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An Evaluation of Changes to the Turkish High School Physics Curriculum

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Abstract

A New Turkish Physics Curriculum has been constructed between the years 2006-2009. It is to the gaining of new perspectives. The purpose of this paper, therefore, is to reflect on the nature of the New Turkish Physics Curriculum (NTPC). To this end, the authors focus on the five themes of the NTPC using a document analysis method: basic reasons and needs of the NTPC, fundamental approaches of the NTPC, learning areas of the NTPC, characteristics of teaching activities in terms of the NTPC, needs of the NTPC. This paper highlights thus focusses on the fundamentals of the NTPC and considerations of its easy adaptation into practice.

Keywords: curriculum development, physics education, New Turkish Physics Curriculum (NTPC)

1. Introduction

Physics through its experimental nature enables ways of thinking about real world phenomena and thus is in continual development. Especially in the last century, the content of physics has expanded both in microscopic and macroscopic perspectives by continuing to capture classic meanings of concepts, as seen in general and special relativity or quantum mechanics theories. Moreover, the production of knowledge nowadays is grounded on these theories and the produced knowledge greatly affects our social life (Pietrocola, 2005). It is clear that since reflections of physics occur in our social life and the growing importance of physics is significantly different from past decades, persons need to understand a degree of specialized physics knowledge to function in today's world. Also, since past practices of separating physics teaching activities from daily life and the profound relationship between physics and mathematics today they are a cause of teaching-learning problems (Bernhard, 2000). Physics is perceived as a difficult discipline to understand. Likewise, even though most of the concepts of physics are used in daily life, physics courses are identified by students as being filled with difficult, boring and useless information (Ahlgren & Walberg, 1973; Yaman *et al.*, 2004). It is clear that this kind of negative perception creates significant and permanent disabilities for learning and thus, updating or reconstructing the physics curriculum is inevitable. On the other hand, changes to the understanding of conceptual learning (answers to how meaningful and effective learning occurs) are also an important reason for curriculum changes. In this manner, any physics curriculum is expected to reflect current trends and provide a strategic development. Researchers such as Brockington *et al.* (2008), Pietrocola (2005) and research projects such as PSSC, ACS, BSCS, NSES, AAAS-Project 2061, SLIP and ROSE summarize efforts by some countries to fill the gap emanating from these advances.

Once several countries recognized the importance of updating or reconstructing their physics curriculum in terms of worldwide trends and development in technical and scientific areas, evaluation studies related to the effectiveness of the revision, the suitability of the objectives, the appropriateness of the principles on new curricula are based or obstacles faced in their applications have taken place. Examples are, those by Hu (2007), Fernandez (2007), Mumba *et al.* (2007) and Mirzoyan and Mirzoyan (2008). Hu (2007) concentrated on opportunities and challenges behind the new Chinese physics curriculum and simultaneous disclosed that reasons for changing the curriculum were closely related with future trends and challenges caused from practices of empirical research results. In this regard, the research identified the fundamental ideas within the curricula as (I) *enhancement of students' basic scientific literacy in general with reference to the students' development*, (II) *emphasis on the process of scientific investigation and training in the spirit of creativity and the development of* *practical ability*, (III) *stressing interrelationships between Science-Technology-Society for promoting the integration of science and humanity*, (IV) *increasing the choice of education, so that the students' learning will be, to a greater extent, based on individual needs and diversity of learning ability*, (V) *allowing multivariate approaches to learning, training and assessment for strengthening students' autonomous learning abilities*. Fernandez (2007), in his/her thesis, studied a new physics curriculum initiated in the early 1990s (full implementation of the curriculum seen in 1997) in New Zealand secondary schools. (S)he related the reasons for changing with trends caused from political and economic changes in society and saw that the curriculum was designed to enable creative and people-oriented learning situations for learners. (S)he determined that the physics curriculum had three levels each consisting of four sections: (I) achievement objectivities, (II) sample learning contexts, (III) possible learning experiences and (IV) assessment examples for each objective. (S)he further highlighted that the achievement objectives were based on three strands: (I) physics concepts-principles-models, (II) the nature of physics theories and impact of physics on society, (III) developing investigative skills and attitudes. (S)he also emphasized that the third strand of achievement objectives, given in a separate section, entitled 'Developing Investigative Skills and Attitudes in Physics,' included four main areas of skills (focusing and planning; information gathering; processing and interpreting; and reporting) in unison with related achievement objectives. Mumba *et al.* (2007) focused on analyzing the new Zambian high school physics syllabus and its practical examinations in terms of levels of inquiry and inquiry skills and highlighted that the syllabus was oriented to implementing inquiry-based science teaching. With regard to the practical examination, the researchers determined that while the syllabus had a detailed nature to elicit inquiry skills rather than on levels of inquiry, it had superficial inquiry activities and guidelines on how to implement inquiry-based science teaching. Mirzoyan and Mirzoyan (2008) discussed physics curriculum reform and the influence of constructivism on the process in Armenia. The researchers indicated that the main reason for the reform was the absence of high quality physics education; but nevertheless they reported that the curriculum reform is under way with all its main documents and materials within the project *Education Quality and Relevance,* financed by the World Bank. The researchers stated that, although the *State Order on General Education* and in-service teacher training was influenced by constructivism, development of the curriculum was carried out in terms of traditional approaches. The researchers highlighted that structure of the curriculum was constructed with three main domains: (I) knowledge, (II) skills, (III) attitudes and values.

It is evident that although the examined curriculum studies are within different perspectives, country efforts are towards capturing the recent trends from a common outlook, *e.g.* skills are as important as knowledge objectives. Table 1 summarizes the needs and focus of such curricula highlighted in this paper.

Table 1. Needs and focus of curricula highlighted in this paper

Paper	**Country**	**Needs of changing**	**Focus of curriculum**
Hu (2007)	China	Future trends and challenges caused from practices of empirical research results	Students' autonomous learning
Fernandez (2007)	New Zealand	Political and economic changes and to keep up with trends	Promoting creative, relevant, and people-oriented learning situations
Mumba *et al.* (2007)	Zambia	Current trends in science education	Inquiry-based science teaching
Mirzoyan & Mirzoyan (2008)	Armenia	Lack of qualified teachers in physics	Constructivist theory

Like changes in other countries, the Turkish physics curriculum at the secondary school level (Note 1) has undergone reconstructing in the years 2006-2009. However, there has been a lack of studies examining the NTPC in Turkey and thus far only three studies have been conducted (see, Üstün, Eryılmaz & Gülyurdu, 2008; Serin & Kanlı, 2008; Ateş *et al.*, 2009). In fact, the study by Üstün, Eryılmaz and Gülyurdu is about (2008) needs assessment for the curriculum, the study by Serin and Kanlı (2008) concerns learning strands of the curriculum, and the study by Ateş *et al.* (2009) concentrates on the philosophy, foundations, and vision of the curriculum. In other words, there is no study investigating the NTPC with all its perspectives.

The present paper analyses the NTPC to reflect on its rationale and perspectives, in particular -its preparation, basic components and learning areas. It is predicted that an analysis of the NTPC is significant, not only to Turkish science educators, but also to science educators elsewhere, who have, or plan to use a similar physics curriculum. It is also claimed that some of the key implications might contribute to the impact of this study for teaching, learning and curriculum design. To this end, the authors asked the following research questions:

1. What are the basic reasons for changing in the physics curriculum in Turkey?
2. What requirements were determined as necessary for a new physics curriculum?
3. What fundamental approaches does the new physics curriculum promote for learning and assessment?
4. What aspects does the new physics curriculum promote in terms of learning and assessment approaches?
5. What aspects does the new physics curriculum promote in terms of learning areas?
6. In what aspects does the new physics curriculum differ in terms of learning areas?
7. How teaching activities should be implemented in the light of the new physics curriculum?
8. Does the new physics curriculum need any revision in a practical sense? If so, what aspects require revision?

The authors present descriptive responses to each question in terms of a documentary analysis so as to elicit the main strands of the new physics curriculum. Documentary analysis is known to be an effective method to analyze collected materials or documents within a systematic criterion (Cohen & Manion, 1994; Çepni, 2005). Also, since the researchers have been worked as members of the Physics Textbooks Writing Commission (Note 2) within the Ministry of National Education, it is thought that the researchers had adequate qualifications and experience to analyze the NTPC.

The analyzes were presented in an order reflecting a systematic approach under the headings of; Basic Reasons and Needs of the NTPC, Fundamental Approaches of the NTPC, Learning Areas of the NTPC, Characteristics of Teaching Activities in terms of the NTPC, Needs of the NTPC.

2. Basic Reasons and Needs of NTPC

The first two research questions were discussed under this heading. To make clear the basic reasons and needs of NTPC, the contextual background of the Turkish Physics Curriculum development process, starting from the establishment of Turkey in 1923 as a new republic, is introduced below.

Turkish Secondary Science Curriculum development process can be divided into three phases: (I) from 1923 to 1960; (II) from 1960 to 1984; (III) from 1984 to present. Briefly, the focus of the first phase was about the new republic regime and the teaching of its importance to the new generations, the second phase is about adapting the curriculum to developments seen in the world in the 1950s, while the third phase includes developing extensive curriculum activities (Ayas, Çepni & Akdeniz, 1993; Ünal, Çoştu, & Karataş, 2004).

The first studies to develop a physics curriculum in Turkey were seen between the years 1934-1940. However, these studies were just constructing a list including titles of subjects (MEB, 2007; 2008a; 2008b; 2009). Thus, it was accepted as a curriculum guide rather than a curriculum and this implementation process was followed for the development of a science curriculum (not a real physics curriculum) until the 1960s (Akdeniz, 1993). In fact, this curriculum was adapted from modern foreign science curricula, and had begun by implementing in a school as a pilot study. As a result of the pilot study, similar science curriculum began to be implemented in about 200 schools after 1971, and the two science curricula were being called ‘the modern science curriculum’ or ‘the classic science curriculum’ (Akdeniz, 1993; MEB, 2007; 2008a; 2008b; 2009; Gülay & Ekici, 2010). To end this discrimination, a common science curriculum was developed, and begun to be implemented in all secondary school from 1985. In the 1990s, despite some modernization, none had a different perspective from the 1985 curriculum (MEB, 2007; 2008a; 2008b; 2009). Because all secondary students encountered physics at grade 9, only the 9th grade curriculum had detailed objectives prepared in 1992. The others were formed as a list including titles of subjects (MEB, 2007). As understood, Turkey did not have a detailed physics curriculum which included objectives, sample teaching methods, assessment perspectives from the establishment up to now. To end this problem, a commission was formed from academicians and teachers in 2007 to construct an exclusive physics curriculum (MEB, 2007; 2008a; 2008b; 2009).

3. NTPC Fundamental Approaches

The third and fourth research questions were discussed under this heading. To understand the fundamental approaches of the NTPC deeply, the structure of the curriculum is outlined in Table 2.

Table 2. The NTPC structure

Background of Curriculum		**Learning Areas** Objectives	Organizations
Philosophy	· To be based on real life · Take into account students' initial learning and differences · Have a spiral structure · Highlight knowledge and skills · Activate physical, cognitive and affective development	· Knowledge objectives · Problem Solving Skills · Physics Society Technology Environment · Informatics and Communication Skills · Attitudes and Values	Chapters
Vision	· Raising productive and creative individuals who internalize the physics as a discipline generated from real life.		
Mission	· Teaching and learning based on real life. · Taking into account knowledge and skills		
Learning Perspectives	· Learning is accepted as individualized. · Learning is not a passive process. · Initial knowledge, opinions, beliefs or attitudes affect learning. · Teaching and assessment methods affect learning.	…	Sample Teaching and Assessment Activities
Teaching Perspectives	· Preferring eclectic approach depends on situations		
Assessment Perspectives	· Process and result-oriented		

As can be seen from Table 2, the NTPC constructed the curriculum within two dimensions: (I) *its background* including its philosophy, vision, mission and (learning, teaching and assessment) perspectives, and (II) *learning areas* including objectives and organizations.

Since common agreement was reached on the effects of prior knowledge on the learning process, and a New Science and Technology Curriculum in elementary school for grades 4-8 was implemented in 2004 in Turkey, the NTPC highlighted a spiral curriculum taking into account subjects from the New Science and Technology Curriculum realizing students' fundamental knowledge before secondary school (MEB, 2007; 2008a; 2008b; 2009). The NTPC especially paid attention to students' potential misconceptions mentioned in related literature. Also, knowledge and skill (Problem Solving Skills (PSS), Physics-Technology-Society-Environment (PTSE), Informatics and Communication Skills (ICS) and Attitudes and Values (AV)) objectives of the NTPC were constructed in harmony with Figure 1.

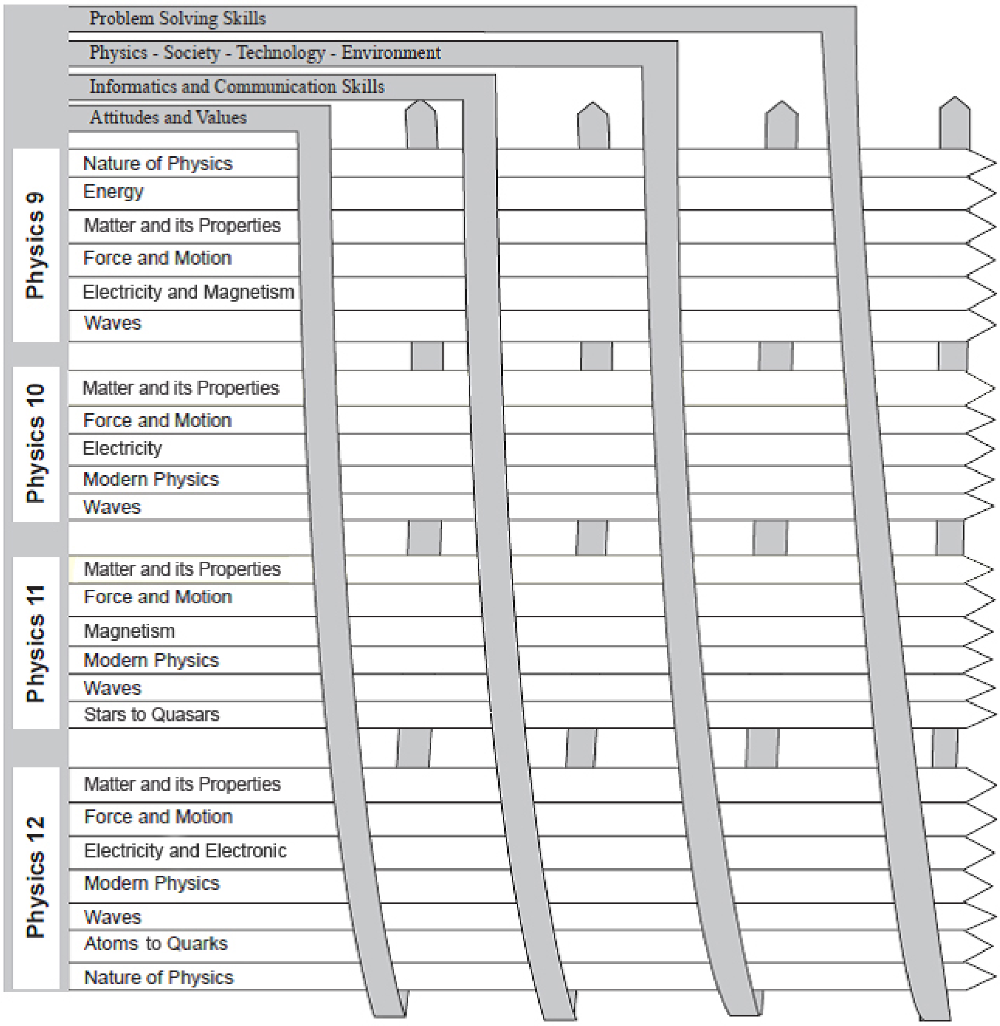

Figure 1. Layers of skills and knowledge objectives in NTPC

The nature of objectives in the NTPC was configured in terms of real life so as to internalize the physics as a discipline generated from real life. In fact, this is the vision of the curriculum. i.e., to raise productive and creative individuals who internalized the physics as a discipline generated from real life. The aim of correlating physics with real life is to provide opportunities for students to understand the close relationship between real life and the abstract concepts of physics. In this manner, engaging the teaching process with examples of real life situations related to a target concept is seen as a major approach for the curriculum. In this process, activating physical, cognitive and affective development of students is also seen important. To take care of real life, skills and knowledge in a holistic perspective is the mission of NTPC. To achieve this, the NTPC defines teachers as designers instead of presenters. That is, teachers are seen as responsible for creating the learning environment. To do this, the NTPC provides an eclectic aspect for teachers (Eryılmaz & Arslan, 2008; Koca & Şen, 2011). Since assessment and the teaching process cannot be separated from each other, teachers are also seen as responsible for selecting appropriate assessment techniques according to their teaching methods. The nature of assessment in the NTPC is summarized in Table 3.

Table 3. Assessment perspectives of the NTPC

Focus	Aim	Explanation
Authentic and Performance Assessment	Diagnostic	Undertaken in order to determine students' prior knowledge, or to plan instruction. That is, it aims at identifying needs of learning.
	Formative	Undertaken in order to determine where the students are in their learning and to deepen their learning.
	Summative	Undertaken in order to summarize attainment, record achievement and judge performance.

As seen in Table 3, the NTPC orients teachers to undertake assessment activities during the whole teaching process. To do this, the NTPC directs teachers and textbook writers to select appropriate assessment techniques by considering the aims of the assessment, subjects, and teaching methods. Here, it is expected teachers and textbook writers will use both traditional (multiple-choice questions, true-false questions, fill in the blanks questions, open ended) questions and alternative assessment techniques (portfolio, projects, peer or self-evaluation, concept maps, *etc*). Briefly, the NTPC rejects the sole use of a result oriented assessment approach, but instead expects both a process and result-oriented assessment approach. In this context, sample teaching and assessment activities are given in the NTPC.

4. Learning Areas of NTPC

The fifth and sixth research questions are discussed under this heading with the learning areas of the NTPC given initially. The NTPC has nine content areas: Nature of Physics, Energy; Matter and its Properties; Force and Motion; Electricity/Electronics/Magnetism; Waves; Modern Physics; Stars and Quasars; Atoms and Quarks.

The content is not applicable to all grades. While there is a wide, experimental, and more relevant to daily life experience curriculum to focus conceptual teaching as all students study physics in grade 9, in upper grades, curriculum are structured for students who specialize in the appropriate fields. For all grades, the general implementation characteristic of the NTPC related to knowledge objectives is given in Table 4.

Table 4. Knowledge objectives of the NTPC in all grades adapted from MEB (2007, 2008a, 2008b, 2009).

Grade	Target group	Weekly course hours	Total course hours	Chapter Numbers	Objective Numbers	The rate of objectives and course hours
9	All students	2	72	6	71	0,99
10	Students who choose in the appropriate fields	2	72	5	47	0,68
11		3	108	6	81	0,75
12		3	108	7	105	0,97

When all grades are examined within a holistic perspective, the content areas of the NTPC has an approach from simple to complex, from easy to difficult, from concrete to abstract, from known to unknown and from closer to distant; *e.g.* the frequency concept is introduced as a fundamental magnitude in grade 9; is given with spiral springs, wires and water waves in grade 10; is thought related to sound waves in grade 11; is thought related to electromagnetic waves in grade 12. The distribution of content areas to the various grades, their objectives and their total course hours are given in Table 5.

Table 5. Curriculum characteristics in terms of knowledge objectives for all grades

Grades	Chapters	Objective Numbers	Course Hours	The rate of objectives and course hours
9	Nature of Physics	16	9	1,78
	Energy	17	18	0,94
	Matter and its Properties	8	9	0,89
	Force and Motion	14	16	0,88
	Electricity and Magnetism	7	10	0,70
	Waves	9	10	0,90
10	Matter and its Properties	7	9	0,78
	Force and Motion	15	25	0,60
	Electricity	10	16	0,63
	Modern Physics	5	9	0,56
	Waves	10	13	0,77
11	Matter and its Properties	9	13	0,69
	Force and Motion	18	25	0,72
	Magnetism	12	17	0,71
	Modern Physics	19	25	0,76
	Waves	8	11	0,73
	Stars and Quasars	15	17	0,88
12	Matter and its Properties	11	12	0,92
	Force and Motion	9	10	0,90
	Electricity and Electronics	13	14	0,93
	Waves	32	33	0,97
	Modern Physics	23	24	0,96
	Atoms and Quarks	11	11	1
	Nature of Physics	6	4	1,50

As seen in Table 5, ‘Matter and its Properties, Force and Motion, Electricity-Electronics-Magnetism, and Waves’ are four-stage chapters; ‘Modern Physics’ is a three-stage chapter; ‘Nature of Physics’ is a two-stage chapter; and ‘Energy, Atoms and Quarks, Stars and Quasars’ are one-stage chapters. Another important point is that the ‘Nature of Physics’ chapter is the first and last chapter. By giving ‘Nature of Physics’ as the first chapter, it is aimed that physics should be internalized by students as a discipline that explains changes in nature, and expects students to behave in parallel to this during all grades. By giving ‘Nature of Physics’ as the last chapter, it is aimed to teach students that the content of physics is not stable. That is, to show the students that current knowledge will be affected from the creativities and imaginations of individuals in the future. In fact, with the new programs, ‘Nature of Physics, Atoms and Quarks, Stars and Quasars and Modern Physics’ chapters are those most radically changing.

The focus subject content areas their objective numbers and implementation hours are given in Table 6.

Table 6. Spiral structure of the NTPC in terms of focus subjects of content areas

Chapter	Grade	Focus Subject	Objective Numbers	Course Hours
Matter and its Properties	9	Matter and its Properties - Classification	5	9
		Exchanges of substance	3	
	10	Relationship between the size and strength in solids	2	9
		Capillarity and surface tension in liquids	3	
		Gas and plasma	2	
	11	Pressure in solid, liquid and gas	5	13
		The heat exchange in solid, liquid and gas	4	
	12	Thermodynamics	5	12
		Change of State	6	
Force and Motion	9	Linear motion	6	16
		The fundamental forces of nature	3	
		Newton’s Laws of Motion	3	
		Frictional force	2	
	10	Force and properties	3	25
		Motion under the effects of balanced forces	3	
		Motion under the effects of unbalanced forces	5	
		Force pairs	2	
		Inertia	2	

	11	Work and Energy	6	25
		Impulse-Momentum	3	
		Torque	2	
		Angular Momentum	3	
		Equilibrium and its Conditions	4	
	12	Volition and its reasons	4	10
		Simple harmonic motion	5	
Electric Magnetism Electronic	9	Electric current	4	10
		Magnetic effects of electric current	3	
	10	Electrostatic	7	16
		Electric circuits	3	
	11	Magnetic Fields and Sources	8	17
		Electromagnetic induction	4	
	12	Variable and Direct Currents	2	14
		Capacitors	5	
		Bobbins	2	
		Transformers	2	
		Electronic circuit elements	2	
Waves	9	Fundamental Magnitudes Related to Waves	9	10
	10	Spiral springs and Waves on Wires	4	13
		Water Waves	6	
	11	Sound Waves	5	11
		Enlightenment	3	
	12	Reflection of Light	6	33
		Refraction of Light	7	
		Concave and Converging Lenses	6	
		Colors	4	
		Electromagnetic Waves	4	
		Wave Nature of Light	5	
Modern Physics	10	Introduction to Modern Physics	1	9
		Special Relativity	4	
	11	Particle properties of light	6	25
		Wave properties of particles	1	
		Structure of Atoms	12	
	12	X-rays	6	24
		Structure of Matters	5	
		Structure of Nucleus	3	
		Radioactivity	6	
		Nuclear Energy	3	
Nature of Physics	9	Study Areas of Physics	3	9
		Nature of Physics	9	
		Modeling and Mathematics in Physics	2	
		Physics, daily life and technology	2	
	12	Nature of Physics	6	4
Energy	9	Work, Power and Energy	3	18
		Transformations and Conservation of Energy	8	
		Energy Sources	3	
		Heat and Temperature	3	
Stars and Quasars	11	Stars	3	17
		Classification of Stars	4	
		Galaxies	3	
		Quasars	2	
		Age of Universe and Its Expansion	3	
Atoms and Quarks	12	Particle, Anti-particle and Photons	3	11
		Classification of Particles	4	
		Building Blocks of Baryon and Meson	4	

The four-stage chapters can be defined as the core chapters of the curriculum. When the focus subjects of these chapters are investigated, it is seen that the NTPC has adopted a spiral structure.

Teachers were responsible for the planning process until the NTPC, e.g. teachers decide the course hours for an objective. Thus, there was no unity in teachers' applications across the country. Instead, teachers generally decided the importance of the subject in terms of the University Entrance Examination questions, and adapted according to it. Now, the NTPC provides clear limits in planning what to teach to the students in all grades by giving objective numbers and course hours for all focus subjects. In this manner, it could be said that teachers and course book writers can find an easy and understandable content areas. This case is another advantage of

NTPC.

One of the important changing in the NTPC is surrounding content by skills as exemplified in Figure 1. The focus of skills in the NTPC and their objective numbers are given in Table 7.

Table 7. Characteristics of skills in terms of focus subjects

Skills		**Focus Subjects**	**Objectives Numbers**	**Total**
PSS	1	Determining a problem to be investigated and planning a solution	7	22
	2	Conducting experiments and collecting data for determining a solution	6	
	3	Handle and interpret the data	9	
PTSE	1	Nature of physics and technology	16	40
	2	Interaction of physics and technology	6	
	3	Interaction of physics and technology with individual, society and environment	18	
ICS	1	Searching, finding and selecting appropriate information	5	22
	2	Developing information	3	
	3	Presenting information	3	
	4	Developing communication skills	5	
	5	Developing informatics skills	6	
AV	1	Developing positive attitudes and values for him/herself and others	13	28
	2	Developing positive attitudes and values for physics and the world	8	
	3	Developing positive attitudes and values for lifelong learning	7	
		TOTAL		112

As seen in Table 7, skills were collected in four domains (PSS, PSTE, ICS and AV) as mentioned above. PSS skills include three focus areas which require gaining a systematic approach to solving a problem. To do this, students should be able to behave in the light of the focus areas of the PSS which includes seven, six, and nine objectives related with the focus areas, respectively. As understood, PPS was constructed with a total of twenty two objectives including scientific process skills, analytical thinking skills, critical thinking skills, data handling skills and creative thinking skills.

PSTE skills include three focus areas that are required understanding and analyzing of the close relationship between physics, society, technology and the environment. To be successful, students should be able to gain sixteen, six, and eighteen objectives related with focus subjects, respectively. That is, PSTE was constructed with a total of twenty two objectives including understanding and analyzing skills.

ICS skills include five focus areas that are related with communication and basic computer skills. These focus areas contain five, three, three, five, and six objectives related with focus subjects, respectively. Last, three focus areas including twenty-eight objectives are stated in AV. Here, it is expected students will gain self-control and self-development skills, and scientific attitudes and values. The distribution of the skill objectives to all grades are given in Table 8.

Table 8. Distribution of the skill objectives to all grade*

Grade	**Target group**	**Chapter Numbers**	**Objective Numbers** PSS	PSTE	ICS	AV
9	All students	6	244	50	226	30
10	Students who turn in the appropriate fields	5	180	47	196	51
11		6	213	98	310	230
12		7	229	142	338	178
	TOTAL	24	866	337	1050	489

* Repetition of some objectives was not taken into account in the creation of the table.

As seen in Table 8 the objectives of PPS, PSTE, ICS and AV were given in a repeated perspective. This situation indicates that the NTPC adopts giving skill objectives to students in a broader time. It is clear that the PSS and ICS objectives are dominant at all grades. That is, PSS and ICS are seen as more important skills than the others. In this manner, it can be also said that PSS objectives have a balance during the four years; PSTE objectives are more important at grade 12, and ICS and AV objectives are more important at grade 11 and 12.

Distribution of the skill objectives to the grades by matching with the focus subjects of chapters are given in Tables 9-12.

Table 9. Distribution of the skill objectives at grade 9*

Chapter	Focus Subject of Chapter	Objective numbers of focus subject of PPS				Objective numbers of focus subject of PSTE				Objective numbers of focus subject of ICS						Objective numbers of focus subject of AV				T
		1	2	3	T	1	2	3	T	1	2	3	4	5	T	1	2	3	T	
Nature of Physics	Study Areas of Physics	-	-	-	**-**	5	-	-	**5**	4	-	-	-	-	**4**	-	1	-	**1**	**10**
	Nature of Physics	2	4	1	**7**	7	-	-	**7**	-	1	-	-	-	**1**	-	-	-	**-**	**15**
	Modeling and Mathematics in Physics	-	-	6	**6**	-	-	-	**-**	-	1	-	-	-	**1**	-	-	-	**-**	**7**
	Physics, Daily Life and Technology	-	-	-	**-**	1	5	-	**6**	-	-	-	-	-	**4**	-	3	1	**4**	**14**
Energy	Work, Power and Energy	2	-	-	**2**	-	2	-	**2**	12	3	-	6	-	**21**	-	-	-	**-**	**25**
	Transformations and Conservation of Energy	-	-	-	**-**	2	2	2	**6**	20	3	2	10	-	**35**	-	-	1	**1**	**42**
	Energy Sources	-	-	-	**-**	-	-	12	**12**	8	2	-	-	-	**10**	3	7	-	**10**	**32**
	Heat and Temperature	3	2	-	**5**	-	2	1	**3**	12	2	3	4	-	**21**	-	-	-	**-**	**29**
Matter and its Properties	Matter and its Properties-Classification	3	3	5	**11**	-	-	-	-	4	-	4	8	-	**16**	5	-	-	**5**	**32**
	Exchanges of Substance	-	-	-	**-**	-	-	-	-	-	-	9	12	-	**21**	-	-	-	**-**	**21**
Force and Motion	- Linear Motion	7	-	15	**22**	1	-	-	**1**	13	-	-	6	-	**19**	-	-	-	-	**42**
	The Fundamental Forces of Nature	-	-	-	**-**	-	-	-	**-**	12	-	-	6	-	**18**	-	-	-	-	**18**
	Newton's Laws of Motion	18	18	24	**60**	-	-	-	**-**	9	-	-	-	-	**9**	-	-	-	-	**69**
	Frictional Force	12	12	16	**40**	-	-	-	**-**	6	-	-	-	-	**6**	-	-	-	-	**46**
Electric and Magnetism	Electric Current	9	12	18	**39**	-	-	-	**-**	-	-	-	2	-	**2**	-	-	-	-	**41**
	Magnetic Effects of Electric Current	3	4	6	**13**	1	2	-	**3**	-	-	-	4	-	**4**	-	-	-	-	**20**
Waves	Fundamental Magnitudes Related to Waves	9	12	18	**39**	1	2	2	**5**	20	4	-	14	-	**38**	-	5	4	**9**	**91**
Total		68	67	109	**244**	18	15	17	**50**	120	16	18	72	-	**226**	8	16	6	**30**	**550**

* Repetition of some objectives was not taken into account in the creation of the table.

Table 10. Distribution of the skill objectives at grade 10*

Chapter	**Focus Subject of Chapter**	**Objective numbers of focus subject of PPS**				**Objective numbers of focus subject of PSTE**				**Objective numbers of focus subject of ICS**						**Objective numbers of focus subject of AV**				**T**
		1	**2**	**3**	**T**	**1**	**2**	**3**	**T**	**1**	**2**	**3**	**4**	**5**	**T**	**1**	**2**	**3**	**T**	
Matter and its Properties	Relationship between the Size and Strength in Solids	1	-	10	**11**	-	-	-	-	10	6	9	10	1	**36**	3	-	-	**3**	**50**
	Capillarity and Surface Tension in Liquids	5	6	10	**21**	-	-	-	-	15	9	9	15	-	**48**	-	-	-	-	**69**
	Gas and Plasma	2	-	3	**5**	2	-	-	**2**	10	6	6	10	-	**32**	3	-	-	**3**	**42**
Force and Motion	Force and Properties	-	-	5	**5**	1	-	-	**1**	4	1	3	-	-	**8**	-	-	-	-	**14**
	Motion Under the Effects of Balanced Forces	4	-	-	**4**	-	-	-	-	4	3	-	-	-	**7**	-	-	-	-	**11**
	Motion Under the Effects of Unbalanced Forces	-	-	17	**17**	-	-	1	**1**	4	-	-	-	-	**4**	-	-	-	-	**22**
	Force Pairs	-	-	5	**5**	-	-	-	-	4	3	-	-	-	**7**	-	-	-	-	**12**
	Inertia	1	4	1	**6**	-	-	-	-	4	1	-	-	-	**5**	-	-	-	-	**11**
Electric	Electrostatic	3	8	16	**27**	1	-	-	**1**	16	6	-	-	-	**22**	-	-	-	-	**50**
	Electric Circuits	3	4	8	**15**	-	-	1	**1**	-	-	-	-	-	-	4	1	-	**5**	**21**
Modern Physics	Introduction to Modern Physics	-	-	-	-	4	3	1	**8**	4	-	-	-	-	**4**	-	4	-	**4**	**16**
	Special Relativity	-	-	-	-	18	6	1	**25**	16	-	2	-	-	**18**	-	4	-	**4**	**47**
Waves	Spiral springs and Waves on Wires	2	8	5	**15**	2	3	1	**6**	3	-	-	-	2	**5**	16	1	-	**17**	**43**
	Water Waves	19	15	15	**49**	-	-	2	**2**	-	-	-	-	-	-	11	1	3	**15**	**66**
Total		40	45	95	**180**	28	12	7	**47**	94	35	29	35	3	**196**	37	11	3	**51**	**474**

* Repetition of some objectives was not taken into account in the creation of the table.

Table 11. Distribution of the skill objectives at grade 11*

Chapter	**Focus Subject of Chapter**	**Objective numbers of focus subject of PPS**				**Objective numbers of focus subject of PSTE**				**Objective numbers of focus subject of ICS**						**Objective numbers of focus subject of AV**				**T**
		1	**2**	**3**	**T**	**1**	**2**	**3**	**T**	**1**	**2**	**3**	**4**	**5**	**T**	**1**	**2**	**3**	**T**	
Matter and its Properties	Pressure in Solid, Liquid and Gas	9	5	18	**32**	6	8	8	**22**	10	6	6	10	1	**33**	61	18	35	**114**	**201**
	The Heat Exchange in Solid, Liquid and Gas	3	-	7	**10**	4	2	5	**11**	10	6	12	20	2	**50**	49	10	28	**87**	**158**
Force and Motion	Work and Energy	-	-	14	**14**	-	2	1	**3**	16	-	12	-	-	**28**	-	-	-	-	**45**
	Impulse-Momentum	-	-	14	**14**	-	2	1	**3**	4	-	3	-	-	**7**	-	-	-	-	**24**
	Torque																			
	Angular Momentum	5	6	16	**27**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**27**
	Equilibrium and Its	-	-	7	**7**	-	-	-	-	5	3	3	5	-	**16**	-	-	-	-	**23**
	Conditions	-	-	18	**18**	-	3	3	**6**	9	3	-	5	-	**17**	-	-	-	-	**41**
Magnetism	Magnetic Fields and Its Sources	6	8	12	**26**	-	1	1	**2**	-	-	-	15	-	**15**	-	-	-	-	**43**
	Electromagnetic Induction	3	4	6	**13**	2	1	-	**3**	-	-	-	10	-	**10**	-	-	-	-	**26**
Modern Physics	Particle Properties of Light	-	-	-	-	-	-	-	-	12	-	-	-	-	**12**	-	-	-	-	**12**
	Wave Properties of Particles	-	-	-	-	-	-	-	-	4	-	-	-	-	**4**	-	-	-	-	**4**
	Structure of Atoms	-	-	22	**22**	25	2	-	**27**	12	9	-	-	-	**21**	-	-	-	-	**70**
Waves	Sound Waves	6	4	1	**11**	6	2	5	**13**	12	1	9	11	5	**38**	13	3	2	**18**	**80**
	Enlightenment	3	3	1	**7**	-	-	1	**1**	-	-	4	5	-	**9**	8	-	1	**9**	**26**
Stars and Quasars	Stars	-	-	-	-	2	-	-	**2**	-	-	3	6	-	**9**	-	-	-	-	**11**
	Classification of Stars	-	-	6	**6**	3	-	-	**3**	4	1	-	3	1	**9**	-	-	-	-	**18**
	Galaxies	-	-	-	-	-	-	-	-	4	-	3	9	2	**18**	-	-	-	-	**18**
	Quasars	-	-	-	-	1	-	-	**1**	4	-	3	3	1	**11**	-	1	1	**2**	**14**
	Age of Universe and Its Expansion	-	-	6	**6**	1	-	-	**1**	-	-	-	3	-	**3**	-	-	-	-	**10**
Total		35	30	148	**213**	50	23	25	**98**	106	29	58	105	12	**310**	131	32	67	**230**	**851**

* Repetition of some objectives was not taken into account in the creation of the table.

Table 12. Distribution of the skill objectives at grade 12*

Chapter	Focus Subject of Chapter	Objective numbers of focus subject of PPS				Objective numbers of focus subject of PSTE				Objective numbers of focus subject of ICS						Objective numbers of focus subject of AV				T
		1	2	3	T	1	2	3	T	1	2	3	4	5	T	1	2	3	T	
Matter and its Properties	Thermodynamic	3	2	3	**8**	3	9	4	**16**	13	3	9	-	-	**25**	13	6	7	**26**	**75**
	Change of State	-	-	-	-	-	-	-	-	20	12	12	20	-	**64**	60	5	35	**100**	**164**
Force and Motion	Volution and Its Reasons	12	6	9	**27**	-	-	-	-	-	-	-	10	-	**10**	-	-	-	-	**37**
	Simple Harmonic Motion	15	12	28	**55**	-	4	4	**8**	-	-	-	-	-	-	-	-	-	-	**63**
Electric and Electronic	Variable and Direct Currents	-	-	-	-	-	1	2	**3**	-	-	-	-	-	-	1	-	-	**1**	**4**
	Capacitors	1	5	3	**9**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**9**
	Bobbins	-	-	-	-	3	-	-	**3**	5	3	3	-	-	**11**	-	-	-	-	**14**
	Transformers	5	6	9	**20**	-	3	-	**3**	5	3	3	-	-	**11**	-	-	-	-	**34**
	Electronic Circuit Elements	1	6	3	**10**	5	-	-	**5**	5	3	6	-	-	**14**	-	-	-	-	**29**
Waves	Reflection of Light	8	14	13	**35**	7	-	2	**9**	-	-	12	9	1	**22**	19	1	9	**29**	**95**
	Refraction of Light	1	5	6	**12**	-	-	-	-	14	2	-	2	-	**18**	-	-	-	-	**30**
	Concave and Converging Lenses	5	10	6	**21**	-	-	-	-	3	2	3	3	-	**11**	2	-	-	**2**	**34**
	Colors	1	5	3	**9**	-	-	-	-	6	4	-	-	-	**10**	-	-	-	-	**19**
	Electromagnetic Waves	-	-	-	-	-	-	-	-	9	6	-	-	-	**15**	-	-	-	-	**15**
	Wave Nature of Light	2	10	6	**18**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**18**
Modern Physics	X-rays	3	-	-	**3**	2	5	-	**7**	16	-	-	1	1	**18**	-	-	-	-	**28**
	Structure of Matters	-	-	-	-	-	20	12	**32**	17	-	-	-	-	**17**	-	5	-	**5**	**54**
	Structure of Nucleus	-	-	-	-	-	-	-	-	4	-	-	-	-	**4**	-	-	-	-	**4**
	Radioactivity	-	-	-	-	3	4	9	**16**	8	-	-	-	7	**15**	-	4	-	**4**	**35**
	Nuclear Energy	-	-	-	-	5	-	18	**23**	4	-	-	-	-	**4**	-	7	-	**7**	**34**
Atoms and Quarks	Particle, Anti-particle and Photons	-	-	-	-	-	-	1	**1**	3	-	-	3	-	**6**	-	-	-	-	**7**
	Classification of Particles	-	-	3	**3**	-	-	-	-	8	-	6	6	2	**22**	-	-	-	-	**25**
	Building Blocks of Baryon and Meson	-	-	-	-	2	2	-	**4**	4	-	3	3	1	**11**	-	1	1	**2**	**17**
Nature of Physics	Nature of Physics	-	-	-	-	8	-	4	**12**	24	-	9	-	-	**33**	-	1	-	**1**	**46**
Total		57	81	92	**230**	38	48	56	**142**	168	38	66	57	12	**341**	95	30	52	**177**	**890**

* Repetition of some objectives was not taken into account in the creation of the table.

As seen in Tables 9-12, skill objectives were given as associated with the overlapping issues, *e.g.* in modern physics chapters, PPS is less coupling between the focus subjects of chapters and skill objectives. Here, the third focus subject of PSS and the first focus subject of PTSE, ICS and AV are salient points. Thus, it can be said that handling and interpreting the data for solution (PSS), understanding nature of physics and technology (PTSE), searching, finding and selecting appropriate information (ICS), and developing positive attitudes and values for himself and others (AV) are the major skills for NTPC. However, the number of skill objectives can be queried. That's not mean that the skill objectives are more important than knowledge objectives for the NTPC and vice versa. Both of them should be seen as reinforcing each other to achieve an aim. It is clear that the NTPC has an appropriate nature to achieve its vision and mission, and is more systematic. Thus, it is major breakthrough for Turkey for the time being.

5. Characteristics of Teaching Activities in the NTPC

The seventh research question was discussed under this heading. In this manner, the answers of ‘Why the NTPC regard the context-based instruction?’ and ‘How an instruction should be implemented with regard to NTPC?’ will be discussed.

It is known that most of the Turkish students query physics concepts by asking ‘why I have to learn it?’ or ‘am I likely to use it?’ Here, it is noticed that students learn better if the concepts are associated with real-life or technology. That is, students learn better if the answers of ‘why they have to learn the subject?’ or ‘how they use it?’ is in the learning environment. Thus, the NTPC aims to teach physics with respect to real-life (MEB, 2007; 2008a; 2008b; 2009). In this perspective, learning is not a necessity, is needed. This changing to the learning is a further difference of the NTPC.

According to the NTPC, the teaching process starts from a context including social and cultural environments where students, teachers and schools interact. However, this is not an aim, it is just a tool for teaching. Here, teachers should begin by presenting sections from real-life or the principle of technological tools related with target concepts. That is, starting from real-life examples is important to find and understand information during the learning process instead of making direct presentation of the concept and practice. To this end, the NTPC suggest an eclectic approach to choose appropriate methods for teaching process. That is, teachers have flexible opportunities to choose how to teach concepts, *e.g.* while teachers may prefer to teach ‘Stars and Quasars’ chapter in a teacher-centered learning environment, they may prefer to teach other chapters in a student-centered learning environment by taking into account the nature of the target concepts, readiness of students, their own capacities, *etc*. However, the NTPC encouraged teachers to choose actual methods such as inquiry based teaching, conceptual change text, analogies, and 5E and 7E models. Here, the answer of how an instruction should be implemented in term of the NTPC can be summarized as shown in Figure 2.

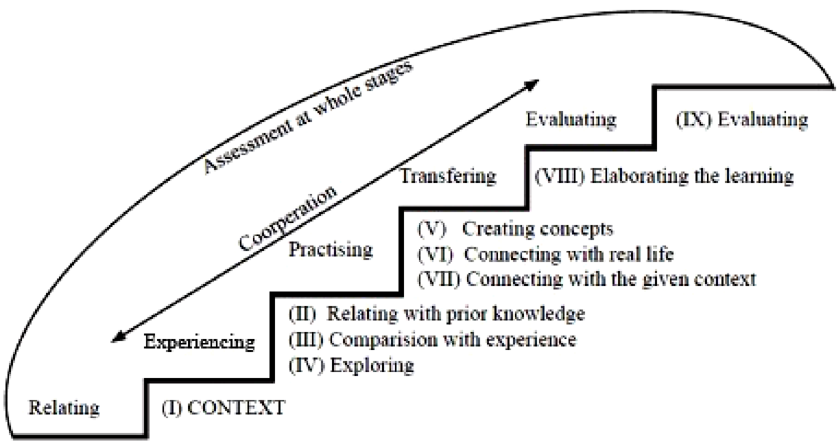

Figure 2. The ideal teaching process in terms of the NTPC

As can be seen from Figure 2, the teaching process starts with introducing the target concept to students within a context. Here, teachers should determine students’ prior knowledge. Teachers should also provide a suitable learning environment in which the students can compare the target concept with their own experiences. Then, teachers should give students exclusive learning activities to gain experience related to the target concept. Thus, the target concept should be constructed and connected with real life. Here, teachers need to explain the relationships by reconnecting the target concept and the given context. Then, teachers should provide an environment where the students are required to show how they transfer their knowledge to real life or technology. Teachers need also to complete the evaluation process. Key points as an example to carry out a teaching process can be seen in Figure 3.

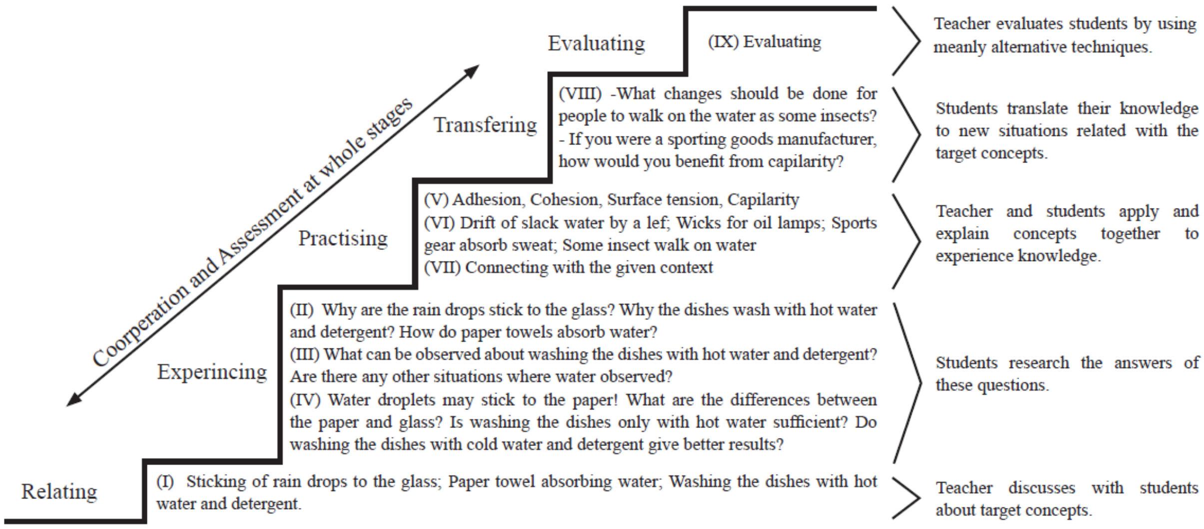

Figure 3. An example for teaching process in terms of NTPC (Note 3)

It is expected from teachers and textbook writers that the teaching process should certainly be constructed in terms of a context or technological device, and relates the context or technological device with target concept. In this manner, the NTPC presents to teachers or textbook writers sample example contexts for the chapters. Also, the NTPC encourages teachers or textbook writers to select any other appropriate contexts by considering the subjects, opportunities and social environments.

6. Needs of NTPC

The eighth research question was discussed under this heading. It is clear that a curriculum change should also be investigated for practices to enact its dissemination. Curriculum implementation studies are used to investigate students' achievements (Fullan & Pomfret, 1977) and factors which affect the implementation process (Fullan, 1992). To define needs of NTPC, results of curriculum implementation studies are needed. However, as mentioned above, there is no study which investigates the NTPC in a longitudinal manner. It is suggested that answers to 'what are the weaknesses, lacks, and effects of the NTPC?' should be queried during its implementation process. Therefore, the NTPC needs re-evaluation by taking conclusions of curriculum implementation studies which identify the weaknesses, lacks, and effects of the NTPC. On the other, with regard to this paper, needs of the NTPC can be highlighted. The NTPC claims that skill objectives surround the knowledge objectives. However, when Table 8 is examined, it is seen that there is no balance in the distribution of skill objectives to the grades. Here, the answers to 'why PSTE and AV have fewer rates at grades 9 and 10?' are worthy to examine. Especially, if the grade 9 curriculum addresses all students, it can be asked why the NTPC focuses on PSS and ICS more than the PSTE and AV skills? In this sense, why is the NTPC neglecting students who turn to other fields? Thus the NTPC needs re-organization of the skill objectives at all grades, but especially at grade 9? Also, although the authors of the textbook have seen the weakness of the curriculum in many dimensions, especially in the need for more objectives and skills, they were not able to put them in the current NTPC textbooks, because the textbook examination commission only covers the formal objectives in the curriculum. As such they frequently dismiss the more activities or new materials which cover the ideal set of objectives. Therefore, textbooks, as is so often the case, are merely a reflection of the curriculum.

The NTPC is completely different from the previous applications in terms of its approaches and other components. Thus, it is clear that there is a need to introduce the NTPC to physics teachers immediately. In Turkey, there are about seven thousand physics teachers. A fundamental approach of the NTPC have been introduced with in-service training by the NTPC development commission members who are supported by the Ministry of National Education. However, since introducing studies undertaken with small groups, most of the physics teachers at present have not taken any course which explains the fundamental perspectives of the NTPC. In such a situation, it is thought that a teacher's guide book consisting of explanations on fundamental perspectives and alternative activities which facilitates the adaptation process of physics teachers should be prepared to increase teachers' beliefs regarding the applicability of the NTPC.

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Notes

Note 1. Turkish school system has two frames as elementary (1st to 8th grades) and secondary (1st to 4th grades).

Note 2. The first researcher worked as one of the textbook writers in the Physics Textbooks Writing Commission, and the second researcher has been worked as the editor of textbooks in this commission.

Note 3. Knowledge objectives for the example are given below.

· Students explain adhesion and cohesion by giving examples.

· Students explain surface tension by giving examples.

· Students explain capillarity in terms of adhesion and cohesion by giving examples.