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DIFFERENCES ARISING FROM LANGUAGE IN PERCEIVING SOME TERMS IN PHYSICS EDUCATION

FİZİK EĞİTİMİNDE BAZI TERİMLERİN ALGILANMASINDA DİLDEN KAYNAKLANAN FARKLILIKLAR

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ABSTRACT: In several resources, especially in textbooks, there are two or more alternatives for terms. These terms generally come from foreign words and alternative equivalences of these words. The aim of the study is to investigate whether this situation causes students problems in perceiving the terms; in which alternatives, the conceptual perception is based on and in this context. Two applications (U1, U2) were made. The sample group is included student groups from 2005-2006 academic year spring semester of Gazi University, Physics Education Undergraduate Programme. Consequently, in all term pairs except one; the terms expressed through foreign languages gave more effective in low level ability and the Turkish ones gave more effective results in generally high level ability to Bloom's Taxonomy. Indicated results in this study and assessments obtained will be very beneficial for teachers and textbook writers. Besides, may get started for similar studies in other countries.

Keywords: Bloom Taxonomy, language, perception, physics education, term

ÖZET: Çeşitli kaynaklarda, özellikle ders kitaplarında, bazı terimlerin iki ya da daha fazla alternatifi bulunmaktadır. Bunlar genellikle yabancı dillerden gelen kelimelerden ve karşılıklarından oluşan alternatiflerdir. Bu durumun, öğrencilerin terimleri algılamalarında bir takım sıkıntılara yol açıp açmadığını, kavramsal algılamanın hangi alternatifler lehine olduğunu araştırmak bu çalışmanın amacını oluşturmaktadır. Araştırmada iki uygulama (U1, U2) yapılmış; örneklem grubunu, 2005–2006 öğretim yılı bahar döneminde Gazi Üniversitesi, Gazi Eğitim Fakültesi, Fizik Öğretmenliği Lisans Programı öğrencileri oluşturmuştur. Sonuç olarak, tek bir terim çifti dışındaki diğer tüm terim çiftlerinde, yabancı kökenli sözcüklerle ifade edilen terimlerin genelde Bloom Taksonomisi'ne göre daha düşük düzey beceri gerektiren davranışlarda; Türkçe kökenli sözcüklerle ifade edilen terimlerin ise genelde daha üst düzey beceri gerektiren davranışlarda daha etkili sonuçlar verdiği ortaya çıkmıştır. Elde edilen sonuç ve değerlendirmelerin özellikle öğretmenler ve ders kitabı yazarları için faydalı olacağı, ayrıca diğer ülkelerde benzer çalışmaların yapılmasına ön ayak olabileceği düşünülmektedir.

Anahtar sözcükler: Bloom Taksonomisi, dil, algılama, fizik eğitimi, terim

1. INTRODUCTION

The root of all natural sciences is physics and all engineering fields use the principles of physics. However, physics is one of the most fearful and failed lessons, and in our country, the percentage of answering the physics questions in university entrance examinations is very low; the number for this in 2001 is in average 2,89 nets per candidate (Eryılmaz & Kırmızı, 2002). In education process, the hardest thing is to understand the relationship of subject with the nature. Although this understanding is relatively easier in the physics lessons, this negative statistics draw students' attention away from physics. This point of view is nothing but a prejudice. Unfortunately, most of the students have prejudice against physics lessons (Woolnough, 1994; Doğan et. al., 2002). And what is worse, it is detected that this prejudice takes its roots from elementary education (Oruncak et. al., 2004). In our country, it is observed that outstanding students who gained the right to have undergraduate education in universities have also difficulties in physics terms. Also, the effects of monotonic education can be observed in these students. For these reasons, in every level of education, it is a must to research the subjects in which the students have difficulties and reasons of these difficulties, and new education methods must be developed (Quoted by: Aycan & Yumuşak, 2002; Gök & Erol, 2002). Up to now, in most studies for physics education, it is accentuated on several factors (logical thinking skills, visual skills, ability in maths and problem solving skills) that affect the success of students in physics lessons (Quoted by: Kavaz & Eryılmaz, 2002) and it is revealed that they have some problems in some levels

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of physics education (Caramazza et. al., 1981; Trowbridge & Mcdermott, 1981; Clement, 1983; Lythcott, 1985; Dreyer, 1992; Bakaç & Kumru, 1998; Doğan et. al., 2002; Doğan et. al., 2003; Kandil İngeç, 2008). In last years, in most studies for physics education, it is centred on perceiving the physics terms correctly by students (Yalçın et. al., 2008). The results of these studies have revealed the wrong perception of some terms and these kind of wrong perceptions and thoughts are get into the language as term misconceptions (Quoted by: Sencar & Eryılmaz, 2002). In terms of the Turkish Public Education System, it observed that qualifications of physics teachers are ignored or studied in a limited scope (Kavcar et. al., 2008). Not only for physics but also for other fields, the perception as an issue of employment instead of being seen as qualification and quality supports this idea.

As a result of several factors, students may have difficulties and confusions in learning the physics terms. There are several studies about term misconceptions and alternative frameworks in students in a national and international level. In these studies, there are various suggestions to reveal the wrong terms, the reasons and the solutions. Not every student has the same level of easiness in learning. The interests and expectations play an important role in this different ness. For this reason, it depends on the tendency level of interest in concrete or abstract terms (Terzi & Şeker, 2006). Students have difficulties especially in learning concrete physics terms (Bahar et al., 2002; Devecioğlu & Akdeniz, 2006; Terzi & Şeker, 2006). Recently, some researches were focused on relationship between language and teaching and learning science. Vygotsky (1962) pointed out using words helps students develop concepts and thus, language development and conceptual development are inextricably linked. Then, researchers in science education have studied students' conceptual understanding through talking and writing in the context of classroom (Hasweh, 1988; Fellows, 1994; Keys, 1994; Rivard, 1994; Varelas 1996; Van Zee & Minstrell, 1997; Webster, 2003; Ha & Song, 2009).

Another problem in teaching physics is the synonymous terms used in the textbooks. It is difficult to classify the terms according to their linguistic diversity. The idea of how frequent the said terms are used by teachers of textbook writers; the effect on the perception of students and not having a study like this before have revealed this study. It's thought that the results obtained will be a concrete reference for teachers and textbook writers and have positive contributions on the education system. The aim of the study is to investigate whether this situation causes students problems in perceiving the terms; in which alternatives, the conceptual perception is based on and in this context.

2. METHOD

In this study, using survey method and documentary analysis a case study was carried out. Firstly, some common synonymous physics terms are determined by looking at some books used by candidates for physics teacher, especially textbooks from primary education to high school. Then, two different applications performed in five weeks apart and how the students perceive these terms whether they are foreign-based or Turkish originated terms; their awareness of synonymous terms; their tendency in choosing terms are examined by using these term pairs. In study, two applications (U1, U2) performed in five weeks apart. The population of the study is the students of Faculty of Education, Physics Teaching Programme in Turkey. The sample group for this study is included the third, fourth, fifth and leap year (5+) student groups from 2005-2006 fall semester of Gazi University, Gazi Education Faculty, Physics Teacher Programme. The distribution of students according to their year involved in foresaid applications are given in Table 1.

Table 1: Frequency-Percentage Table of Sample Groups Involved in U1 and U2 According to Their Year

Class	*f*		*%*	
	U1	**U2**	**U1**	**U2**
3	*16*	*30*	*22,9*	*35,3*
4	*19*	*19*	*27,1*	*22,4*
5	*28*	*32*	*40,0*	*37,6*
5+	*7*	*4*	*10,0*	*4,7*
Total	**70**	**85**	**100,0**	**100,0**

U1 and U2 based on a questionnaire which is included 24 pairs of physics terms to be defined (as a sentence or a term) or at least to correlate with a synonymous term. In these pairs, one of the two terms is foreign originated and the other one is Turkish originated. In Table 2, the foresaid terms are given with their foreign and Turkish equivalences.

U1 and U2 applications are given in different times; one pair of terms is in U1 and the other one is in U2. Also, the number of foreign originated and Turkish originated terms in one application is the same. For example, it is expected to define *Aborbsiyon* in U1 and *Soğurma* in U2, or at least it is expected to correlate with a synonymous term. There is no inculcation of defining the terms as a sentence or expressing with one word. But in the classification period, it is thought that the tendency to define with a sentence is corresponded to Bloom's Taxonomy and to express with just one word is corresponded to information step. The definitions as sentences and synonymous terms given by students are classified according to Table 3.

Table 2: Terms Taken for the Study and Their Origins

Code	Term	Origin of Term					
		Foreign	**U1**	**U2**	**Turkish**	**U1**	**U2**
T1	Absorption	*Absorbsiyon*	✓		*Soğurma*		✓
T2	Circulation	*Sirkülâsyon*		✓	*Dolanım*	✓	
T3	Elastic	*Elastik*	✓		*Esnek*		✓
T4	Entropy	*Entropi*	✓		*Düzensizlik*		✓
T5	Relativity	*Rölativite*		✓	*Görelilik*	✓	
T6	Radiation	*Radyasyon*		✓	*Işınım*	✓	
T7	Concave	*Konkav*		✓	*İçbükey*	✓	
T8	Principle	*Prensip*		✓	*İlke*	✓	
T9	Impulse	*İmpuls*		✓	*İtme*	✓	
T10	Isolation	*İzolasyon*	✓		*Yalıtım*		✓
T11	Capacity	*Kapasitans*	✓		*Sığa*		✓
T12	Infrared	*İnfrared*		✓	*Kızılötesi*	✓	
T13	Concentration	*Konsantrasyon*	✓		*Derişim*		✓
T14	Corrosion	*Korozyon*	✓		*Aşınma*		✓
T15	Polarization	*Polarizasyon*		✓	*Kutuplanma*	✓	
T16	Magnetism	*Manyetizma*		✓	*Mıknatıslık*	✓	
T17	Quantitative	*Kantitatif*		✓	*Nicel*	✓	
T18	Oscillator	*Osilatör*	✓		*Salınıcı*		✓
T19	Premier	*Primer*	✓		*Birincil*		✓
T20	Rheostat	*Reosta*	✓		*Değişken Direnç*		✓
T21	Theory	*Teori*	✓		*Kuram*		✓
T22	Reaction	*Reaksiyon*		✓	*Tepkime*	✓	
T23	Thermal	*Termal*	✓		*Isıl*		✓
T24	Ordinate	*Ordinat*		✓	*Y-ekseni*	✓	

Table 3: Integrated Rubric Used in Scoring the Answers Responded to U1 and U2

Classifying of Answers			
Knowledge		Comprehension	
No Comment	K0	*No Comment*	C0
False Synonym	K1	*False Definition*	C1
True Synonym	K2	*Partly Definition*	C2
		True Definition	C3

3. FINDINGS

The results of first (U1) and second (U2) applications are presented as a whole in Table 4 and Table 5. Frequency-percentage and changing ratio which give category distributions related to chosen definition way of terms in both applications are presented in Table 4 and Table 5. In both applications, the term pairs given as synonym are evaluated as together and changing frequency rates are calculated. The changing frequency rates are determined by calculating differences in percentage frequencies of category between two synonymous words. The difference in percentage is valued as positive if the is decline from first term to second and valued as negative on the contrary. As it is shown in Table 4 and Table 5, if one term is a foreign word, the other one is Turkish originated.

According to Table 4 and Table 5, interesting or meaningful findings are presented below with their percent values. When T1, T2, T5, T6, T8, T9, T12, T14, T15, T16, T17 and T24 examined the students who didn't give an answer for foreign originated ones are more than in comparison with the Turkish originated ones. When T3, T7, T10, T13, T18, T19, T21, T22 and T23 examined the students who didn't give an answer for Turkish originated ones are more than in comparison with the foreign originated ones. In T4 pair, the number blanks for *Entropi* and *Düzensizlik* wasn't seen any change. The situation is considerably interesting in respect of blanks for the T11 term pair which consists of *Kapasitans* and *Sığa.* There is no blank for the term *Sığa* and the frequency for giving no answer is 14. It is interesting that all of the students gave an answer for the terms *Reosta* and *Değişken Direnç* which are forming the T20 term pair. Also, according to the Bloom's Taxonomy, perception step which requires higher level skills is increased in favour of Turkish originated ones except T21.

According to the Bloom's Taxonomy, when T1 examined, perception step which requires higher level skills is increased by 850, 0% in favour of *Soğurma.* Because of the blanks for *Soğurma* is fewer and the perception step ratio is higher; this situation reflects wrong, missing and correct defining rates. The wrong identification rate for *Absorbsiyon* is 0% while it is 23,7% for *Soğurma.* The situation for T2 is like T1.

As another interesting finding in T5, general defining rate is higher in favour of *Görelilik* by 70,4% and the blanks are 92,9% higher for *Rölativite* in comparison to *Görelilik.* Besides, there is no difference in the rate of giving wrong synonym. When the perception step type answers examined, there is an increasing of correct and definition identification by 233,3% and also there is an increasing of missing identification tendency by 84,6% in favour of *Görelilik.* This shows that the students have developed their high level skills for Turkish originated *Görelilik* in contrast to English originated *Rölativite*.

There is no significant difference between answers of synonym and identification for T6 but the conspicuous point is the changing rates of types internally. That is to say, in giving synonyms which requires lower skills, the correct matching with a synonym is in favour of *Radyasyon* by 71,1% while giving the wrong synonym matching is 400,0% for the word *Işınım.* In answers of perception step type which requires high level skills, there is an increase in favour of *Işınım* by 300,0% in correct identification and by 63,6% in missing identification. There is a 50,0% increase in the number of wrong identification for *Radyasyon.* For this reason, we draw a conclusion such as the students are more successful in foreign originated word *Radyasyon* when developing low level skills and in Turkish originated word *Işınım* when developing high level skills. The situation for T7 and T8 are like T6.

Another conspicuous result is seen in T9 term pair. In matching with a synonym answer type which requires lower level skills, there is an increase by 63,3% in favour of *İmpuls*. In matching with a correct synonym rate, the word İmpuls has more frequency than *İtme* by 75,0%. So, *İmpuls* is more successful in matching with a correct synonym answer type. On the other hand, the situation is in contrast to this in the identification type answers which require higher level skills. Generally, there is an increase in the identification type answers in favour of *İtme* by 51,5%. There is an increase established in the correct identification by 122,2%; in the missing identification by 225,0% in favour of *İtme* and in the wrong identification by 75,0% in favour of *İmpuls*.

Table 4: The Table of Frequency-Percentage and Changing Ratio Distribution in U1 and U2 for Category of "Synonym" of the Terms

Code	Terim	*No Comment (K0, C0)*			*Knowledge Level*								
					False Synonym (K1)			*True Synonym (K2)*			*Total*		
		f	*%*	*PD**	*f*	*IR***	*PD*	*f*	*IR*	*PD*	*f*	*IR*	*PD*
T1	*Absorbsiyon*	10	14,3	60,0	2	3,6	-50,0	54	96,4	25,9	56	80,0	23,2
	Soğurma	4	4,7		3	7,0		40	93,0		43	50,6	
T2	*Sirkülâsyon*	27	31,8	92,6	9	26,5	11,1	25	73,5	36,0	34	40,0	29,4
	Dolanım	2	2,9		8	33,3		16	66,7		24	34,3	
T3	*Elastik*	2	2,9	-50,0	6	11,5	66,7	46	88,5	67,4	52	74,3	67,3
	Esnek	3	3,5		2	11,8		15	88,2		17	20,0	
T4	*Entropi*	8	11,4	0,0	13	41,9	46,2	18	58,1	11,1	31	44,3	25,8
	Düzensizlik	8	9,4		7	30,4		16	69,6		23	27,1	
T5	*Rölativite*	14	16,5	92,9	1	2,3	0,0	43	97,7	48,8	44	51,8	47,7
	Görelilik	1	1,4		1	4,3		22	95,7		23	32,9	
T6	*Radyasyon*	11	12,9	27,3	3	7,3	-400,0	38	92,7	71,1	41	48,2	36,6
	Işınım	8	11,4		15	57,7		11	42,3		26	37,1	
T7	*Konkav*	7	8,2	-100,0	16	29,6	-25,0	38	70,4	76,3	54	63,5	46,3
	İçbükey	14	20,0		20	69,0		9	31,0		29	41,4	
T8	*Prensip*	16	18,8	75,0	4	8,3	-325,0	44	91,7	56,8	48	56,5	25,0
	İlke	4	5,7		17	47,2		19	52,8		36	51,4	
T9	*İmpuls*	3	3,5	33,3	17	34,7	41,2	32	65,3	75,0	49	57,6	63,3
	İtme	2	2,9		10	55,6		8	44,4		18	25,7	
T10	*İzolasyon*	1	1,4	-200,0	2	3,7	50,0	52	96,3	69,2	54	77,1	68,5
	Yalıtım	3	3,5		1	5,9		16	94,1		17	20,0	
T11	*Kapasitans*	14	20,0	∅	16	69,6	62,5	7	30,4	-200,0	23	32,9	-17,4
	Sığa	0	0,0		6	22,2		21	77,8		27	31,8	
T12	*İnfrared*	18	21,2	72,2	1	2,7	-400,0	36	97,3	∅	37	43,5	86,5
	Kızılötesi	5	7,1		5	100		0	0,0		5	7,1	
T13	*Konsantrasyon*	1	1,4	-300,0	17	37,8	52,9	28	62,2	14,3	45	64,3	28,9
	Derişim	4	4,7		8	25,0		24	75,0		32	37,6	
T14	*Korozyon*	30	42,9	63,3	9	36,0	22,2	16	64,0	50,0	25	35,7	40,0
	Aşınma	11	12,9		7	46,7		8	53,3		15	17,6	
T15	*Polarizasyon*	11	12,9	18,2	1	2,2	0,0	45	97,8	88,9	46	54,1	87,0
	Kutuplanma	9	12,9		1	16,7		5	83,3		6	8,6	
T16	*Manyetizma*	5	5,9	40,0	3	8,6	33,3	32	91,4	∅	35	41,2	94,3
	Mıknatıslık	3	4,3		2	100		0	0,0		2	2,9	
T17	*Kantitatif*	48	56,5	95,8	1	8,3	-1800	11	91,7	-100,0	12	14,1	-241,7
	Nicel	2	2,9		19	46,3		22	53,7		41	58,6	
T18	*Osilatör*	4	5,7	-375,0	38	95,0	63,2	2	5,0	-300,0	40	57,1	45,0
	Salınıcı	19	22,4		14	63,6		8	36,4		22	25,9	
T19	*Primer*	3	4,3	-100,0	7	11,9	-100,0	52	88,1	38,5	59	84,3	22,0
	Birincil	6	7,1		14	30,4		32	69,6		46	54,1	
T20	*Reosta*	0	0,0	∅	14	23,7	∅	45	76,3	2,2	59	84,3	25,4
	Değ. Direnç	0	0,0		0	0,0		44	100		44	51,8	
T21	*Teori*	2	2,9	-200,0	5	38,5	-200,0	8	61,5	-150,0	13	18,6	-169,2
	Kuram	6	7,1		15	42,9		20	57,1		35	41,2	
T22	*Reaksiyon*	2	2,4	-50,0	3	5,8	33,3	49	94,2	38,8	52	61,2	38,5
	Tepkime	3	4,3		2	6,3		30	93,8		32	45,7	
T23	*Termal*	7	10,0	-71,4	14	25,5	78,6	41	74,5	56,1	55	78,6	61,8
	Isıl	12	14,1		3	14,3		18	85,7		21	24,7	
T24	*Ordinat*	5	5,9	80,0	14	21,5	64,3	51	78,5	41,2	65	76,5	46,2
	Y-ekseni	1	1,4		5	14,3		30	85,7		35	50,0	

* Percentage of Differences [For example for code T7, frequencies 7 and 14, PD is (-100%)]

** Percentage of Interior Rate

Table 5: The Table of Frequency-Percentage and Changing Ratio Distribution in U1 and U2 for Category of "Definition" of the Terms

Code	Terim	*No Comment (K0, C0)*			*Comprehension Level*											
					False Def. (C1)			*Partly Def. (C2)*			*True Def. (C3)*			*Total*		
		f	*%*	*PD**	*f*	*IR***	*PD*	*f*	*IR*	*PD*	*f*	*IR*	*PD*	*f*	*%*	*PD*
T1	*Absorbsiyon*	10	14,3	60,0	0	0,0	∅	1	25,0	-2400,0	3	75,0	-33,3	4	5,7	-850,0
	Soğurma	4	4,7		9	23,7		25	65,8		4	10,5		38	44,7	
T2	*Sirkülâsyon*	27	31,8	92,6	15	62,5	-6,7	9	37,5	-155,6	0	0,0	∅	24	28,2	-83,3
	Dolanım	2	2,9		16	36,4		23	52,3		5	11,4		44	62,9	
T3	*Elastik*	2	2,9	-50,0	4	25,0	-825,0	4	25,0	-375,0	8	50,0	-12,5	16	22,9	-306,3
	Esnek	3	3,5		37	56,9		19	29,2		9	13,8		65	76,5	
T4	*Entropi*	8	11,4	0,0	12	38,7	-266,7	18	58,1	44,4	1	3,2	∅	31	44,3	-74,2
	Düzensizlik	8	9,4		44	81,5		10	18,5		0	0,0		54	63,5	
T5	*Rölativite*	14	16,5	92,9	8	29,6	75,0	13	48,1	-84,6	6	22,2	-233,3	27	31,8	-70,4
	Görelilik	1	1,4		2	4,3		24	52,2		20	43,5		46	65,7	
T6	*Radyasyon*	11	12,9	27,3	20	60,6	50,0	11	33,3	-63,6	2	6,1	-300,0	33	38,8	-9,1
	Işınım	8	11,4		10	27,8		18	50,0		8	22,2		36	51,4	
T7	*Konkav*	7	8,2	-100,0	14	58,3	64,3	7	29,2	-71,4	3	12,5	-233,3	24	28,2	-12,5
	İçbükey	14	20,0		5	18,5		12	44,4		10	37,0		27	38,6	
T8	*Prensip*	16	18,8	75,0	10	47,6	30,0	10	47,6	-70,0	1	4,8	-500,0	21	24,7	-42,9
	İlke	4	5,7		7	23,3		17	56,7		6	20,0		30	42,9	
T9	*İmpuls*	3	3,5	33,3	16	48,5	75,0	8	24,2	-225,0	9	27,3	-122,2	33	38,8	-51,5
	İtme	2	2,9		4	8,0		26	52,0		20	40,0		50	71,4	
T10	*İzolasyon*	1	1,4	-200,0	2	13,3	-150,0	9	60,0	-388,9	4	26,7	-300,0	15	21,4	-333,3
	Yalıtım	3	3,5		5	7,7		44	67,7		16	24,6		65	76,5	
T11	*Kapasitans*	14	20,0	∅	13	39,4	46,2	9	27,3	-255,6	11	33,3	-72,7	33	47,1	-75,8
	Sığa	0	0,0		7	12,1		32	55,2		19	32,8		58	68,2	
T12	*İnfrared*	18	21,2	72,2	8	26,7	-112,5	4	13,3	-525,0	18	60,0	0,0	30	35,3	-100,0
	Kızılötesi	5	7,1		17	28,3		25	41,7		18	30,0		60	85,7	
T13	*Konsantrasyon*	1	1,4	-300,0	11	45,8	18,2	12	50,0	-150,0	1	4,2	-900,0	24	34,3	-104,2
	Derişim	4	4,7		9	18,4		30	61,2		10	20,4		49	57,6	
T14	*Korozyon*	30	42,9	63,3	4	26,7	-1000	6	40,0	-83,3	5	33,3	20,0	15	21,4	-293,3
	Aşınma	11	12,9		44	74,6		11	18,6		4	6,8		59	69,4	
T15	*Polarizasyon*	11	12,9	18,2	17	60,7	70,6	11	39,3	-272,7	0	0,0	∅	28	32,9	-96,4
	Kutuplanma	9	12,9		5	9,1		41	74,5		9	16,4		55	78,6	
T16	*Manyetizma*	5	5,9	40,0	12	26,7	50,0	22	48,9	-40,9	11	24,4	-154,5	45	52,9	-44,4
	Mıknatıslık	3	4,3		6	9,2		31	47,7		28	43,1		65	92,9	
T17	*Kantitatif*	48	56,5	95,8	7	28,0	-171,4	18	72,0	72,2	0	0,0	∅	25	29,4	-8,0
	Nicel	2	2,9		19	70,4		5	18,5		3	11,1		27	38,6	
T18	*Osilatör*	4	5,7	-375,0	22	84,6	18,2	2	7,7	-150,0	2	7,7	-950,0	26	37,1	-69,2
	Salınıcı	19	22,4		18	40,9		5	11,4		21	47,7		44	51,8	
T19	*Primer*	3	4,3	-100,0	1	12,5	-200,0	7	87,5	-114,3	0	0,0	∅	8	11,4	-312,5
	Birincil	6	7,1		3	9,1		15	45,5		15	45,5		33	38,8	
T20	*Reosta*	0	0,0	∅	0	0,0	∅	1	9,1	-1000,0	10	90,9	-180,0	11	15,7	-272,7
	Değ. Direnç	0	0,0		2	4,9		11	26,8		28	68,3		41	48,2	
T21	*Teori*	2	2,9	-200,0	5	9,1	-300,0	26	47,3	23,1	24	43,6	83,3	55	78,6	20,0
	Kuram	6	7,1		20	45,5		20	45,5		4	9,1		44	51,8	
T22	*Reaksiyon*	2	2,4	-50,0	16	51,6	81,3	12	38,7	-33,3	3	9,7	-433,3	31	36,5	-12,9
	Tepkime	3	4,3		3	8,6		16	45,7		16	45,7		35	50,0	
T23	*Termal*	7	10,0	-71,4	1	12,5	-1300	5	62,5	60,0	2	25,0	-1700	8	11,4	-550,0
	Isıl	12	14,1		14	26,9		2	3,8		36	69,2		52	61,2	
T24	*Ordinat*	5	5,9	80,0	3	20,0	33,3	6	40,0	-250,0	6	40,0	-83,3	15	17,6	-126,7
	Y-ekseni	1	1,4		2	5,9		21	61,8		11	32,4		34	48,6	

* Percentage of Differences [For example for code T7, frequencies 7 and 14, PD is (-100%)]

** Percentage of Interior Rate

In this case, it is possible to say that the word *İtme* is more successful in the identification answer type. Also, the high tendency for defining *İtme* and the high tendency for matching *İmpuls* with a synonym support this idea. In matching T10, with synonyms answer type by 68,5% in favour of *İzolasyon*. Also, for the correct identification by 300,0%; for missing identification by 388,9% and for the wrong identification by 150,0%, the word *Yalıtım* is more dominant in the identification answer type. For the correct synonym by 69,2% and the wrong synonym by %50; the term *İzolasyon* is more dominant in matching with a synonym type.

The T12 term pair consists of *İnfrared* and *Kızılötesi.* This could be an indication that this word is less meaningful for the candidates. In the tendency of identification, there is an increase in favour of *Kızılötesi* by %100. However; while the number of students who gave the correct definition for both words is the same, the word *Kızılötesi* is more dominant in missing identification by 525,0% and in the wrong identification by 112,5%. There are more answers for *İnfrared* in matching with a synonym by 86,5%. It is also conspicuous that there is no student who gave the correct matching for *Kızılötesi* and the matching with a wrong synonym is by 400,0%.

In T13 term pair, there is an increase in favour of *Derişim* by 104,2 in the identification answer type and also there is an increase in the correct definition by 900,0% and in the missing identification by 150,0%. There is not significant difference in matching type. However, there are more answers for *Konsantrasyon* than the word *Derişim* by 52,9% in matching with a wrong synonym. This case shows that the word *Derişim* has more contribution than *Konsantrasyon* in developing higher level skills. On the other hand, the blanks for *Derişim* by 300,0% can be ignored since the frequency is low.

For T15 term pair, conspicuous point is, there is no student who gave the correct definition for *Polarizasyon* while there are nine students who gave the correct definition for *Kutuplanma.* The T16 term pair consists of the terms *Manyetizma* and *Mıknatıslık* which is a sub-subject in physics, matching with a synonym is higher in favour of *Manyetizma* by 94,3%. The frequency of *Mıknatıslık* in matching with a correct synonym is zero while this number for *Manyetizma* is 32. However, when we look at the ability of identification which requires higher level skills, the term *Mıknatıslık* is defined more correctly by 154,5%. In the wrong identification, the number is higher in favour of *Manyetizma* by 50,0%.

Although there is no student who gave the correct definition of *Kantitatif,* there are three students giving the correct definition for *Nicel* in T17. In the missing identification, the term *Kantitatif* is more successful by 72,2%. In the wrong identification, there are more answers for *Nicel* by 171,4%. When we look at matching with a synonymous word, the number is higher in favour of *Nicel* in general by 241,7%; in matching with correct synonym by 100,0%; in matching with wrong synonym by 1800,0%. As a result, both in matching with a synonym which requires low level skills and in identification answer type which requires higher level skills; the word *Nicel* has developed higher skills in comparison to *Kantitatif*.

The students give different meanings for these terms in T18. The term *Salınıcı* is associated with a magnetic pendulum or a periodic motion while the term *Osilatör* is associated with the resource of periodic electrical signals. The T19 term pair consists of the terms *Primer* and *Birincil.* In this pair, there are more blanks for *Birincil* by 100,0% in comparison to the term *Primer.* However, the tendency to define *Birincil* is higher by 312,5%. When we look at the number of students who gave the correct definition; there is no student who gave the correct definition of *Primer* while the number for *Birincil* is 15. For T20 term pair, in matching with a synonym answers type which requires lower level skills; there is no student who give the wrong matching for the term *Değişken Direnç* while the frequency value for *Reosta* is 14. There are more answers by 272,7% for *Değişken Direnç* in identification answer type which requires higher level skills. There is an increase in the correct identification by 180,0% and in the missing identification by 1000,0% in favour of *Değişken Direnç.* The frequency for *Reosta* in the wrong identification is zero while it is two in *Değişken Direnç.* In matching T21, with a synonym answer type, the number is generally higher in favour of *Kuram* by 169,2 %. There are more students in favour of *Kuram* who matched with the correct synonym by 150,0% and with the wrong synonym by 200,0%. In the wrong identification, the number is higher for *Kuram* by 300, 0% while in the correct identification the number is higher for *Teori* by 83,3%.

4. DISCUSSION

In accordance with the results of the study, the students are more successful in usage preference and adequateness in the cognitive field if the terms are given in Turkish. The most important reason for this is the grammar structure of Turkish which is different from many European languages. Since Turkish is an agglutinative language, the words are formed by joining morphemes together. In this context, there can be an association between the word and the origin of it. Also, non-scientific usages in daily life affect the perception in a positive way. For example; the word *Soğurma* is often used in daily life by its several meanings such as "absorb, aspirate" while the word *Absorbsiyon* is less meaningful since its usage is not common. The similar situation is valid for *Esnek, Düzensizlik, İlke, Yalıtım, Aşınma and Kutuplanma* since they are generally used in daily language.

All the terms can be an example of the association between the word and the origin of it except *İçbükey, Kızılötesi, Değişken Direnç and Y-ekseni* since these are compound words. Because compound words are the combination of two or more words. The word *Dolanım* can be expressed as "*Dola-n-ım*"; *Esnek* as "*Esne-k*"; *Kuram* as "*Kur-am*" by seperating their affixes in essence of their structures. The situation is similiar for the others (As seen at Table 6).

Based on the results of the study, the proficiency of the students in cognitive field is in the higher level if the terms are given in Turkish. In this context, textbook writers or teachers should prefer the physics terms in Turkish to prevent the mistakes in using the terms and make the cognitive perception easier. Moreover, there should be decided on a common usage by the suggestions of authorities, science institutions and universities and conventional terms should be determined. These terms should be standardized by the help of a dictionary of scientific terms prepared by Turkish Language Agency.

Table 6: Mean of Turkish, Word Structure and Turkish Word Origin of Terms

Code	Term	Turkish	Word Structure	Mean of the Turkish Word Origin*
T1	Absorption	*Soğurma*	*Soğur-ma*	*to suck; to absorb; to take in; to soak up*
T2	Circulation	*Dolanım*	*Dola-n-ım*	*to wind round; to encircle; to twist, to coil; to bandage*
T3	Elastic	*Esnek*	*Esne-k*	*to yawn; to gape; to stretch; to bend*
T4	Entropy	*Düzensizlik*	*Düz-en-siz-lik*	*flat; uniform*
T5	Relativity	*Görelilik*	*Gör-e-li-lik*	*to see; to observe; view; to behold*
T6	Radiation	*Işınım*	*Işı-n-ım*	*to shine; to radiate; to light up; ray*
T7	Concave	*İçbükey*	*İç/bük-ey*	-
T8	Principle	*İlke*	*İlke*	*principle; postulate*
T9	Impulse	*İtme*	*İt-me*	*to push*
T10	Isolation	*Yalıtım*	*Yalıt-ım*	*to isolate*
T11	Capacity	*Sığa*	*Sığ-a*	*to fit into a container or place*
T12	Infrared	*Kızılötesi*	*Kızıl/öte-si*	-
T13	Concentration	*Derişim*	*Der-iş-im*	*to gather; to collect; to pick*
T14	Corrosion	*Aşınma*	*Aşın-ma*	*to corrode; be abraded; waste away*
T15	Polarization	*Kutuplanma*	*Kutup-lan-ma*	*pole*
T16	Magnetism	*Mıknatıslık*	*Mıknatıs-lık*	*magnet*
T17	Quantitative	*Nicel*	*Nice-l*	*how many; a fair amount of; rather a lot of*
T18	Oscillator	*Salınıcı*	*Sal-ın-ıcı*	*to let off; to release*
T19	Premier	*Birincil*	*Bir-inci-l*	*one*
T20	Rheostat	*Değişken Direnç*	*Değiş-ken/Dire-n-ç*	-
T21	Theory	*Kuram*	*Kur-am*	*to set up; build; construct; to found*
T22	Reaction	*Tepkime*	*Tep-ki-me*	*to kick; to spurn*
T23	Thermal	*Isıl*	*Isı-l*	*heat; thermo; warmth*
T24	Ordinate	*Y-ekseni*	*Y/eksen-i*	-

* Turkish Language Assembly Official Web Site

Besides, in every educational level, teachers should make physics more attractive and the contributions of developments in physics to the society should be underlined to make the students more active about this issue. Physics teachers should work harder to attract students' attention in physics. The subjects which are harder for the students should be determined and the reasons of why there subjects are harder should be established. Also, the teachers have a connection with up-to-date experiences and train the students in a more organized way (Woolnaugh, 1994; Eryılmaz & Kırmızı, 2002).

To support the cognitive perception of the students, the foresaid terms are thought to be used in practice by the help of comprehensive facilities and projects which are applied by the programs. Accordingly, it is necessary for physics teachers to make comments on practical applications and also there should be studies which support the development of assessment skills.

5. CONCLUSION

As a result of the U1 and U2 applications, when we look at all term pairs generally, in all term pairs except one term pair; the terms expressed through foreign languages gave more effective results in behaviours requiring low level ability to Bloom's Taxonomy and the terms expressed in Turkish gave more effective results in behaviours generally requiring high level ability (defining and explicating).

With this study, it is shown that the candidates haven't developed their theoretical and practical knowledge and also their degree of perception the terms are not in the sufficient level.

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Geniş Özet

Ders kitapları başta olmak üzere, çeşitli kaynaklarda bazı Fizik terimlerinin iki ya da daha fazla alternatifi bulunmaktadır. Fizik terimleri arasında dil çeşitliliği bakımından yabancı ya da Türkçe kökenli şeklinde kesin bir sınıflandırma yapmak zor olmakla birlikte, bu terimler genellikle yabancı dillerden gelen kelimelerden ve bunların kullanılan dildeki karşılıklarından oluşan alternatifler olarak karşımıza çıkmaktadır. Öğretmenlerin ve ders kitabı yazarlarının söz konusu terimleri kullanma sıklıklarının; terimlerin kullanım tercihlerini ve öğrencilerin algılamasını etkilediği düşüncesi ve bu konuda bir çalışmanın daha evvel yapılmaması, böyle bir çalışmanın yapılması fikrini ortaya çıkarmıştır. Bu durumun, öğrencilerin bu terimleri tanımlama ve algılamalarında bir takım sıkıntılara yol açıp açmadığı, kavramsal algılamanın hangi alternatifler lehine olduğu ve bu bağlamda hangilerinin öğretmenler ve ders kitabı yazarlarınca tercih edilmesi gerektiği soruları, bu çalışmanın çıkış noktasını oluşturmuştur.

Çalışmanın örneklem grubu olarak, Türkiye'de 2005–2006 öğretim yılı bahar döneminde Gazi Üniversitesi, Gazi Eğitim Fakültesi, Fizik Öğretmenliği Lisans Programında öğrenim gören üçüncü, dördüncü, beşinci ve artık yıl (5+) öğrencilerden oluşan gruplar (N_{U1}= 70; N_{U2}= 85) yer almıştır. Çalışmada veri toplama aracını oluşturmak için öncelikle, fizik öğretmeni adaylarının, ilköğretimden yüksek öğretime kadar kullandıkları fizik ve fen ders kitapları başta olmak üzere, çeşitli kaynaklar incelenerek bazı genel eş anlamlı terimler belirlenmiştir. Elde edilen terim çiftleri incelenerek, sık kullanılanları arasından 24 çifti rasgele seçilmiştir. Daha sonra bu terim çiftleri kullanılarak beş hafta arayla yapılan ilk iki uygulama ile öğrencilerin bunların aynı anlama gelip gelmediğinin farkında olup olmadıkları araştırılmıştır. Araştırmada iki farklı (U1, U2) uygulama (önce U1, beş hafta sonra U2

olmak üzere) yapılmıştır. U1 ve U2, seçilmiş toplam 24 çift fizik teriminin cümle ya da eş anlamlı terim olarak ifade edilmesinin; tanım tercih edilmiyorsa en azından bir eş anlamlı terimle ilişkilendirilmesinin beklendiği birer anket formuna dayanmaktadır. Bu terim çiftleri, biri yabancı kökenli, diğeri Türkçe karşılıklardan oluşan çiftlerdir. U1 ve U2 testleri, terim çiftlerinden biri U1'de, diğeri U2'de olacak şekilde ayrı zamanlarda verilmiştir. Ayrıca, her bir testte yabancı kökenli ve Türkçe terim sayıları eşit tutulmuştur. Örneğin birinci uygulama olan U1'de *Absorbsiyon'*un, ikinci uygulama olan U2'de ise *Soğurma'*nın tanımlanması, tanım tercih edilmiyorsa en azından bir eş anlamlı terimle ilişkilendirilmesi beklenmiştir. Öğrencilere terimleri cümle halinde tanımlamaları veya bire bir kelime olarak karşılıklarını ifade etmeleri şeklinde bir telkinde özellikle bulunulmamıştır. Fakat sınıflama yapılırken, cümle halinde açıklama eğiliminin Bloom Taksonomisi'ne göre kavrama basamağına; bire bir kelime ile ilişkilendirme eğiliminin ise bilgi basamağına karşılık geldiği düşünülmüştür. Testten elde edilen veriler doküman analizi yöntemiyle betimsel olarak incelenmiş ve sonuçları kaydedilmiştir.

Elde edilen bulgular incelendiğinde, kullanılan terim çiftlerinden 12 adedinde yani yarısında, yabancı kökenli kelime şeklindeki fizik terimlerini Türkçe olanlarına göre daha çok boş bırakmışlardır. Söz konusu terim çiftlerinin dokuzunda ise bu eğilimim tersine, Türkçe kökenli kelime şeklindeki fizik terimlerini, yabancı kökenli olanlarına göre daha çok boş bırakmışlardır. Terim çiftlerinden biri olan *Entropi* ve *Düzensizlik* için ise boş bırakma oranları bakımından herhangi bir farklılık gözlemlenmemiştir. Dikkate değer bir başka durum olarak, *Kapasitans* ve *Sığa* terim çiftinden *Sığa* için hiç boş bırakılan cevaba rastlanmamıştır. *Reosta* ve *Değişken Direnç* terim çiftinde hiçbir öğrenci cevap formundaki ilgili kısmı boş bırakmamıştır.

Elde edilen bulgular ve analizler ışığında, tüm terim çiftlerine genel olarak baktığımızda tek bir terim çifti (*Teori-Kuram*) dışındaki diğer tüm terim çiftlerinde, yabancı kökenli sözcüklerle ifade edilen terimlerin genelde Bloom Taksonomisi'ne daha düşük düzey beceri gerektiren davranışlarda (tek kelime ile karşılama – bilgi düzeyi); Türkçe kökenli sözcüklerle ifade edilen terimlerin ise genelde daha üst düzey beceri gerektiren davranışlarda (tanımlama ve açıklama – kavrama düzeyi) daha etkili sonuçlar verdiği ortaya çıkmıştır.

Yapılan bu çalışmayla öncelikle, öğretmen adaylarının kendi alanlarındaki kuram ile uygulama bilgilerini yeterince ilişkilendiremedikleri, seçilmiş bu terimleri algılama düzeylerinin yeterli düzeyde olmadığı görülmektedir. Öte yandan öğrencilerin kullanmayı seçtikleri sözcüklere ve bilişsel alandaki yeterliliklerine baktığımızda, terimlerin Türkçe sözcüklerle verilmesi durumunda kavramsal algılamada daha başarılı olabilecekleri öngörülmektedir. Bunun en önemli gerekçesi olarak; Türkçe'nin dilbilgisi bakımından diğer birçok Avrupa dillerinden farklı yapıda olması akla gelebilir. Bilindiği gibi, Türkçe yapı olarak, sondan eklemeli bir dil olduğu için, sözcükler genelde belirli kelime köklerinden türeyerek üretilir. Bu bağlamda, bir Türkçe kelimenin türediği kök ile kendisi arasında kolaylıkla çağrışım yapılabilir. Bunun yanında, günlük yaşamdaki bilimsel olmayan kullanımların da algılamayı çağrışım yoluyla olumlu etkilediği durumların da olduğu ifade edilebilir.

Araştırma sonuçlarına dayanarak, öğrencilerin bilişsel alandaki yeterliliklerinin, terimlerin Türkçe sözcüklerle verilmesi durumunda daha üst düzeyde olabileceği görülmektedir. Bu çerçevede, fizik terimlerinin kullanımında bir kargaşaya neden olmamak ve kavramsal algılamayı kolaylaştırmak için ders kitaplarında ve öğretmenlerin bireysel söylemlerinde öncelikle, Türkçe olan terimler tercih edilmelidir. Hatta bu konuda ortak bir kullanım yoluna gidilerek; alanında yetkin eğitim otoritelerinin, bilimsel kuruluşların, üniversitelerin görüşleri de alınarak üzerinde uzlaşılmış terimler belirlenmelidir. Araştırmadan elde edilen sonuç, değerlendirme ve önerilerin özellikle öğretmenler ve ders kitabı yazarları için faydalı olabileceği düşünülmektedir.