Context-Based Comparative Analysis of Turkish Physics Curriculum of Republic Period

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Abstract
In this study, changes occurring in the content of the applied physics courses curriculum in Turkey since the declaration of Turkish Republic until today are intended to be comparatively analyzed. The study is different from similar studies in terms of extent and content. It is thought that it will be a descriptive source which shows the contents of all physics courses in the Republican period. The data for the study were collected by the document analysis technique which is one of the data collection tools in qualitative research. In Republic Period, Physics was lectured as an individual course not only in high school but also in 7th and 8th-grade curricula. Therefore, in the study, the curricula of the physics courses of middle schools in 1930, 1938 and 1951, and high schools in 1934, 1938, 1952, 1985, 1992, 1997, 2007, 2013 and 2017 were examined. According to the findings obtained from the study, it was determined that the content creation concept was not included in the physics lesson curriculum in the historical process. Due to this deficiency, it was seen that the content was increased in some curricula and reduced by removing from others. In line with the results obtained from the study, it is suggested for the researchers, planning to carry out a study on the same subject, to analyze the reflection of physics topics on the textbooks, as well as carrying out a comparative-analysis on physics curricula in terms of assessment and evaluation.
Keywords: Physics curriculum, physics course, curriculum development, content comparison.

INTRODUCTION

With scientific and technological developments, it can be said that social, cultural, economic, political and environmental changes are reflected on educational policies under the influence of social expectations and needs. The reflections on the education policies lead the curricula to be changed and updated (American Association for the Advancement of Science (AAAS) (1990, 1993); National Research Council (NRC) (1996, 2007); National Science Teacher Association (NSTA) (2003, 2012); Next Generation Science Standard (NGSS) (2013)). Education is recognized as a continuous process by the society, which brings in the idea that it is a must for this process to evaluate today's world accurately, thus making more solid and coherent predictions. In this context, it is underlined that rapid development, change and transformation of information and informatics force societies to change their political, economic, social and other respective factors, and it is achievable to keep pace with an effective power, which, in present case, is education (Nalçaci, 2001; Demirtaş & Yağbasan, 2005).

Gözütok (2003) states that the system of education comprises three elements: student, teacher, and curriculum. Demirtaş and Yağbasan (2005) mention that the changes in information, along with being transmitted to the society, is performed via curricula that are evaluated within the scope of educational activities and drawn up in written form. In a study carried out by Yazıcı (1994), it is mentioned that the struggle to educate people in developed countries under today's conditions is reflected our country, thus affecting and forming the innovative studies in education. Dindar and Taneri (2001) stated that it is ensured for the students to be aware of innovative developments via education provided based on the curricula.

In Turkey, studies on developing and updating the curricula have been carried out by either the committee or in line with the reports of international experts. Today, the development, amendment and update studies of curricula are carried out by the Turkish Board of the Ministry of National Education (MoE).

Demirel (2013) stated that curriculum development is a dynamic process, including certain interactive elements like aim, content, educational status, assessment, and evaluation. Therefore, it is possible to expect that the change of an element would affect the entire curriculum. Physics topics, as one of the disciplines in life sciences, are substantially affected by the rapid changes in science and technology, due to being closely related to daily life. Hence, the objective of this study is to identify the changes in the context of physics curriculum by comparing the topics that have been taught since the proclamation of the Republic.

It is noted that the number of studies, which were carried out on physics curricula via the comparative-analysis technique, is quite limited in Turkey. Similarly, the number of such studies, carried out specifically on Physics curricula, is unsatisfactory within the scope of international literature, either. In our study, you can see a comparative-analysis on the Physics curricula, which was applied in Turkey's Republic Period. Within this context, the challenges, being experienced while teaching physics (Akdeniz & Karamustafaoğlu, 2003; Aycan & Yumuşak, 2003; Doğan, Oruncak & Günbayı, 2003; Karakuyu, 2008), opinions of teachers and academic members (Arslan, Ercan & Tekbıyık, 2012; Ayvacı, 2010; Ayvacı, Bebek, Özbek & Yamak 2015; Ergin, İngeç & Şafak, 2011; Ertem & Gökalp, 2016; Tortop, 2012) on curricula in terms of certain variables and analysis of the physics curriculum activities for 2007 and 2013 are set forth concerning (Kavcar & Erdem, 2017) the physics curricula in the study. There are also studies where the physics curricula are analyzed by researchers, yet without comparison (Koca & Şimşek, 2001; Yazıcı, 1994). It is thought that this study, comparing the physics curricula in terms of the contexts from the Republic period to date, will contribute to the literature, thus being used as a resource for curriculum developers on physics and life sciences.

METHOD

Research Model

This study has been carried out using the document analysis technique, as one of the qualitative research methods. According to Yıldırım and Şimşek (2016), qualitative research can be described as follows: "A research, where certain qualitative data collection methods like observation, interview, and document analysis are used, following a qualitative process for setting forth the perceptions and events on a realistic and integrative form in its nature.". Document analysis, on the other hand, is the analysis of oral, written or visual data based on categories that are connected to the research subject (Silverman, 2006).

Data Collection

Based on the objective of this study, the secondary school physics curricula for the years 1930, 1938, 1951 and high school physics curricula for the years 1934, 1938, 1952, 1985, 1992, 1997, 2007, 2013, 2017, applied throughout the Republic Period, have been examined. In Table 1, you can see the data source of the documents used in this study, along with the details on where these documents have been obtained from. As can be seen in Table 1, physics was lectured not only in high school but also in 7^{th} and 8^{th} grades, as well. Therefore, physics from 1930, 1938 and 1951 curricula for secondary school are used as the sample of the study. Additionally, physics curricula were prepared by governmental institutions, upon which were decided to be applied as per Turkey's constitution across the country.

Considering that physics curricula are official documents, up-to-date curricula were accessed, including the curricula that are currently applied – through official websites. In short, access to the respective documents was fulfilled via true resources. Making use of official websites for accessing the official documents, which are true and correct, renders them valid and more reliable. Knowledge and experience of 3 instructors and 2 developers, has published articles on the respective subject in peer-reviewed journals, were utilized for the validity and reliability of the study. We worked in cooperation with these experts for identifying the stages of document analysis process, making the required corrections in line with the agreed points following the comparative-analyses on curricula, which, as a matter of fact, makes the preferred analysis technique serve as a model for interdisciplinary studies (Altheide, 2000; Bowen, 2009; Patton, 1990; Yıldırım & Şimşek, 2016).

Table 1. *The documents used as samples in the study*

Curriculum for Physics		*Data Resource*	*Obtained From*
Sec. S	*High S*		
1930		Board of Education 1930 Secondary School Curriculum	MoE Department of Publications – Archive Library
1938		Ministry of Culture 1938 Secondary School Curriculum	MoE Department of Publications – Archive Library
1951		MoE 1951 Sec. School Curriculum	MoE Department of Publications – Archive Library
	1934	Board of Education 1934 High school Curriculum	MoE Department of Publications – Archive Library
	1938	Ministry of Culture 1938 High school Curriculum	MoE Department of Publications – Archive Library
	1952	MoE 1952 High school Curriculum	MoE Department of Publications – Archive Library
	1985	MoE & Ministry of Youth and Sports 1987 High school Curriculum	MoE Department of Publications – Archive Library
	1992	9-11th grades Physics Curriculum	MoE 1992 Journal of Notices 55/2359
	2007	9 - 12th Grades Curriculum	Head Council of Education and Morality
	2013	9 - 12th Grades Curriculum	Head Council of Education and Morality Website
	2017	9 - 12th Grades Curriculum	MoE Curricula Website

Data Analysis

Bogdan and Biklen (2007) describe data analysis in qualitative research as a process, where the data is regulated and categorized, and arranged in a manner to find the answers of sub-problems, and where the researcher decides on the type of information to be used.

Miles and Huberman (1994) approach the data analysis process in qualitative research under three stages. In the first stage, the data collected with the document analysis technique is to be simplified, reduced and sorted out in line with the sub-problems. The second stage is described as a section where the visualization is carried out, which is thought to have the ability to render the simplified data more convenient for the readers to comprehend. In the visualization process, the authors underlined that graphics, tables, and figures can be used. The third and last stage is where the research is concluded. Data analysis of our study was carried out in line with the method by Miles and Huberman (1994) as above stated. The data, collected with document analysis in the study, was visualized with tables, along with the comparisons.

FINDINGS

The findings, obtained in line with the purpose of the research, are analyzed under two categories: secondary school and high school.

Physics Curricula in the Republic Period

The secondary school physics topics from the Republic period were applied for 7th and 8th-grade students in the physics curricula of 1930, 1938 and 1951. However, the topics were not involved in the physics contents in 1930 and 1938 curricula, but rather being stated in written form. Therefore, physics topics comparison of the following curricula can be seen in a more detailed manner in Table 2 and 3.

Table 2. *1930, 1938 and 1951 Physics Curricula for 7th Grade*

1930 Curriculum	*1938 Curriculum*	*1951 Curriculum*
Gravity-weight, slope - plane, the angle between the plump lines of two distant points **Center of gravity**-experimental information, balance conditions of hanged objects. **Force**- Direction, application point, impact. The weighing method with old tools: spring scale. Metric system (concept and application). Solid and fluid objects' volume with metric containers. Pressure on the solid object areas. Single pressure, traditional patterns. The balance of solids and gases. Pressure and traditional patterns effecting on a wall, where the free surfaces of solids are horizontal, and common surfaces of two solids that are not mixed in a single container. Testing process. **Archimedes law**- experimental proof, floating objects. Air pressure, barometer, change of air pressure with altitude, old manometers. Description of Boyle-Mariotte law, traditional patterns. Gases and water pump. Heat, temperature, mercuric and spirituous thermometers. Centigrade method, thermostatic objects, testing procedures. Heating level, measuring the heating level, information specific to heating, results of heating water. Melting, melting temperature, rigidification. Evaporation; heating water in a closed container, steam-boilers, Change of water vapor pressure with temperature within the boilers. Fundamental details on evaporation, information on the process and its power, traditional patterns, information on the strength of machinery used in industry, traditional patterns, information about the strength of machinery used in the industry. Boiling, change of boiling temperature with pressure, distillation, availability of water vapor in the air, along with the corresponding events. Evolvement and testing of heating.	Three states of matter, stereometry, fragmentation, weight and measurement of matter, specific gravity and determination. Force, the concentration of forces, the center of gravity, balance and balance types, friction. Definition of work, respective details, simple machinery Transmission of pressure by fluids, hydraulic press, the pressure of fluids, communicating vessels, ascending force of fluids, capillarity actions. Pressure and measuring a gas, open air pressure and measuring, mariotte law, water pumps, flusher, gas pumps, balloon, and plane. Temperature source, thermometer, solid, liquid and gas expansion, measurement and amount of light, melting, evaporation, short information on meteorology, radiation of light. Sound and generation of it, specifications, sound-generation tools, phonograph, throat, and ear.	**Physics topic, units**-Physics starts with measuring; length, surface, volume units, measuring with these units; weight unit, weighing, double scale, spring scale; timescale, measuring time; density. **Force, work and energy**-Force, unit, quantity of force; intersecting forces, parallel edge pattern, resultant of parallel forces, center of gravity, balance types of an object; work; motion, force on motion; friction force; potential, kinetic, and mechanical energy, conservation of energy. **Simple machinery**-Simple machine; rope, bar; spools and hoist; winding wheel, weighbridge, trolley; gear wheel; inclined plane. **Mechanical specifications of matter**-Flexibility and durability of solids; flexibility of fluids, pressure transmissibility capacity, hydraulic press; specific pressures of liquids; fluid flanks are a plane; communicating vessels; water systems of cities, water installations of houses, tap structure; Archimedes' principle, floating, ships, submarines, aerometers; streams, water wheel, hydraulic turbine, importance of streams. **Specifications of gases**- Weight, volume and density measuring of gases; gas pressure, pressure unit, pressure measurement; open air pressure; Torricelli experiment, barometers, weather forecast, winds, making use of wind; marriote law, pumps; Archimedes law. **Heating**-Heating; heating and temperature, thermometers; expansion of solids, fluids, and gases; temperatures of objects. **Heat dissipation**-Heat dissipation; convection of heat, heating units, hot and cold winds; the furnaces; heat dissipation; transmission of heat, solutions on heat preservation; heat dissipation. **State change of matter**-Melting of solids and melting temperature, b) freezing; boiling; condensation; evaporation; distilled water; boiling, pressure cooker, drying oven, pressurized braiser; saturation, humidity, humidity measurement, humidity for living creatures. **Heat energy and work**-Generating heat with mechanical energy, heat for work; converting heat into work, importance and service of evaporation machinery; steam engine, steam wheel; internal combustion engines and importance.

Table 3. *1930, 1938 and 1951 Physics Curricula for 8th Grade*

1930 Curriculum	*1938 Curriculum*	*1951 Curriculum*
Sound, nature, and characteristics of sound. Light, Direct radiation of light, shadow, semi-shadow Plane mirror: Reflection laws and details on reflection, Experiments, lenses (completely on experimental basis) flow of rays, actual and external visions. Eye**,** Myopic, hypermetropic, Presbyopia eyes -, concise details on microscope and telescope. Photograph, cinematograph where the White light is ink Magnet: magnets, magnet types, experimental description of the magnetic area, force lines, magnetic gravity, compass, and testing procedures. Objectives and units of work and force, measuring, practices, Electrics, Occurrence of electric flow, products, transmissions, nominative cases, simple details on electrolyzing, description and units of electrics amount and flow power. Batteries (Fery, Laclanehe, Daniell batteries), brief information on accumulators. Magnetic area of an electric flow, bobbin magnet, electrical experiment, amperemeter, information on strength, Unit of strength, information and electrical force stimulants. Ohm law. Voltmeter, joule law, illumination, and heat-testing. Effect of magnetism on electricity. Induction, magneticity, dynamo, electrification.	Radiation of light, the speed of light, reflection law, the image on a plane mirror, refraction law, reflection as a whole, prism, segregation of White light, images on lenses, eyes, glasses, lighting tools. Magnets, magnetization, magnetic force lines, the magnetization of gravity. General information on electric flow, potential electric energy, positive and negative electric, condensers, electrification with friction and mechanics, lightning rod, batteries, connections, flow direction and galvanometer, electrolyze and coating, accumulator, heating, and lighting with electricity. Magnetic area of electric flow, electromagnet, bell, telegram, the effect of magnetic area on current, gauges. Electric motor, the resistance of a conductor, Ohm law, flow rate and measuring the difference of potential energy, induction, induction spool and the user instruction, phone. Steam engines, blast motor, dynamo, alternative current and alternative variance. General information on energy	**Sound-**Characteristics of sound; propagation; reflection; sound generating; the gramophone. **Light-** Our light sources, along with a practical comparison of them; linear radiation of light, shadow; reflection of light, fragmented reflection, the lighting of halls, direct and indirect lighting; concave and convex mirrors, places of use, actual and external images. **Refraction of light-**Refraction; light prism and color segmentation; lenses and external & original images through the lens; eye defects, corercting eye defects; magnifying glass, camera, microscope, telescope, cinematography. **Magnetism-**Natural loadstone, magnetic rod, continuous and temporal magnetism; magnets; compass; magnetism of the earth; magnetism with impact, molecular magnetism. **Electric current-**Electric producers, batteries; electric circuit, conductors and insulators; electric current, batteries and electromotor force; transmission of electric current, electric current direction; electric current strength, electrolyzing, amperemeter; accumulators; transmission of electric current through gases, **Static electricity-**Charging by friction; types of electrification; electroscope; the structure of matter and the nature of electricity; charging by contact; Condensator; electricity on conductors; lightning, thunderbolt. **Effects of electric current-**Heating on electric current; heat-equivalent of electric power; thermic gauges, electrical pressing, electric heater, fuse, electric lamp, magnetism effect of the current; magnetism effect of direct current; electricity on magnet; electromagnets, telegram, electric motor, gas motors. **Resistance of conductors-**Resistance of a conductor, resistance unit; measuring the resistance; rheostats; conditions of resistance; segregation of current; voltmeter. **Induction-**Experimental analysis of induction; induction bobine; telephone; current generator, dynamo, and alternator; short information on alternating current; transformers, transmission of electric energy; radio, telegram and telephone, audio-cinema.

It can be seen in Table 2 that the content comprises of the topics in physics lectured in 7th grade within the 1930 curriculum. The following topics are included in the curriculum: Gravity, Center of Gravity, Pressure of Solids, Fluids and Gases, Archimedes Law, Boyle – Mariotte Law, Heating, Temperature, Melting, Evaporation, etc.

Examining the curriculum from 1938, the students are lectured on “Three States of Matter” in the beginning. Then the following topics are taught: Specific weight, Force, Work, Simple Machinery, Pressure, Temperature, Light and Sound, etc.

In the curriculum from 1951, a more hierarchical structure can be seen compared to the previous curricula. The topics are addressed within a certain system by being enumerated. The first topic in the curriculum from 1951 is “Topic, Units, and Measurements of Physics”. This topic had been lectured on an individual base within the previous curriculum, but here, it is addressed under a common topic, as well as providing scientific information. Similarly, the topics “Force” and “Work” had been lectured on an individual basis on the previous curricula, while being lectured under a common topic in this curriculum from 1951, by adding the topic “Energy”, which was seen for the first time on 7th grade level. Additionally, “Mechanical Specifications of Matter” and “Specifications of Gases” can be cited as contently examples for 7thgrade students. The topics for 8th grade, as the continuance of 7th-grade physics topics, can be seen in Table 3.

In table 3, you can see the physics topics in the 1930, 1938 and 1951 curricula for students in 8th grade. It can be seen that the curriculum from 1930 comprises the topics like Sound, Light, Plane Mirror, Magnetism, Work and Force, Electricity and Batteries, while the curriculum from 1938 comprises Light, Lenses, Magnets, Electric current, Magnetic area, and Energy. In the curriculum from 1951, the topics are expressed under a more detailed and systematic manner compared to the curricula from 1930 and 1938. For example, “Electrics” is under a single topic within the curricula from 1930 and 1938, while it is categorized under “Electric Current”, “Static Electric”, “Effects of Electric Current”, “Resistance of Conductors” and “Induction in the curriculum from 1951.

It can also be seen from the physics topics in the curriculum from 1930 for 8th-grade students that the lessons are interrelated to each other. In this context, “Short Information about Eye”, as a topic of biology, can be seen under the topic “Plane Mirror”.

Based on the physics topics from 1930, 1938 and 1951 curricula, it can be seen that the students are required to carry out research and application practices; particularly in the curriculum from 1930. For example, the topic “Lenses” involves an instruction, which goes as “Completely on an experimental basis.”. Additionally, we also see the instruction “Experiments (Testing Procedures) under the topics Magnetism, Ohm Law and Induction. However, it can be recognized as a deficiency in the curriculum from 1930 for both 7th and 8th grades that the topic “Energy” is not involved in any shape or form. As can be understood from the 1930, 1938 and 1951 curricula, the topics for students in 7th and 8th grades are interchanged between the school years. For example, the topic “Sound” is under 8th grade in the curriculum from 1930, while it is under 7th grade in curriculum from 1938, and 8th grade in the curriculum from 1951. Moreover, the topic “Solids’ pressure” is involved in 1930 and 1951 curricula, while it is not involved in 1938.

Republic Period and Current Physics Curricula

Comparison of topics in physics curriculum from the Republic period can be seen in Table 4, 5, 6, and 7 as per the class levels.

Table 4. *Comparison of the topics in the 9th grade Physics Curricula*

1934	Various states of matter, force, measuring, dynamometers, work and energy, units of force, work, and energy, protection law of work, spool, heaver, slope, plane, winding wheel, force of gravity, direction, strength, and center of gravity, matter and mass, density, pressure, heating, temperature, pressurization capacity of gases, melting, water vapor in the air.
1938	Absolute scales system, heating, the state change of matter, water balance, geometrical optics.
1985/1992	Measuring and unit systems, force, motion, newton's motion laws, motion on earth, impulse and momentum, energy.
2007	Nature of physics, matter and its specifications, force and motion, energy, electrics and magnetism, waves.
2013	Introduction to physics, matter and its specifications, force and motion, energy, heat and temperature.
2017	Introduction to physics, matter and its specifications, force and motion, energy, heat and temperature, electrostatics.

As can be seen in Table 4, the physics topics for 9th grade from 1934 curriculum topics are a follow-up of the secondary school curriculum from 1930 as stated in Table 2 and 3. The content in 1934 curriculum was constituted by listing the topics. In the curriculum, an interdisciplinary relation can be seen based on the geographic topic "Clouds Movements, Precipitation Types, Climate and Windows" under the topic "Water Vapor in the Air".

The content of physics curriculum from 1938 for 9th grade was simplified compared to the 1394 curriculum with new concepts. In fact, there are only 5 topics for topics in the curriculum for 1938. What stands out in this curriculum is that the topic "Absolute Scales System", comprising of information on measuring & scales, is the beginning topic. Additionally, it involves the topics "Water Balance" and Geometrical Optics" as different from 1934 curriculum. The topic "Water Balance" involves information on Pressure of Fluids, Archimedes Law and Pressure of Gases. It is seen that it was the first time the topic "Geometrical Optics" was lectured in 9th grade. This topic comprises the Lightspeed, Reflection Law, Structure of Mirrors and Lenses.

In 1952 curriculum, the high school education was extended 4 years, not involving physics for 9th grade. Between 1938 and 1985 curricula, radical changes can be seen in the curriculum. In 1938 curriculum, the topic "Force and Motion" was not involved for 9th grade, while it was addressed under 5 separate topics as follows: Force, Motion, Newton's Motion Law, Motion on earth, Impulse and Momentum. Moreover, the topic "Energy" was included in 1985 for the first time on 9th grade. Similarly, it was the first time for the following topics to be involved in a curriculum within the curriculum from 1985: Vectors, Moment, Steady Motion, Acceleration, Friction Laws, Inertia, Freefall, Projectile motion, Rotational motion, Newton laws, Kepler's laws, Harmonic motion, Impulse, Momentum, Kinetic Energy, Potential Energy and Preservation of Energy.

In 1992 curriculum, the physics topics were published without any change in the 1985 curriculum for 9th grade. In 2007 curriculum new topics were added to the physics curricula from 1985 and 1992 while gathering similar topics under the same topic. For example, the topics "Force and Motion", which were gathered under 5 separate topics in curricula from 1985 and 1992, were addressed as a single topic as "Force and Motion" in 2007 curriculum. Moreover, it is noted that the fundamental topics of physics like "Matter and its specifications", "Electrics and Magnetism" and "Waves", which were not involved in 1934, 1938, 1985 and

1992 curricula, were involved in a manner correlating with our daily lives. However, it can be seen as a deficiency for this curriculum not to involve the topic "Heat and Temperature".

"Nature of Physics" stands out within the physics topics from 2007 curriculum. In fact, the students are lectured on the occupation field of physics, observation, and experiments, using mathematics in physics, the relation of physics with daily life and technological developments with the sub-topics within this unit.

It can be seen that the physics topics for 9th grade were reduced more in the 2013 curriculum compared to 2007. In this context, the units "Electrics and Magnetism" and "Waves" were removed from the program but adding the unit "Heat and Temperature" which, as a matter of fact, is simpler by nature. Additionally, the unit "Nature of Physics" from 2007 curriculum, was replaced with "Introduction to Physics", which is contextually similar, in the curriculum from 2013.

It can also be seen that the physics topics for 9th grade are the same, including the teaching order, in 2017 curriculum, and that the topic "Electrostatics" was added as different from 2013 curriculum. This was the first time this topic was included in the physics curriculum for 9th grade. Physics topics for 10th grade in the Republic Period are given with the comparison of curricula in Table 5.

Table 5. *Comparison of the topics in the 10th grade physics curricula*

1934	Light, magnetism, repeating the units of work and energy, electricity.
1938	Geometrical optics, magnetism, electricity, electric current.
1985/1992	Units and measurement, mechanics of steady solids, mass and weight, work and energy, properties of static fluids (hydrostatics), properties of static gases, heat, expansion of objects via heating, heating and measurement, heat and work, state change of matters, heat dissipation, meteorology.
2007	Magnetism, electrostatics, electric current, electromagnetic induction, light.
2013	Matter and its properties, force and motion, electrics, modern physics, waves.
2017	Pressure and buoyancy force, electrics and magnetism, waves, optics.
2018	Electricity and magnetism, pressure and buoyancy force, waves, optics

As can be seen in Table 5, the topics for 10th grade in 1934, 1938 and 2007 curricula indicate that the integrative principle was intended between the school years (MoE, 2007). For example, the topic "Repeating the Units of Work and Energy" in 10th grade, as can be seen in Table 5i is the follow-up of the topic "Work and Energy" for 9th grade in 1934 curriculum within Table 4; and the topic "Geometrical Optics Cont'd" for 10th grade in Table 5 is the follow-up of the topic "Geometrical Optics" for 9th grade in 1934 curriculum within Table 4, similarly. In 2007 curriculum, it can be seen that the topic "Matter and its specifications" is included both for 9th and 10th grade.

It is seen that the physics topics for 10th grade in the Republic Period were generally the same, except for 1952 curriculum. What stands out in these curricula is that the topics like "Magnetism, Optics, Electric current, and Electrics" coincide with each other. The topics for the second school year of high school in 1952 curriculum were not included for 9th grade since the high school education was extended to 4 years. Therefore, the students were lectured on physics, along with the physics topics in 9th grade, for the time in 10th grade within the scope of the 1952 curriculum. Additionally, department choice was first introduced with this curriculum for the 10th grade with the above-stated expression "Science Department".

It can be seen that the topics "Modern Physics" and "Waves" were first introduced for 10th grade in the 2007 curriculum. Moreover, it can also be seen that the topics from 1934, 1938, 1985 and 1992 curricula were simplified in 2007. In this context, the topics "Magnetism, Electrostatics, Electric Current and Electromagnetic Induction" which were involved under separate topics in 1982 and 1992 curricula, were gathered under the same topic "Electrics" in 2007 curriculum.

We also see that the topics are exchanged between the curricula in general, while also being added or removed. In this context, it can be seen that the topic "Modern Physics" from the 2007 curriculum was not included in the 2013 curriculum; instead, the topic "Optics" was added. What also stands out that the topics in 2017 curriculum are almost the same with those from the 2013 curriculum, with minor changes on the lecturing order. The topics that lectured for the 11th year in the Republic Period can be seen as compared with the contents specified in Table 6.

Table 6. *Comparison of 11th year topics in the Physics Curricula*

1934	*Science Department*: Gravity force and availability of general gravity, g value and variability energy, allocation of gases, measurement units, general information on vibration motions, sound events, light events, electrics events *Literature Department*: force, heating machinery, physiological characteristics of sound, electricity
1938	*Science Department*: Kinetics and dynamics, balance, flow of fluids, sound, nature of light literature department: general information on motion, work and energy, general information on vibration motions, nature of light
1952	Light, reflection of light, global mirrors, refraction of light, lenses, lighting tools, magnetism, electrostatics, electric current, heating effect of current, chemical effect of current, magnetic effect of electric current
1985	*Science Department*: wave motions, wave model of light, atomic theory, motions of charged particles in an electrical field, atomic nucleus, solar energy *Mathematics Department*: motions of wave, light theory, atomic theory, motions of charged particles in an electrical field, semi-conductors, atomic nucleus, solar energy
1992	*Mathematics* and *Science Department*: wave motion, light theory, atomic theory, motions of charged particles in an electrical field, atomic nucleus, solar energy
2007	Matter and its specifications, force and motion, magnetism, modern physics, waves, from stars to quasi-stellar
2013	Force and motion, electricity and magnetics
2017	Force and motion, electricity and magnetics

Examining Table 6, it can be understood that the students in the 11th grade were given the opportunity to choose a department in 1934, 1938, 1985 and 1992 curricula. Physics topics as specified in 2007, 2013 and 2017 curricula, represent the content within the elective courses for an 11th grade.

It can be seen that the topics for 11th grade in 1934 and 1938 curricula are similar yet named differently. In this context, the topics from 1934 curriculum "Gravity and Availability of General Gravity, g Value and Variability, Force, General Information on Vibration Motions are represented under the topic "Kinetics and Dynamics, Balance and Circular Motion" in 1938 curriculum. Moreover, the topics "Sound Events" and "Light Events" from 1934 curriculum were involved as "Importance of Sound and Light" in 1938 curriculum.

It can be understood that the physics topics for the 11th grade from 1938 curriculum were reduced compared to 1934 curriculum. While 1934 curriculum involves the topic "Electrics", it was removed from the 1938 curriculum. It can also be understood that the physics topics for the 11th grade from 1952 curriculum bear the same structure as those for 10th grade. The reason for this matter is that the high school education was extended to 4 years in 1952 curriculum, so physics was started to be lectured in the 10th grade.

It can be seen that the physics topics for 11th grade have changed almost completely since 1985 curriculum, comprising of a more difficult structure compared to the previous curricula. In today's world, such topics like "Wave Motion, Atomic Theory, Motion of Charged Particles in Electrical Field, Atomic Nucleus and Solar Energy", which are the topics of Modern Physics" were first introduced in 1985 curriculum. In other words, the foundation of 2007, 2013 and 2017 curricula for 12th grade was laid with the physics topics for the 11th grade from 1985 curriculum. It can be seen that the physics topics from 1992 curriculum are the same with those from 1985 curriculum, with changes on the field names.

In 2007 curriculum, it can be seen that the integrative relation maintains with other grades, as previously mentioned. While this was seen in the 9th and 10th grades within the scope of 1934 and 1938 curricula, it was present in all grades for the 2007 curriculum. For example, the topics "Matter and its specifications, Force and motion, waves" are included in each and every grade within the scope of the 2007 curriculum on different content capacities. Additionally, the topics "Modern Physics" and "From Stars to Quasi Stellar" were first introduced in the 2007 curriculum. It can be understood that the 2013 and 2017 curricula were simplified in terms of their topics compared to the previous curricula. Both of these curricula comprise the topics "Force and Motion" and "Electrics and Magnetism", only.

Physics for 12th grade was lectured within 1952, 2007, 2013 and 2017 curricula. The physics topics for 12th grade is given as comparatively in Table 7.

***Table 7**. Comparison of the 12th grade topics in the physics curricula*

1952	*Science Department: M*otion, work and energy, motion, flexibility and impact, rotational motion, the resistance of liquids and gases, pendulum, newton's law of gravity, wave motion, sound, wave nature of light, induction, alternative current, transformers, current transmission from low-pressure gasses, electrical vibrations, radioactivity. *Literature Department: M*otion, work and energy, pendulum, wave motion, light, induction, alternative current, discharge inside gases, electrical vibrations
2007	Matter and its specifications, force and motion, electrics and electronics, waves, modern physics, from atoms to quarks, nature of physics
2013	Steady circular motion, simple harmonic motion, wave mechanics, introduction to atomic physics and radioactivity, modern physics, technological practices of modern physics
2017	Circular motion, simple harmonic motion, wave mechanics, introduction to atomic physics and radioactivity, modern physics, technological practices of modern physics

It can be seen in Table 7 that the topics "Matter and its specifications, Force and motion, Waves and Modern physics" were involved in the 11th grade within the 2007 curriculum. This indicates the integrative relation was preserved for 12th grade, as well. Another example is that the topic "Nature of Physics" was involved both in the 9th and 12th grades.

Examining the topics "Matter and its Specifications", "Electrics and Electronics" and "Waves", involved in 2007 curriculum, it is thought that these topics seem to be simple for 12th grade, due to bearing the same information provided for 8th-grade students. In this context, it is aimed at providing students with such information as; "*examples are given for solids, fluids, and gases, performing the best energy transfer via transmission, radiation, and convection*" and "*The required energy is calculated using the state change graphics*". Additionally, certain gains concerning the reflection of life in the topic "Waves" like "*The image formation is displayed by drawing on a plane mirror*" and concerning the refraction of light like "*The reason for light refraction is explained*" can be cited as examples to this matter.

It can be seen that the 2013 curriculum for 12th grade was addressed in a more detailed manner compared to the 2007 curriculum. Accordingly, the topics "Circular and Harmonic Motion" under the unit "Force and Motion" in 2007 curriculum can be cited as an example to this matter for it was taken under 2 separate units in 2013 curriculum. Moreover, what stands out is that the unit "Technological Practices of Modern Physics", describing the interrelation of physics and technology, today's technological developments were introduced in this curriculum for the first time.

Another difference between the 2007 and 2013 curricula is in the unit "Modern Physics". With this unit, the topics "X-rays, Structure of matter, Structure of nucleus, Radioactivity and Nuclear energy" were involved in 2007 curriculum, while involving the topics "Special Relativity, Radiation of Black Body, Photoelectrical Event, Compton Effect, De Broglie Wavelength" in 2013 curriculum.

2013 and 2017 curricula for a 12th grade can be seen under individual units within Table 7. Notwithstanding that the same unit topics were used, it was detected that the topics were addressed under a more detailed manner in 2017 curriculum. For example, while providing the gain "Inertia moment concept is described" under the topic "Rotary Displacement Motion" in 2013 curriculum, this topic is given as "It analyses the variables related to the inertia moment" within 2017 curriculum; similarly, while teaching the topic "Gravitation and Kepler Laws" in 2013 curriculum altogether, it was given under 2 separate topics as "Gravitational Force" and "Kepler Laws" in 2017 curriculum.

DISCUSSION

Physics topics for secondary school 7th and 8th-grade students in 1930, 1938 and 1951 curricula, were constituted by being lined up on a random basis. Ertem and Gökalp (2016) stated that the physics curricula, which were organized before 2005, comprise solely topic headings. However, requiring the students to carry out research or application in certain physics topics within 1930 curriculum rendered this curriculum different from others. Examining 1938 and 1951 curricula, no such approach was detected. Additionally, the topics in 1938 and 1951 curricula ensured that the students, graduating from secondary school, were provided with fundamental topics of physics by being allocated to 7th and 8th grades. But in 1930 and 1938 secondary school curricula, no information on the topic "Energy" was included, which is one of the fundamental topics of physics.

On the other hand, it can be seen that the physics topics for 7th and 8th-grade students were exchanged between 1930, 1938 and 1951 curricula based on the class levels. For example, the topics "Sound" for 8th grade in 1930 curriculum was included for 7th grade in 1938 curriculum, while being included for 8th grade in 1951 curriculum. Similarly, the topic "Pressure of Solids" was included in the 1930 curriculum, while being removed from the 1938 curriculum, then being re-added in 1951 curriculum. Based on this data, it can be seen that adding & removing topics in & from curricula is a general approach in creating the curricula, which is maintained in the present time, as well. Özcan and Düzgünoğlu (2017) mentioned in their studies that the topics, which are intended to be included in the updated curricula, were ensured to be addressed by adding & removing topics between curricula.

MoE (2007) stated that the first development & application studies for physics curricula in our country were first initiated in 1934 and that a number of curricula were created after this process yet is limited to the listing up of topic headings.

Examining within this context, the physics topics on secondary school level were recognized as preparatory for an upper level, thus being addressed within a tight correlation between the secondary school and high school. The following statement from 1952 curriculum supports this idea: "Since almost each and every unit of the physics curriculum was lectured in secondary school on the same level, an explanatory remark, which goes as "repeated", was added to the topic names" (MV, 1952). Additionally, considering that the students had learned the respective topics, yet forgot them, it was stated that repeating the topics learned from the secondary schools would be recognized as a facilitator for correlating the same with the new topics to be learned in the first and second school years of high school. However, while it was a must for the high school students in the 9^{th} and 10^{th} grades to learn the new physics topics based on the previously learned topics, no further steps were taken apart from repeating the topics, which were already learned in the secondary school. This supports the idea that the physics topics, included in the curricula until 1968, were not suitable for the students, considering their advanced levels.

The topics in the physics curricula for high school were constituted via adding & removing and exchanging in & from and between the programs based on the class levels and from past to date within the same class until 1985 curriculum. However, such topics like "Wave Motion, Atomic Theory, Motion of Charged Particles in Electrical Field, Atomic Nucleus and Solar Energy", which were recognized as the topics of modern physics, comprising today's technological development information were included in 1985 curriculum by means of adding topics. In the same time, these topics were included in 2007, 2013 and 2017 curricula, as well.

Extending the high school education from 3 years to 4 in 2005, the high school physics curriculum, which had been applied for more than 20 years, was substituted with 2007 curriculum, which was organized based on 2005 secondary school science and technology curriculum. The integrative approach in the curriculum of "science and technology" was stated to have been confirmed for the 2007 physics curriculum, as well. However, this integrative approach, adopted within the 2007 curriculum, was not only between the high school grades but also with the secondary school lesson "science and technology". Additionally, recognizing the topics in 2007 curriculum to be a continuance of the lesson "science and technology" might lead the physics to be comprehended easily. Yet, the topics like "Matter and its specifications", "Electrics and Electronics" and "Waves display a resemblance to the physics units for secondary school 8^{th} grade.

Similarly, it was stated in the 2007 curriculum that the physics lesson was lectured for all the students in 9^{th} grade (first school year of high school), due to be a shared lesson. Therefore, topics, which are essential for each individual and which can be related to our lives, were preferred, unlike other class levels, in the 9^{th} grade. However, it can be defined as a deficiency for this curriculum to not involve the topic "Heat and Temperature", which is one of the fundamental topics of physics, as well as being closely related to our lives. In fact, some of the students not being subjected to physics lesson after 9^{th} grade can be inferred as that they will not have any high-school level information on this matter. It may be thought that deficiencies within the curriculum contents are caused by the approach to create curriculum contents.

As previously stated, the physics topics in 2007 curriculum are easier to comprehend compared with those in previous curricula. Similarly, Aycan and Yumuşak (2003) placed these physics topics in the lower tier while listing the topics, in which the students have difficulty while learning. Considering that it was deemed required for students to be provided with the knowledge and skills they would need in university education within the scope of 2013 curriculum, it was mentioned that the topics were rendered to be more difficult and comprehensive (MoE, 2013). However, Kavcar and Erdem (2017) stated that the unit "Modern Physics" was challenging for students to understand due to involving a number of abstract concepts. Similarly, Aycan and Yumuşak (2003) suggested that these topics are at the top place of the list of those, for which the student have difficulty in learning. Moreover, considering the physics topics for 12^{th} grade in the 2013 curriculum, it can be seen that it is more detailed compared to the 2007 curriculum.

In 2007 physics curriculum, the nature of science was recognized as an innovation. Physics lesson is expected to be integrated into scientific information due to its practices, as well as involving such conceptions. In this context, nature of science was first introduced under two separate complementary units as "Nature of Physics" within physics, by being listed within physics topics, in 2007 physics curriculum of 9th and 12th grade. In the 2013 curriculum, the students were expected to understand the nature of science, as one of the objectives of physics lesson (MoE, 2013). In line with this, the topic "Introduction to Physics", comprising of the nature of science" is included in the 2013 curriculum for 9th grade.

It was noted that the topics that were planned to be taught to students were changed while shifting from 2007 physics curriculum to 2013. It can also be seen that this approach was applied in 2013 and 2017 curricula, as well. It can be understood that the topics, which were projected to be taught to students in the first and second school year of high school, adding, exchanging or removing were applied, as specified in the findings. Koca and Şimşek (2001) suggested that the topics until that period were inadequate, thus requiring certain new topics to be added to the curriculum.

While preparing the curricula, it is a must for the topics to possess the vision for meeting the skill and equipment needs of today's world within the scope of their contents. Rendering the content in curricula as well-directed depends on having a strong vision (Güzel and Karadağ, 2013). Therefore, the curricula are updated in line with the needs of that time once every five years (MoE, 2007). Where the contents of curricula are not capable of meeting the necessities of our time, it is a must for the curricula to be updated. However, having differences displayed in almost all levels within the scope of the topics of physics curriculum is one of the most significant findings of the study. Comparing the physics curricula, which were applied since the proclamation of the Republic to date, it can be inferred that the content creation approaches are not satisfactory. Due to the lack of a competent approach, the things that were done on the curricula under the name "developing, changing, renewing or updating, are nothing but adding & removing topics.

For eliminating the above-stated deficiencies, we suggest the followings:

- Topic headings like "Nature of Physics, Matter and its Specifications, Force and Motion, Energy, Light and Sound, Electrics, Heat, and Temperature" should be specified particularly for 9th-grade students by the respective experts. In the 12th grade, "current issues", involving developments on physics around the world and which are to be updated on an annual basis should be included, along with the topic matter knowledge. In this way, the developments in physics would be followed-up not only by teachers but also the students.
- It can be seen that the physics topics were addressed under a detailed manner in 2007 physics curriculum, while the contents in 2013 and 2017 curricula have been simplified. Detailed expression of contents enlarges the limits, but simplifying may also lead to differences. A certain method is to be constituted by the respective experts on this matter.
- Where the physics topics are addressed on an individual basis as in 1930, 1938 and 1951 secondary school curricula, it is thought that it would be easier to correlate between the topics in high school, thus ensuring coherence between the secondary school and high school. Otherwise, the students would not grow an awareness of the lesson "physics". In that, a student in 9th grade cannot constitute a special interest in any field, once he/she is provided with physics along with the lessons "biology and chemistry" under the name of "life sciences".

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