “misconception” and “material development” are the issues that are studied most in physics, chemistry and biology theses. (Tsai and Wen, 2005; Gül and Sözbilir, 2015; Erdoğan, Marcinkowski and Ok, 2009; Lee, Wu and Tsai, 2009; Erdem, 2011; Doğru, Gençosman, Ataalkın and Şeker, 2012; Önder et al., 2013). A new study was published by Lin, Lin and Tsai (2014) showed that in recent years “*argumentation, inquiry-based learning, scientific modeling, students’ learning, science teaching, and students’ conceptual learning*” were mostly researched by science education scholars. As can be seen in the detailed researches made in this area, there are two research-type studies in Turkey; Gül and Sözbilir (2015) studied the articles at national and international level whereas Doğru, Gençosman, Ataalkın and Şeker, 2012) made research on physics, chemistry and biology studies that took place in science education and as biology studies were taken into consideration, few (108) sources were reached at. Furthermore, in most of the review studies mentioned above, the methods and analysis techniques utilized in case studies were dealt with. On the other hand, the extent the topics making up a discipline are included in researches and whether these are in conformity with the curriculum were generally neglected. Due to the lack of a comparative research related to the universities teaching biology, this research was made to reveal out the extent master’s and doctoral degree theses done in Turkish universities teaching biology covered the topics of biology. Our comparative research aimed to reveal out the distribution of biology subjects matters concerning the studies in universities and the areas studies. Comparisons with the curriculum were made to help the researchers and the decision maker managers in the education system. In parallel to these, the following issues were inquired;

What was the distribution of theses among the universities?

What were trends in biology theses in term of publication type, sample, research type?

What elements were frequently investigated in term of university, publication type, sample, research method?

What subjects and subject matters were frequently investigated in term of university, publication type, sample, research method?

METHODS

The qualitative research method was used in this study. The qualitative research method basically makes use of the target text to create the category system, it organizes these to reveal out inter-categorical relations and features (McMillan and Schumacher, 2010). The content analysis was used in data analysis. The inductive and deductive approaches can be used together in content analysis. Yet, the inductive approach is mostly preferred. As the texts are read, the concepts and categories are formed. The available category system can also be used in content analysis (Elo and Kyngas, 2008). The codes were used for this study including publication type, sample, publication year and research method. The codes that listed above were used in many study for review the science literature (Tsai and Wen, 2005; Lee, Wu and Tsai, 2009; Doğru, Gençosman, Ataalkın and Şeker, 2012; Gül ve Sözbilir, 2015; Ormanci, Cepni, Deveci and Aydin, 2015). Besides this, some studies included highly-cited papers, number of authors and authors nationality etc. (Tsai and Wen, 2005; Lee, Wu and Tsai, 2009; Chang, Chang, and Tseng, 2010; Gül ve Sözbilir, 2015; Ormanci, Cepni, Deveci and Aydin, 2015). In the study, Content Analysis Form (CAF) (Appendix-1) was generated according to the purpose of the research. The content analysis form includes; the university the study was made in, publication type (MS and PhD), publishing year, sample that the levels the study was intended for (Primary School-PS, Secondary School-SS, High Education-HE and Others), the research method (Qualitative, Quantitative and Mixed), elements that the topics studied

(consists of 13 concepts) and the biology topic chosen (8 main subjects and 34 subjects matters related to these). Biology topics were determined from primary and secondary science curriculum (MEB 2013a and MEB 2013b). As can be seen in Table 1;

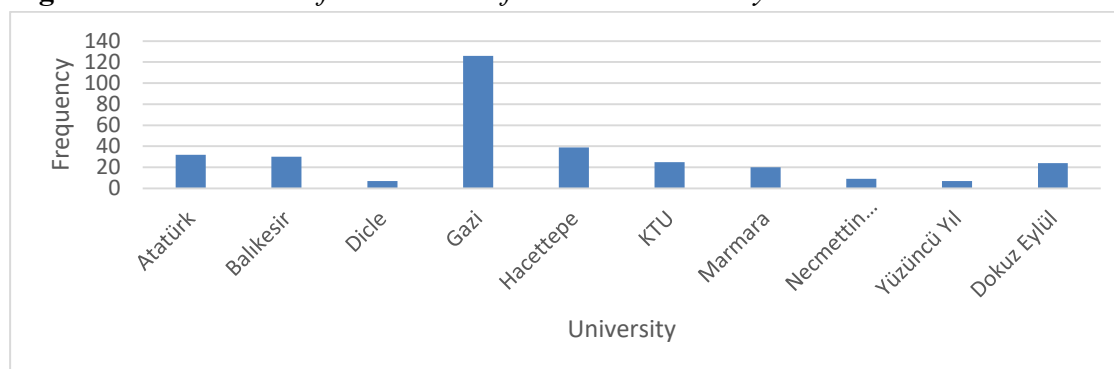
Table 1. *Biology subjects and subjects matters*

Biology:Life Sciences (BLS)	Cell (C)	Genetics and Heredity (GH)	Environmental Education (EE)
-The Nature of Scientific Knowledge and Biology (NSKB) - Common Features of Living Things (CFLT) -Compounds of Living Things (CLT)	- Substance Transport (ST) - Diversity and Classification of Living Things (DCLT) - Kingdom and Features (KF) - Cell Division (CD) -Cell (Ce)	- Reproduction, Growth and Development (RGH) - Modern Genetics and Biotechnology (MGB) - From Gene to Protein (FGP) -Basic Principle of Heredity (BPH)	- Current Environmental Issues (CEI) - Ecosystem Ecology (EEc) - Biomes (Bs) - Community Ecology (CEc) - Population Ecology (PE)
Evolution (E)	Tissues (Ts)	Systems (Ss)	Energy (Egy)
-Behavior (Be) -The Origin of Life (OL) - Evolution (Ev)	- Plant tissues and Plant Construction (PTPC) - Hormones and Homeostasis (HH) - Substance Transport in Plants (STinPs) -Animal Tissues (AT)	- Nervous System (NS) - Digestive System (DS) - Respiratory System (RS) - Urinary System (US) - Circulatory System (CS) - Muscular and Skeletal Systems (MSSs)	- Energy and Vitality (EV) - Photosynthesis (Ph) - Cellular Respiration (CR) -Chemosynthesis (Ch)

The Higher Education Council National Theses Centre was referred to as the source of data. 319 theses were reached within the context of graduate school of natural and applied sciences and graduate school of educational sciences at universities conducting MS and doctoral degree studies in biology education. No key words were used for the relevant research. The main reason for that was to exclude the theses on science education and to avoid re-counting of the study. In the research, institutes of the universities were chosen one by one through the National Theses Centre and all the studies conducted between 1989 and 2015 were aimed to reach at in chronological order. For the analysis of data SPSS 16 and Microsoft Excel were used. Findings of research were presented as both figure and table. Figures were only showed with frequency. But tables were showed percentage and frequency together. It done to express data more clearly.

FINDINGS

Findings of the research are presented in percentage-frequency and graphics depending on the universities, type of publication, year of publishing, the research method, the issues investigated elements and the research topic.

Figure 1. Distribution of the amount of thesis on university basis

As can be seen in Figure 1, “Gazi” University possesses the greatest amount of master’s degree theses. “Ataturk” (10.3%), “Balikesir” (9.4%), “Gazi” (39.5%), “Hacettepe” (12.2%), “KTU” (7.8%), “Marmara” (6.3%) and “Dokuz Eylul” (7.5%) universities are among the universities that have conducted 20 researches and more whereas “Dicle” (2.3%), “Necmettin Erbakan” (2.8%) and “Yuzuncu Yil” (2.3%) universities have conducted fewer amount of researches. It can be stated that; studies on biology education conducted in universities remain at low level. In certain universities (Yuzuncu Yil, Necmettin Erbakan and Dicle), this amount is even lower.

Table 2. Distribution of the research elements on university basis

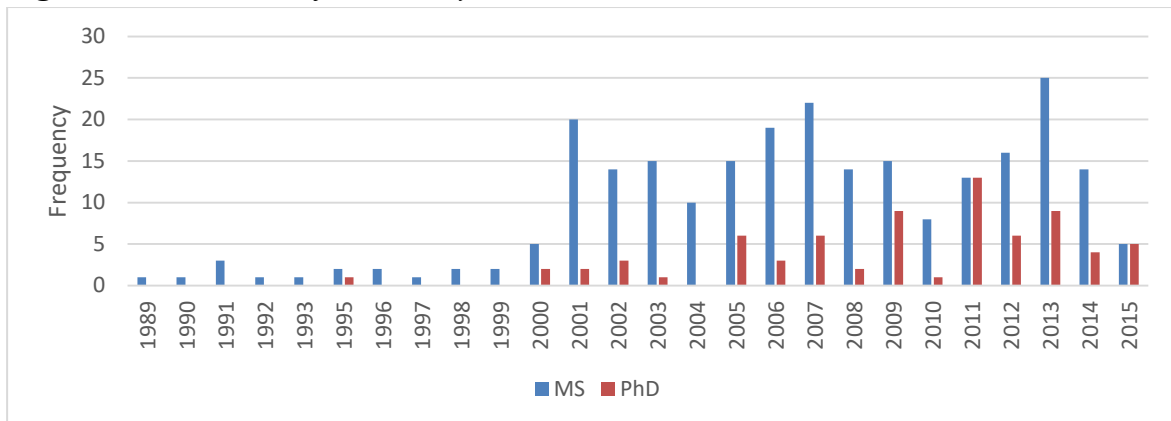
University	MS	PhD	PS	SS	HE	Others	Qualitative	Quantitative	Mixed
Ataturk	6(16)	22(16)	13(5)	11(17)	11(5)	8 (5)	10(4)	9(21)	11(7)
Balikesir	10(24)	8(6)	42(16)	6(10)	6(2)	3(2)	17(7)	7(16)	27(17)
Dicle	2(4)	4(3)	0	3(4)	3(1)	3(2)	0	3(6)	2(1)
Gazi	41(101)	34(25)	24(9)	37(58)	37(32)	45(27)	22(9)	44(99)	29(18)
Hacettepe	12(30)	12(9)	0	14(22)	14(7)	17(10)	20(8)	10(24)	11(7)
KTU	9(22)	4(3)	13(5)	8(13)	8(2)	8(5)	8(3)	7(16)	9(6)
Marmara	6(16)	6(4)	5(2)	5(8)	5(6)	7(4)	5(2)	7(16)	3(2)
Necmettin Erbakan	4(9)	0	0	4(6)	4(3)	0	5(2)	3(6)	2(1)
Yuzuncu Yil	3(7)	0	0	4(6)	0	2(1)	13(5)	1(2)	0
Dokuz Eylul	7(17)	10(7)	3(1)	8(13)	8(6)	7(4)	0	9(20)	6(4)

*Frequency (f) was in parentheses. Percent (%) was outside of parentheses.

As can be seen in Table 2; in all of the universities, the share of master’s degree theses is higher in the distribution of post graduate theses. The greatest share belongs to Gazi University in terms of both “MS” (41%) and “PhD” (34%). The lowest share belongs to “Yuzuncu Yil” University in terms of “MS” theses and to “Necmettin Erbakan” (0%) and “Yuzuncu Yil” (0%) universities in terms of “PhD” theses.

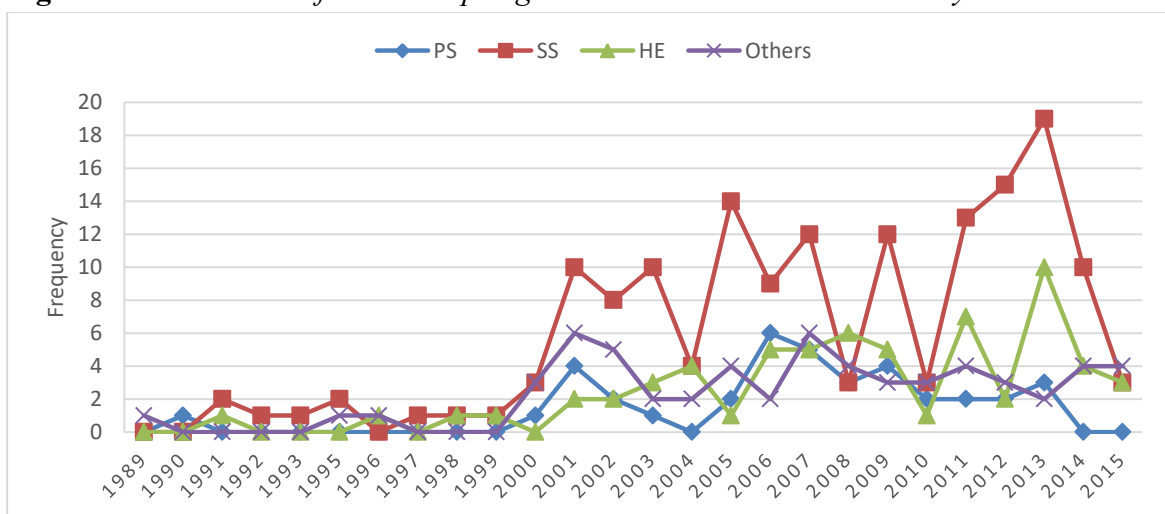
In terms of the levels the studies conducted in universities were intended for; “Ataturk”, “Balikesir”, “Gazi”, “KTU”, “Marmara” and “Dokuz Eylul” conducted studies intended for all the levels. The highest values belong to “Gazi” University in “SS” (37%), “HE” (37%) and “Others” categories and to “Balikesir” University in “PS” (42%) category. The lowest values belong to “Dicle”, “Hacettepe”, “Necmettin Erbakan” and “Yuzuncu Yil” in “PS” category; to “Yuzuncu Yil” in “HE” category and to “Necmettin Erbakan” University in “Others” category.

As for the categories related to the research method; the highest values belong to Gazi in “Qualitative” (22%), “Quantitative” (44%) and “Mixed” (29%) categories; the lowest values belong to “Dicle” (0%) and Dokuz Eylul” (0%) in “Qualitative” category; and to “Yuzuncu Yil” in “Quantitative” (1%) and “Mixed” (0%) categories.

Figure 2. *Distribution of theses on year basis*

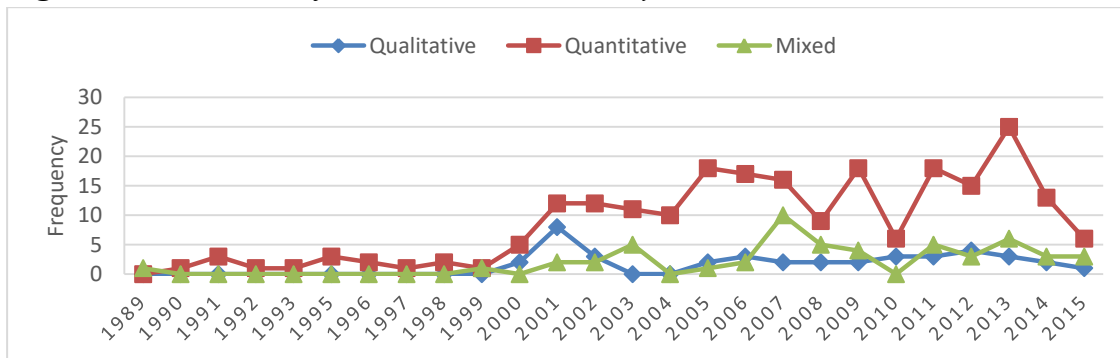
The amount of publications as for the postgraduate theses done in universities on biology education is rather low in before 2000. There is a rapid increase as of the year 2000 and several postgraduate theses have been published since then. The amount of “PhD” studies have increased, as well. The greatest amount of publications belongs to year 2013. “MS” studies were mainly conducted before 1999 and “PhD” studies were only conducted in 1995. From 1989 to 2015, only in 1994 no study on Biology education was conducted in universities. There is a decrease in the amount of postgraduate theses after 2013. There has been significant increase in the amount of postgraduate theses after 2000. Similarly; while there was increase in the amount of doctoral theses, decreases were observed in 2003 and 2010 (Figure 2).

While after 1999 there was increase in the amount of postgraduate theses intended for all level, decreases were observed in some years. As for the primary schools, there is no publication after 2013. Before 2000, the amount of studies was low for all levels. In terms of the research target group, the secondary education level can be stated to be preferred most by the researches. “SS” and “Others” are observed to be among the most preferred research target groups after 2000 (Figure 3).

Figure 3. *Distribution of the levels postgraduate theses were intended on year basis*

The “Quantitative” method is preferred more in universities. Though the utilization of “Qualitative” and “Mixed” research methods showed increase in time, they were preferred less by the universities in general. Whereas the researchers utilized the “Quantitative” method before 2000, the “Qualitative” and “Mixed” methods also started to be preferred after 2000 (Figure 4).

Figure 4. *Distribution of the research method on year basis*



Though there has been increase in the types of research methods utilized after 2000, the greatest increase has been observed in the quantitative methods. Besides the quantitative methods, the researchers have begun to prefer the qualitative and mixed methods, as well. As for the research methods, the highest values belong to the “Quantitative” method in 2013, the “Qualitative” method in 2001 and the “Mixed” method in 2007. On the other hand; it is possible to say that the “Qualitative” method has remained at a certain level after 2005 (Figure 4).

Figure 5. *General distribution of the investigated elements*

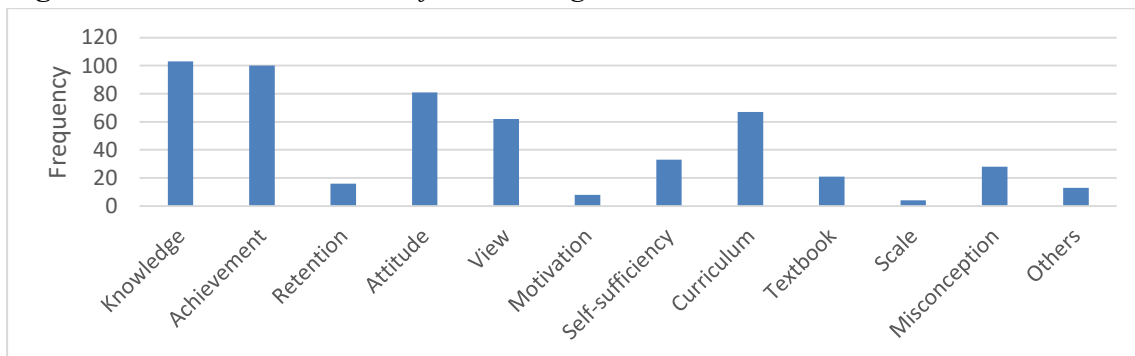
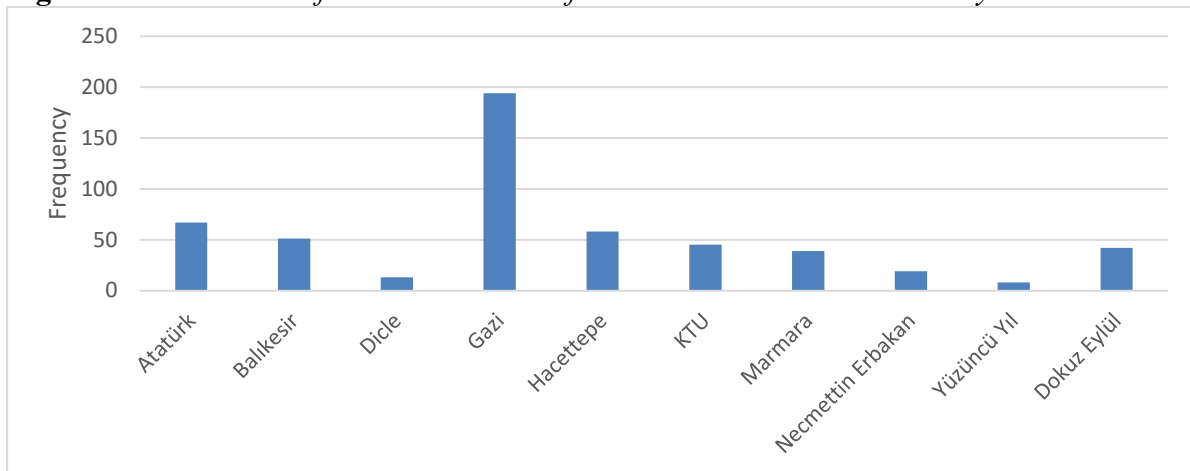


Figure 5 shows that; “Knowledge” (19.2%), “Achievement” (18.7%), “Attitude” (15.1%), “View” (11.7%), “Self-Sufficiency” (6.2%), “Curriculum” (12.5%), “Textbook” (3.9%) and “Misconception” (5.2%) elements were investigated the most. Categories of “Retention” (3%), “Motivation” (1.5%), “Scale” (0.8%) and “Others” (2.4%) were investigated less. It can be stated that, “Knowledge” has been the category focused on most and “Scale” has been the category focused on the least by the universities in the postgraduate studies.

Figure 6. Distribution of the total amount of research elements on university basis

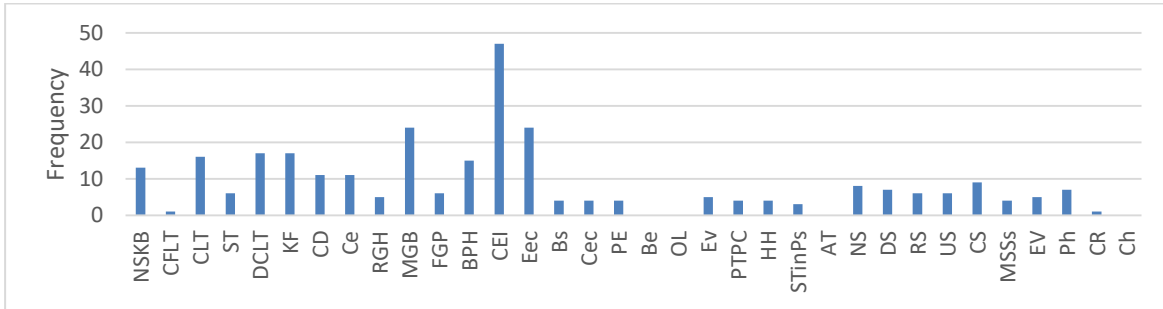
With regards to the elements consisting of 12 categories, the highest value belongs to “Gazi” University. Apart from “Gazi” university, there are two universities (Atatürk and Hacettepe) that take a value of 50 and higher. “Yüzüncü Yıl” University can be stated to take the lowest value with regards to the total number of elements covered.

As shown in Table 2; “Dicle”, “KTU”, “Marmara” and “Yüzüncü Yıl” universities are among the ones that have been unable to take the first and second highest values. The first or second highest values with regards to the elements investigated, are observed to belong to “Gazi” University. In “Atatürk” University, “Retention”; in “Balıkesir” University, “Misconception” and in “Hacettepe” University, “Textbook” has been among the elements with the highest values.

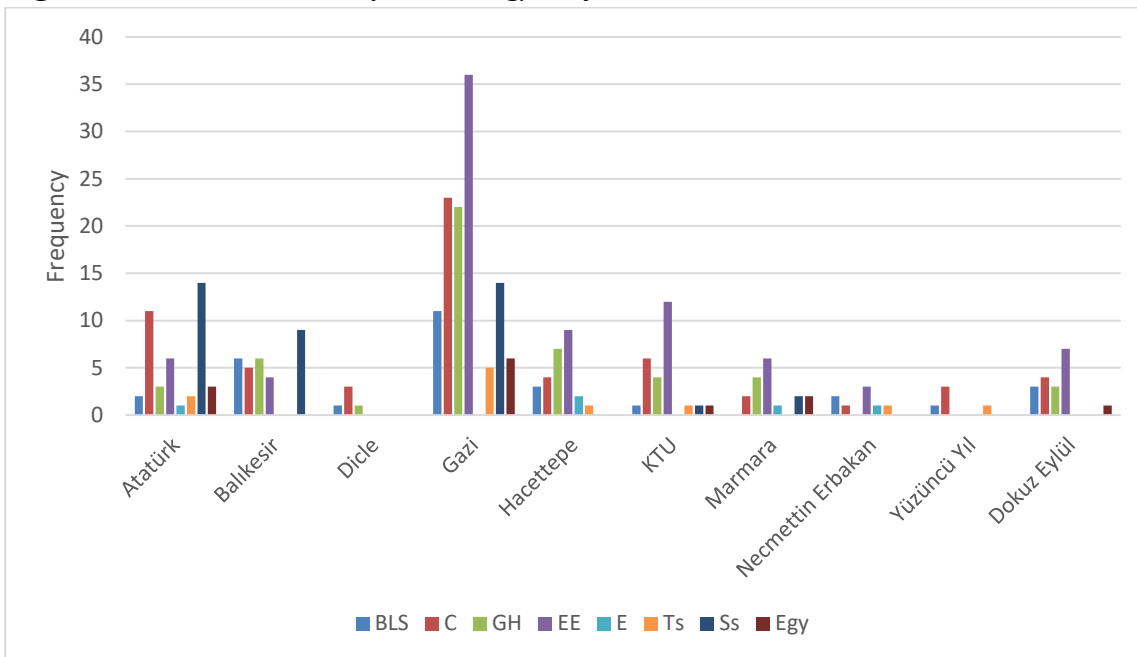
Table 3. Distribution of the research elements on university basis

	Atatürk	Balıkesir	Dicle	Gazi	Hacettepe	KTU	Marmara	N.Erb.	Y. Yıl	D. Eylül	Total
Knowledge	13.6(14)*	13.6(14)*	1.9(2)	30.1(31)*	9.7(10)	10.7(11)	10.7(11)	4.9(5)	1(1)	3.9(4)	103
Achievement	16(16)**	9(9)	2(2)	46(46)*	4(4)	7(7)	5(5)	0	0	11(11)	100
Retention	50(8)*	6.3(1)	0	31.3(5)**	6.3(1)	0	6.3(1)	0	0	0	16
Attitude	9.9(8)	12.3(10)	4.9(4)	34.6(28)*	4.9(4)	6.2(5)	6.2(5)	6.2(5)	1.2(1)	13.6(11)**	81
View	11.3(7)**	8.1(5)	1.6(1)	40.3(25)*	11.3(7)**	8.1(5)	8.1(5)	3.2(2)	1.6(1)	6.5(4)	62
Motivation	0	12.5(1)	12.5(1)	37.5(3)*	25(2)**	0	0	12.5(1)	0	0	8
Self-sufficiency	6.1(2)	0	9.1(3)	54.5(18)*	6.1(2)	3(1)	9.1(3)	0	0	12.1(4)**	33
Curriculum	9(6)	6(4)	0	28.4(19)*	25.4(17)**	10.4(7)	6(4)	3(2)	6(4)	6(4)	67
Textbook	9.5(2)	0	0	19(4)**	38.1(8)*	9.5(2)	14.3(3)	4.8(1)	4.8(1)	0	21
Scale	0	0	0	75(3)*	0	0	0	25(1)*	0	0	4
Misconception	10.7(3)	25(7)*	0	21.4(6)**	7.1(2)	17.9(5)	7.1(2)	7.1(2)	0	3.6(1)	28
Others	7.7(1)	0	0	46.2(6)*	7.7(1)	15.4(2)	0	0	0	23.1(3)**	13
Total											536***

*The highest value with regards to the categories. ** The second highest value. *** This value appeared as more than one element was investigated in the same research.

Figure 7. General distribution of the biology topics studied in researches

“CEI” (16%) is observed to be the topic that is most preferred by the researchers. “Be”, “OL”, “AT” and “Ch” on the other hand, are not preferred at all. Whereas the topics from “NSKB to Eec” are particularly preferred, the topics from “Bs to Ch” are preferred less. As for the 34 sub topics determined in the research; topics related to Power transformations, systems and tissues are observed to be at lower frequency ranges. As for the biology topics dealt with in the studies, it is possible to say that there has been a greater focus on certain topics.

Figure 8. Total distribution of the biology subjects studied in researches

With regards to the biology topics that are dealt with in 8 categories, “Atatürk” University is the only one that conducted study on all the topics. In terms of the topics preferred most, it is observed that; the topics “BLS”, “C”, “GH”, “EE”, “Ts” and “Egy” are mostly preferred in “Gazi” University; “SS” in “Gazi” and “Atatürk”; “E” in “Atatürk”. In terms of the total number of topics, the lowest figures belong to “Dicle” and “Yüzüncü Yıl” universities. It is also observed that; “EE” topic has attracted the greatest attention in all universities except for “Atatürk”. “Ss” topic has been mainly studied in “Balıkesir”, “Gazi” and “Atatürk” universities.

With regards to the values related to biology topics, the highest values belong to “Gazi” in “NSKB” and “CLT”; “Dokuz Eylül” in “CFLT”, “Gazi” in “ST”, “DCLT”, “KF”, and “Ce”; “Gazi” and “Atatürk” in “Ce”; “KTU” in “RGH”; “Gazi” in “MGB”; “Gazi” and “Hacettepe” in “FGP”; “Gazi” and “Marmara” in “BPH”; “Gazi” in “CEI”, “EEc”, “Bs” and

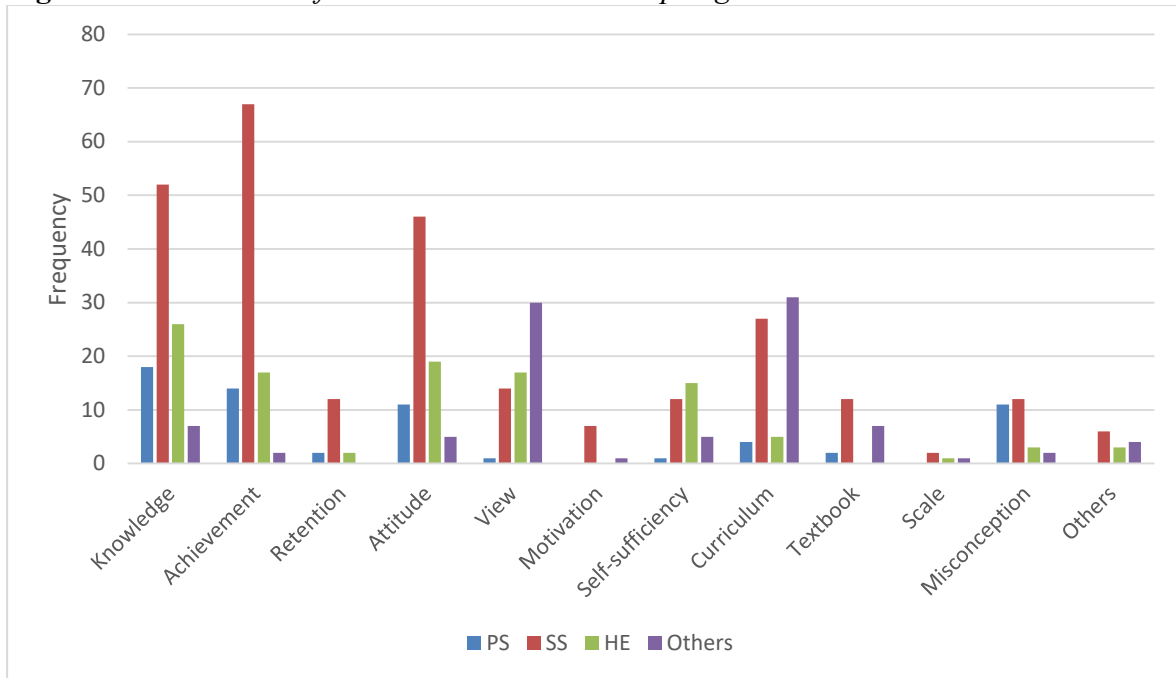
“CEc”; “Hacettepe” in “Ev”; “Gazi” in “PTPC” and “HH”; “Gazi”, “Hacettepe” and “Necmettin Erbakan” in “STinPs”; “Atatürk” and “Gazi” in “NS” and “MSSs”; “Atatürk”, “Balıkesir” and “Gazi” in “DS”, “RS” and “US”; “Balıkesir” in “CS”; “Atatürk” and “Marmara” in “EV”; and to “Gazi” in “Ph” and “CR” topics (Table 4).

Table 4. Distribution of the topics on university basis

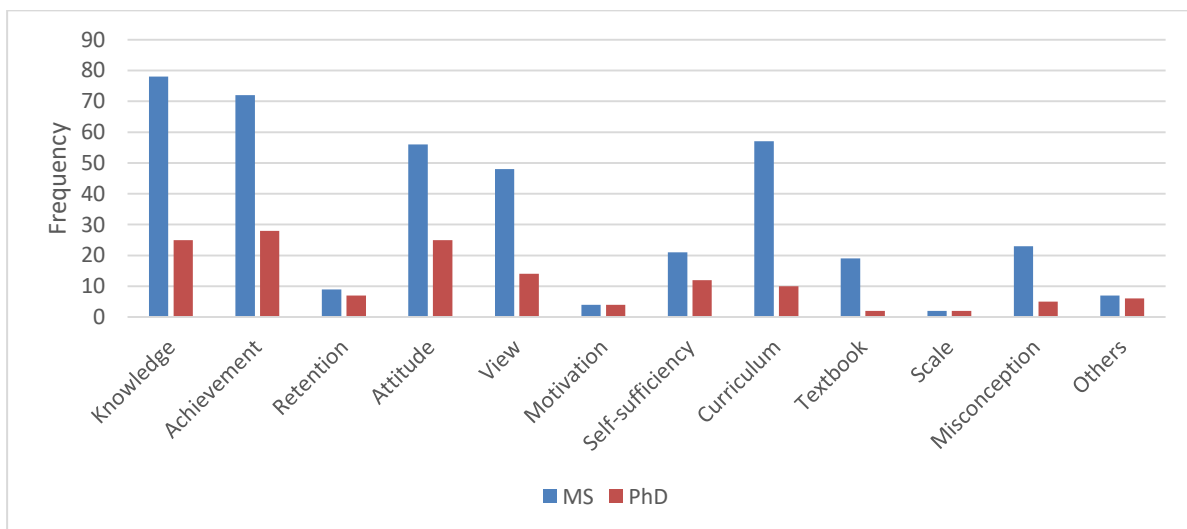
	Atatürk	Balıkesir	Dicle	Gazi	Hacettepe	KTU	Marmara	Necmettin Erbakan	Yüzüncü Yıl	Dokuz Eylül
NSKB	0	23.1(3)**	0	38.5(5)*	0	0	0	15.4(2)	7.7(1)	15.4(2)
CFLT	0	0	0	0	0	0	0	0	0	100(1)*
CLT	12.5(2)	18.8(3)**	6.2(1)	37.5(6)*	18.8(3)**	6.2(1)	0	0	0	0
ST	16.7(1)**	0	0	50(3)*	0	0	0	16.7(1)**	0	16.7(1)**
DCLT	17.6(3)**	11.8(2)	5.9(1)	35.3(6)*	0	11.8(2)	5.9(1)	0	5.9(1)	5.9(1)
KF	11.8(2)	5.9(1)	0	35.6(6)*	23.5(4)**	5.9(1)	0	0	5.9(1)	11.8(2)
CD	27.3(3)*	9.1(1)**	9.1(1)**	27.3(3)*	0	27.3(3)*	0	0	0	0
Ce	18.2(2)**	9.1(1)	9.1(1)	45.5(5)*	0	0	9.1(1)	0	9.1(1)	0
RGH	0	20(1)**	20(1)**	0	0	40(2)*	0	0	0	20(1)**
MGB	0	8.3(2)	0	70.8(17)*	12.5(3)**	0	4.2(1)	0	0	4.2(1)
FGP	16.7(1)**	16.7(1)**	0	33.3(2)*	33.3(2)*	0	0	0	0	0
BPH	13.3(2)**	13.3(2)**	0	20(3)*	13.3(2)**	13.3(2)**	20(3)*	0	0	6.7(1)
CEI	4.3(2)	6.4(3)	0	42.6(20)*	14.9(7)**	14.9(7)**	6.4(3)	6.4(3)	0	4.3(2)
Eec	4.2(1)	4.2(1)	0	41.7(10)*	8.3(2)	8.3(2)	12.5(3)	0	0	20.8(5)**
Bs	25(1)**	0	0	50(2)*	0	25(1)**	0	0	0	0
Cec	25(1)**	0	0	50(2)*	0	25(1)**	0	0	0	0
PE	25(1)**	0	0	50(2)*	0	25(1)**	0	0	0	0
Be	0	0	0	0	0	0	0	0	0	0
OL	0	0	0	0	0	0	0	0	0	0
Ev	20(1)**	0	0	0	40(2)*	0	20(1)**	20(1)**	0	0
PTPC	25(1)**	0	0	50(2)*	0	0	0	0	25(1)**	0
HH	25(1)**	0	0	50(2)*	0	25(1)**	0	0	0	0
STinPs	0	0	0	33.3(1)*	33.3(1)*	0	0	33.3(1)*	0	0
AT	0	0	0	0	0	0	0	0	0	0
NS	50(4)*	0	0	50(4)*	0	0	0	0	0	0
DS	28.6(2)*	28.6(2)*	0	28.6(2)*	0	0	14.3(1)**	0	0	0
RS	33.3(2)*	33.3(2)*	0	33.3(2)*	0	0	0	0	0	0
US	33.3(2)*	33.3(2)*	0	33.3(2)*	0	0	0	0	0	0
CS	22.2(2)**	33.3(3)*	0	22.2(2)**	0	11.1(1)	11.1(1)	0	0	0
MSSs	50(2)*	0	0	50(2)*	0	0	0	0	0	0
EV	40(2)*	0	0	0	0	20(1)**	40(2)*	0	0	0
Ph	14.3(1)**	0	0	71.4(5)*	0	0	0	0	0	14.3(1)**
CR	0	0	0	100(1)*	0	0	0	0	0	0
Ch	0	0	0	0	0	0	0	0	0	0

*The highest value with regards to the categories. ** The second highest value. Frequency (f) was in parentheses. Percent (%) was outside of parentheses.

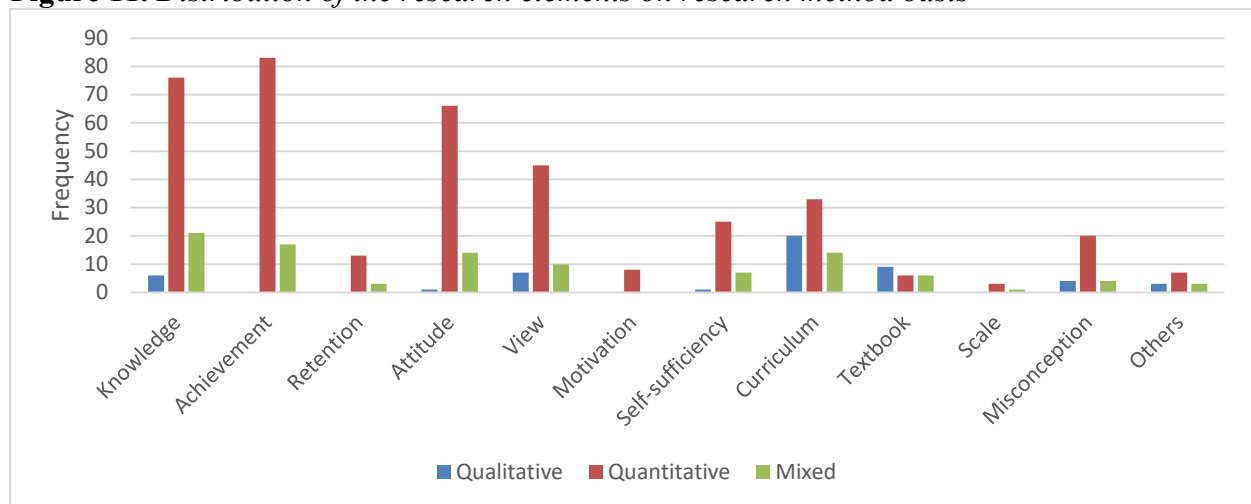
As seen in Figure 9, with regards to the topics studied in different school levels; “Knowledge”, “Achievement” and “Attitude” are studied the most at “SS” level; “Knowledge”, “Achievement”, “Attitude” and “Misconception” are studied the most at “PS” level; “Knowledge”, “Achievement”, “Attitude”, “View” and “Self-sufficiency” are studied the most at “HE” level; “View” and “Curriculum” are studied the most at “Others”. “Retention”, “Motivation”, “Scale” and “Others” are among the elements studied the least.

Figure 9. *Distribution of the research elements on postgraduate theses basis*

As observed in Figure 10; “Knowledge”, “Achievement”, “Attitude” and “Curriculum” are the elements investigated the most in master’s degree and doctoral studies. In “Retention”, “Motivation”, “Scale”, and “Others” categories, the values are similar to each other in master’s degree and doctoral studies. Yet; master’s degree studies are observed to take higher values in other elements.

Figure 10. *Distribution of the research elements on level basis*

As can be seen in Figure 11, the “Quantitative” method is the most preferred method in research elements and the “Qualitative” method is the least preferred one. The “Qualitative” method is not utilized by researchers in “Achievement”, “Retention”, “Motivation” and “Scale” elements; the “Mixed” method is not utilized in “Motivation” and “Scale” elements. On the other hand; in “Textbook” element exclusively, the “Qualitative” method is preferred more than the “Quantitative” method.

Figure 11. Distribution of the research elements on research method basis

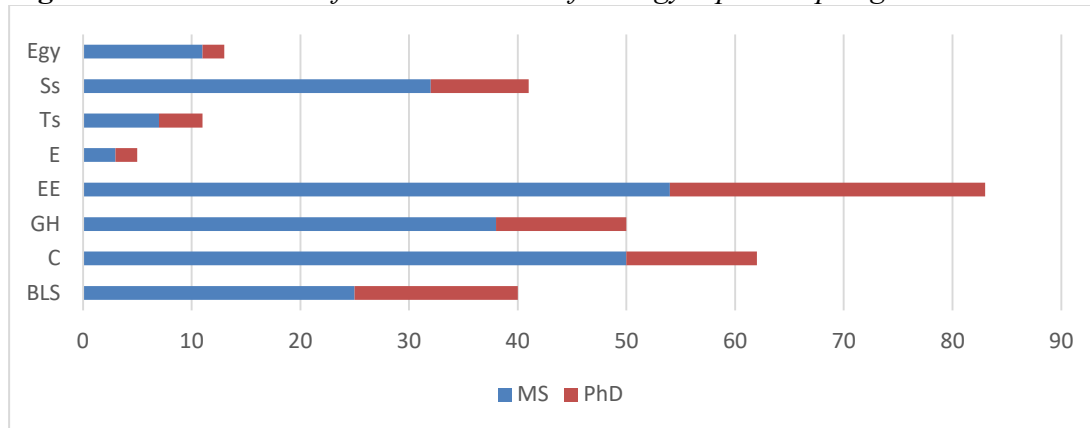
With regards to the type of publication (MS and PhD), the highest values belong to “MS” category in all of the elements. With regards to the levels the researches are intended for (PS, SS, HE and Others); the highest values belong to “SS” level in the “Knowledge”, “Achievement”, “Retention”, “Attitude”, “Motivation”, “Textbook”, “Scale”, “Misconception” and “Others” elements; “HE” level in the “Self-sufficiency” element and to “Others” in the “Curriculum” element (Table 5).

With regards to the research method (Qualitative, Quantitative and Mixed); the “Quantitative” method is observed to take the highest values in all the elements except for the “Textbook” and the “Qualitative” method is observed to take the highest value in the “Textbook” element (Table 5).

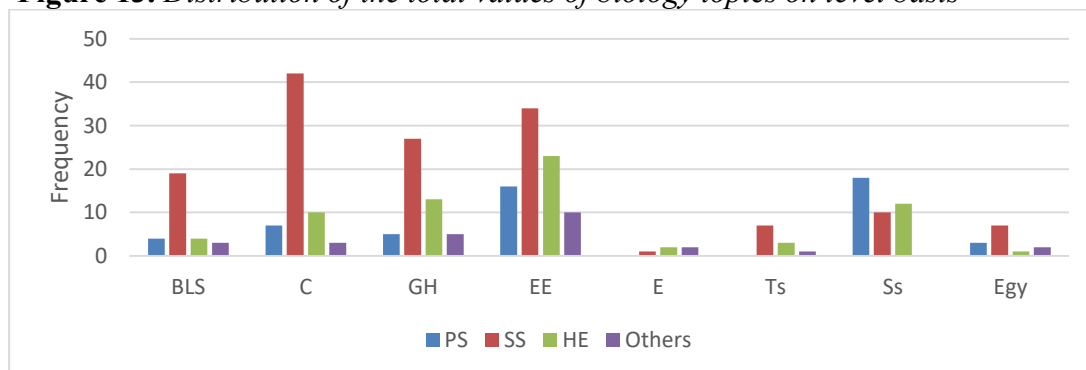
Table 5. General Distribution of the research elements

	MS	PhD	PS	SS	HE	Others	Qualitative	Quantitative	Mixed
Knowledge	75.7(78)	24.3(25)	17.5(18)	50.5(52)*	25.2(26)**	6.8(7)	5.8(6)	73.8(76)*	20.4(21)
Achievement	72(72)	28(28)	14(14)	67(67)*	17(17)**	2(2)	0	83(83)*	17(17)
Retention	19(9)	15(7)	4(2)	25(12)*	4(2)	0	0	27(13)*	6(3)
Attitude	69.1(56)	30.9(25)	13.6(11)	56.8(46)*	23.5(19)**	6.2(5)	1.2(1)	81.5(66)*	17.3(14)**
View	77.4(48)	22.6(14)	1.6(1)	22.6(14)	27.4(17)**	48.4(30)*	11.3(7)	72.6(45)*	16.1(10)**
Motivation	50(4)	50(4)	0	87.5(7)*	0	12.5(1)**	0	100(8)*	0
Self-sufficiency	63.6(21)	36.4(12)	3(1)	36.4(12)**	45.5(15)*	15.2(5)	3(1)	75.8(25)*	21.2(7)**
Curriculum	85.1(57)	14.9(10)	6(4)	40.3(27)**	7.5(5)	46.3(31)*	29.9(20)**	49.3(33)*	20.9(14)
Textbook	90.5(19)	9.5(2)	9.5(2)	57.1(12)*	0	33.3(7)**	42.9(9)*	28.6(6)**	28.6(6)**
Scale	50(2)	50(2)	0	50(2)*	25(1)**	25(1)**	0	75(3)*	25(1)**
Misconception	82.1(23)	17.9(5)	39.3(11)**	42.9(12)*	10.7(3)	7.1(2)	14.3(4)**	71.4(20)*	14.3(4)**
Others	53.8(7)	46.2(6)	0	46.2(6)*	23.1(3)	30.8(4)**	23.1(3)**	53.8(7)*	23.1(3)**

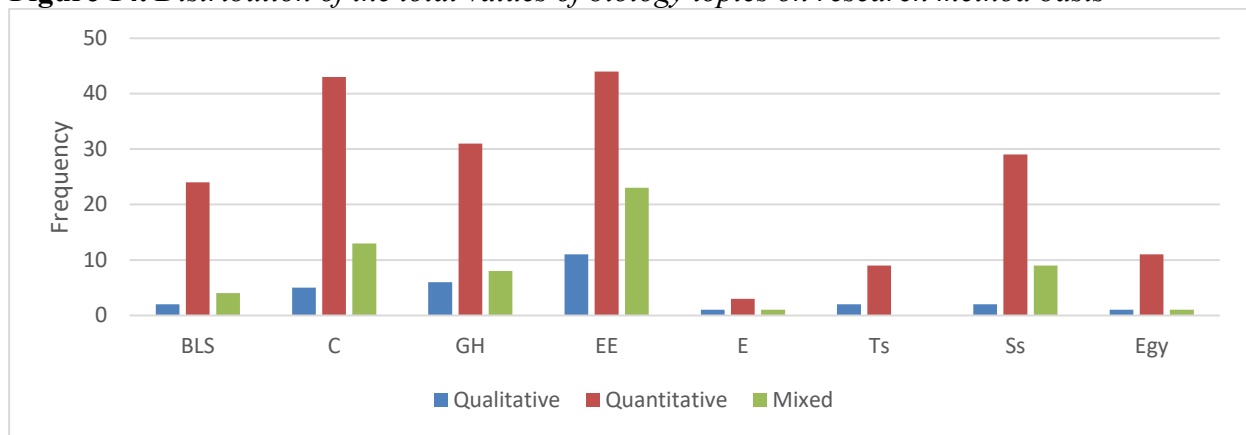
*Frequency (f) was in parentheses. Percent (%) was outside of parentheses.

Figure 12. *Distribution of the total values of biology topics on postgraduate theses basis*

As seen in Figure 12, the most preferred topics with regards to “MS” and “PhD” categories are “BLS” (MS 62%, PhD 38%), “C” (MS 81%, PhD 19%), “GH” (MS 76%, PhD 24%), “EE” (MS 65%, PhD 35%) and “Ss” (MS 78%, PhD 22%). “E” (MS 60%, PhD 40%), “Ts” (MS 64%, PhD 36%) and “Egy” (MS 85%, PhD 15%) are among the least preferred topics. “EE” (MS 65%, PhD 35%) is the most preferred topic both in “MS” and in “PhD” categories. The least preferred topic is “E”. But all of total values of biology topics have more score in MS. In all of categories PhD has lower values.

Figure 13. *Distribution of the total values of biology topics on level basis*

As seen in Figure 13, with regards to the topics that are preferred the most, it can be stated that “EE” is preferred in at all levels (PS 19%, SS 41%, HE 28 and Others 12%). “Ss” and “EE” are among the most preferred topics at “PS” level; “C”(PS 11%, SS 68%, HE 16 and Others 5%), GH” (PS 10%, SS 54%, HE 26 and Others 10%) and “EE” are among the most preferred topics at “SS” level and “EE” is among the most preferred topics in “Others” category. “E”,(PS 0%, SS 20%, HE 40 and Others 40%) “Ts” (PS 19%, SS 41%, HE 28 and Others 12%) and “Egy” (PS 0%, SS 64%, HE 27 and Others 9%) are among the least preferred topics at all levels.

Figure 14. Distribution of the total values of biology topics on research method basis

With regards to the research methods; the “Qualitative”, “Quantitative” and “Mixed” research methods have taken the highest values in “EE” category. The highest values in all topics belong to the “Quantitative” method (BLS 80%, C 71%, GH 69, EE 56%, E 60%, Ts 82%, Ss 72% and Egy %84). The lowest value belongs to “E” for all the three methods. “Ts” is observed to be the category which has not included any of the three methods in the studies. “BLS” (Qualitative 7%, Quantitative 80% and Mixed 13%), “E” (Qualitative 20%, Quantitative 60% and Mixed 20%), “Ts” (Qualitative 18%, Quantitative 82% and Mixed 0%) and “Egy” (Qualitative 8%, Quantitative 84% and Mixed 8%) are observed to be among the topics in which the “Qualitative” and “Mixed” research methods have taken the lowest values.

With regards to the type of publication (MS and PhD) and the research methods (Qualitative, Quantitative and Mixed); “MS” and THE “Quantitative” method have taken the highest values in all topics. With regards to the levels (PS, SS, HE and Others); the highest values belong to; “SS” in “NSKB” and “CLT”; “PS” in “CFLT”; “SS” and “HE” in “ST” and “KF”; “SS” in “DCLT”, “CD”, “Ce”, “RGH”, “MGB”, “FGP”, “BPH”, “CEI” and “EEc”; “PS” and “HE” in “BS”, “CEc” and “Pe”; “SS” and “HE” in “Ev”; “SS” in “PTPC” and “HH”; “HE” in “STinPs”; “SS” and “HE” in “CS”; “SS” in “EV” and “Ph” and to “PS” in “CR”.

Table 6. Distribution of the biology topics on the basis of all variables

	MS	PhD	PS	SS	HE	Others	Qualitative	Quantitative	Mixed
NSKB	76.9(10)	23.1(3)	0	69.2(9)*	23.1(3)**	7.7(1)	7.7(1)	69.2(9)	23.1(3)
CFLT	100(1)	0	100(1)*	0	0	0	0	100(1)	0
CLT	87.5(14)	12.5(2)	18.8(3)**	62.5(10)*	6.2(1)	12.5(2)	6.2(1)	87.5(14)	6.2(1)
ST	83.3(5)	16.7(1)	0	83.3(5)*	16.7(1)*	0	0	66.7(4)	33.3(2)
DCLT	70.6(12)	29.4(5)	11.8(2)**	82.4(14)*	0	5.9(1)	5.9(1)	76.5(13)	17.6(3)
KF	82.4(14)	17.6(3)	11.8(2)**	41.2(7)*	41.2(7)*	5.9(1)	17.6(3)	64.7(11)	17.6(3)
CD	81.8(9)	18.2(2)	27.3(3)**	63.6(7)*	9.1(1)	0	0	72.7(8)	27.3(3)
Ce	90.9(10)	9.1(1)	0	81.8(9)*	9.1(1)**	9.1(1)**	9.1(1)	72.7(8)	18.2(2)
RGH	80(4)	20(1)	40(2)**	60(3)*	0	0	0	80(4)	20(1)
MGB	79.2(19)	20.8(5)	0	50(12)*	37.5(9)**	12.5(3)	16.7(4)	66.7(16)	16.7(4)
FGP	50(3)	50(3)	0	50(3)*	33.3(2)**	16.7(1)	16.7(1)	50(3)	33.3(2)
BPH	80(12)	20(3)	20(3)**	60(9)*	13.3(2)	6.7(1)	6.7(1)	73.3(11)	20(3)
CEI	70.2(33)	29.8(14)	14.9(7)	46.8(22)*	21.3(10)**	17(8)	10.6(5)	68.1(32)	21.3(10)
Eec	62.5(15)	37.5(9)	12.5(3)	50(12)*	29.2(7)**	8.3(2)	12.5(3)	58.3(14)	29.2(7)
Bs	50(2)	50(2)	50(2)*	0	50(2)*	0	25(1)	25(1)	50(2)
Cec	50(2)	50(2)	50(2)*	0	50(2)*	0	25(1)	25(1)	50(2)
PE	50(2)	50(2)	50(2)*	0	50(2)*	0	25(1)	25(1)	50(2)

Be	0	0	0	0	0	0	0	0	0
OL	0	0	0	0	0	0	0	0	0
Ev	60(3)	40(2)	0	20(1)**	40(2)*	40(2)*	20(1)	60(3)	20(1)
PTPC	50(2)	50(2)	0	75(3)*	0	25(1)**	25(1)	75(3)	0
HH	50(2)	50(2)	0	75(3)*	25(1)**	0	0	100(4)	0
STinPs	100(3)	0	0	33.3(1)**	66.7(2)*	0	33.3(1)	66.7(2)	0
AT	0	0	0	0	0	0	0	0	0
NS	62.5(5)	37.5(3)	25(2)**	37.5(3)*	37.5(3)*	0	0	75(6)	25(2)
DS	71.4(5)	28.6(2)	71.4(5)*	14.3(1)**	14.3(1)**	0	14.3(1)	71.4(5)	14.3(1)
RS	100(6)	0	50(3)*	16.7(1)	33.3(2)*	0	0	83.3(5)	16.7(1)
US	66.7(4)	33.3(2)	33.3(2)**	16.7(1)	50(3)*	0	0	83.3(5)	16.7(1)
CS	88.9(9)	11.1(1)	55.6(5)**	22.2(2)*	22.2(2)*	0	11.1(1)	66.7(6)	22.2(2)
MSSs	75(3)	25(1)	25(1)**	50(2)*	25(1)**	0	0	50(2)	50(2)
EV	80(4)	20(1)	0	80(4)*	20(1)**	0	0	80(4)	20(1)
Ph	85.7(6)	14.3(1)	28.6(2)**	42.9(3)*	0	28.6(2)**	14.3(1)	85.7(6)	0
CR	100(1)	0	100(1)*	0	0	0	0	100(1)	0
Ch	0	0	0	0	0	0	0	0	0

*Frequency (f) was in parentheses. Percent (%) was outside of parentheses.

CONCLUSION AND DISCUSSION

This study was conducted to reveal out which biology topics were preferred the most in Turkey in postgraduate theses; and to make comparisons of the university teaching biology, the types of publications, the research methods and research elements. It was also aimed to find out the intensity of biology topics dealt with in primary school and secondary school curricula with regards to course hours on the basis of both the grades and the biology topics (MEB 2013a and MEB 2013b) to check whether there was a congruity with the postgraduate theses or not (Figure 15 and Figure 16).

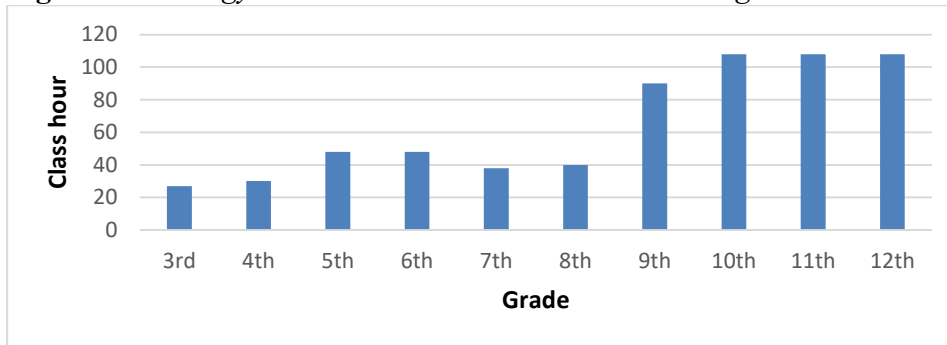
“Except for the “Gazi” university, all the universities were observed to make few theses on biology topics between 1989 and 2015 (Figure 1). There are two reasons for that; first of all, educational researches have gained speed in our country after 2000 and reforms have been made in these areas, as well. The second reason is that, in some of the universities teaching biology, the postgraduate studies were left to the preference of the students. The students can study biology or biology education at postgraduate level. On the other hand, some universities have different approaches. For example, in biology education at education faculty, postgraduate studies are made obligatory. The ones intending to study the area are directed to the institutes of natural sciences.

It was observed that; before 2000, MS theses were mostly done and PhD theses were fewer (Figure 2). “SS” level was mostly preferred as for the research group (Figure 3) and the “Quantitative” method was mostly preferred as for the research method (Figure 4). The “Quantitative” method had been most frequently utilized in several studies that had been conducted in the past (Chang and Hsieh, 1997; White, 1997; Tsai and Wen, 2005; Çalık et. al., 2008; Erdoğan, Marcinkowski and Ok, 2009; Şimşek et. al., 2009; Lee, Wu and Tsai, 2009; Çiltaş, Güler and Sözbilir, 2012; Doğru et. al., 2012; Gül and Sözbilir, 2015). The quantitative methods are preferred more in researches as they are easier to express statistically and to compare with past data (Çalık et. al., 2008). On the other hand; there has been increase in all variables after the year 2000. Particularly the researches on natural sciences are new in Turkey; this can be considered as the reason why the amount of publications was fewer before the year 2000. When the tendency towards researches on natural sciences increased after the year 2000, there has been increase in the amount of studies conducted by researchers. This tendency has brought about variability in the research methods utilized. As researches on

natural sciences have found place in Turkey since 1990ies, they have improved in terms of quality and increased in terms of quantity. These improvements have gained speed particularly after the year 2000 (Çalık et. al., 2008; Gül and Sözbilir, 2015). On the other hand; with the reforms made in education faculties after 1990ies, academicians in these faculties tended towards educational researches (Çiltaş, Güler and Sözbilir, 2012). This was particularly reflected on the university entrance exam. With the improvements made in education after 2000 and the increase in the amount of researches, there has been a change in the quality of the questions asked in university entrance exams. While the questions before that date were mainly focused on certain topics and they were commonly based on knowledge, since 2000 the quality of questions has been improved and the questions have been distributed homogenously in terms of topics (Sülün, 2002). “SS” level is one of the research groups mostly preferred by the researchers (Figure 3). This can be due to the fact that; the number of biology course hours is greater in secondary schools with a greatest share among all the classes (Figure 15). In a similar study, biology topics were reported to be more comprehensive and in greater amount in secondary schools (Gül and Sözbilir, 2015).

The number of biology course hours is observed to be greater in secondary schools. While the number of course hours is 80 and above in secondary school, the number is below 60 in primary schools (Figure 15).

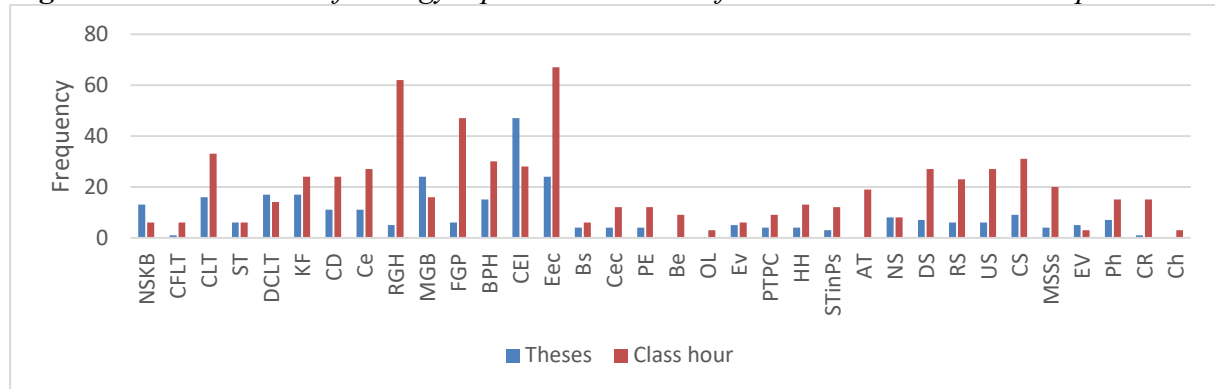
Figure 15. Biology class hours and their distribution on grade basis



It was revealed out that; the environment, cell and variety of the living beings were among the topics that were studied the most in researches while the tissues, evolution, systems and power transformations were studied the least. This can be mainly related to the intensity of the topics taught in primary and secondary schools. There is a similarity between the biology topics given in secondary schools and the topics preferred the most by the researchers (Figure 7, Table 4, Figure 12, Figure 13, Figure 14 or Table 6). Considering the general distribution of the biology topics taught in curricula (Figure 16); the environment, cell, variety of the living beings and classification of the living beings are among the topics taught in greater number of course hours both in primary and in secondary schools. The evolution, tissues, systems and power transformations topics are the ones with fewer course hours. The researches made on less favourable topics such as the reproduction, genetics, tissues, system and power transformations were revealed out to be the topics the students were having the most difficulty in understanding. Insufficiency of the materials, inability to make associations with the daily life and the fact that the topics are based on memorization were reported to be the main reasons for this (Bahar, Johnstone and Hansell, 1999; Özatlı and Bahar, 2010; Kurt and Temelli, 2011; Güneş and Güneş, 2005). To relieve the students from memorization and to enable meaningful learning is one of the most significant objectives of biology education (Özatlı and Bahar, 2010). On the other hand; unless the biology topics making up the most of the biology topics and in which students are having difficulty are included in researches and high quality materials are put into the use of teachers, meaningful

learning cannot be achieved. According to Hong, Shim and Chang (1998); the interest of the individuals on the subject has a great impact on their success. Most probably, students will have a negative attitude against the topics they are having difficulty in understanding. This would bring about inattention and failure.

Figure 16. Distribution of biology topics on the basis of course hours and theses topics



“Knowledge”, “Achievement” and “Attitude” are among the elements that are studied the most, “Retention”, “Motivation”, “Scale” and “Textbook” are among the elements that are studied the least by the researchers (Table 5 and Table 3). With the increase observed in the intensity of science education in recent years, academic success and attitudes of the students have started to be included among the elements that are studied the most (Tsai and Wen 2005). The purpose of education can be stated to be one of the most significant reasons that “knowledge”, “success” and “attitude” are studied the most. This is because; students are expected to develop favourable behaviours through education and to learn information related to the subjects they are studying in the classroom environment (Uitto, Juuti, Lavonen and Meisalo, 2006). In other words, it is significant for the teachers, researchers and educational institutions to find out whether the individuals have developed the expected behaviors and to evaluate these.

In conclusion; the amount and variety of the researches on biology education have increased after the year 2000. On the other hand, certain biology topics have been preferred whereas the topics the students find boring, have difficulty in understanding and the teachers have difficulty in explaining (the systems, tissues, power transformations) are generally neglected in the researches. The topic students have difficulty in learning have small share in the curriculum compared to the other topics.

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Appendix-1

Content Analysis Form (CAF)

1- University:

2- Publication year:

3- Publication type: MS (...) PhD (...)

4- Sample the study was intended for: Primary school (...) Secondary school (...) High education (...) Others(...)

5-Research method: Qualitative (...) Quantitative (...) Mixed (...)

6- Investigated elements	
61-Knowledge	67-Self-sufficiency
62-Achievement	68-Curriculum
63-Retention	69-Textbook
64-Attitude	610-Scale
65-View	611-Misconception
66-Motivation	612-Others

Biology Subjects and Subjects Matters

7- Biology:Life Sciences (BLS)	8-Cell (C)	9- Genetics and Heredity (GH)	10- Environmental Education (EE)	11-Evolution (E)
71-The Nature of Scientific Knowledge and Biology (NSKB) 72- Common Features of Living Things (CFLT) 73Compounds of Living Things (CLT)	81- Substance Transport (ST) 82- Diversity and Classification of Living Things (DCLT) 83- Kingdom and Features (KF) 84- Cell Division (CD) 85-Cell (Ce)	91- Reproduction, Growth and Development (RGH) 92- Modern Genetics and Biotechnology (MGB) 93- From Gene to Protein (FGP) 94-Basic Principle of Heredity (BPH)	101- Current Environmental Issues (CEI) 102- Ecosystem Ecology (EEc) 103- Biomes (Bs) 104- Community Ecology (CEc) 105- Population Ecology (PE)	111-Behavior (Be) 112- The Origin of Life (OL) 113- Evolution (Ev)
12- Tissues (Ts)	13- Systems (Ss)	14- Energy (Egy)	15-Others (if any ...)	
121- Plant tissues and Plant Construction (PTPC) 122- Hormones and Homeostasis (HH) 123- Substance Transport in Plants (STinPs) 124-Animal Tissues (AT)	131- Nervous System (NS) 132- Digestive System (DS) 133- Respiratory System (RS) 134- Urinary System (US) 135- Circulatory System (CS) 136- Muscular and Skeletal Systems (MSSs)	141- Energy and Vitality (EV) 142- Photosynthesis (Ph) 143- Cellular Respiration (CR) 144- Chemosynthesis (Ch)		