AN ASSESSMENT OF
HIGH SCHOOL BIOLOGY CURRICULUM IMPLEMENTATION

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This is to certify that we read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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ABSTRACT

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This study was conducted to investigate and assess the implementation process of the new high school biology curriculum. The major areas in the study included teaching methods and techniques, and instructional materials physical structure and facilities, and local, school and classroom level factors that influence the process of curriculum implementation. The research questions were the following: 1) How are the curriculum intentions implemented in biology classes? 2) What local, school and classroom level factors influence the implementation process of the new high school biology curriculum? A survey questionnaire, Biology Curriculum and Instruction Evaluation Questionnaire, was designed. The data collected from randomly selected 685 biology teachers working in public, Anatolian and private/foundation schools in fifteen cities were then analyzed through descriptive and inferential statistics, and qualitative data analysis techniques.

The results revealed that the implementation process of the new high school biology curriculum shows differences at local, school and classroom levels. These differences rely on the physical structure and facilities of schools, some teacher characteristics and some teacher beliefs and perceptions. Yet, one common feature in all these different conditions is the attention called to the need for a change from learning being teacher-centered to student-centered teaching and learning process and the need to revise curriculum content and timing for its implementation.

Keywords: biology teaching, curriculum implementation, teacher characteristics, teacher beliefs and perceptions

ÖZ

LİSE BİYOLOJİ ÖĞRETİM PROGRAMININ UYGULAMA SÜRECİNİN BELLİ FAKTÖRLERE GÖRE DEĞERLENDİRİLMESİ

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Bu çalışma yeni lise biyoloji öğretim programının biyoloji sınıflarında uygulama sürecini araştırmak amacıyla gerçekleştirilmiştir. Çalışmada dersler sırasında kullanılan öğretim yöntem ve teknikleri ve öğretim araç gereçleri, okulların fiziksel koşul ve olanakları ve programın uygulanışını bölgesel, okul ve sınıf düzeyinde etkileyen faktörler incelenmiştir. Çalışmaya yön veren araştırma soruları şöyledir: 1) Öğretim programının hedefleri biyoloji sınıflarında nasıl uygulanmaktadır? 2) Yeni lise biyoloji öğretim programının uygulanmasında etkili olan bölge, okul ve sınıf düzeyindeki faktörler nelerdir? Bu çerçevede veri toplamak üzere bir anket, Biyoloji Programı ve Öğretimi Değerlendirme Anketi, geliştirilmiş ve uygulanmıştır. Seçkisiz örnekleme yöntemiyle belirlenen onbeş ildeki devlet, özel/vakıf ve Anadolu liselerinde çalışmakta olan 685 öğretmenden toplanan veriler betimleyici ve yordayıcı istatistiki yöntemler ve nitel veri analizi teknikleri ile çözümlenmiştir.

Çalışma sonuçları yeni lise biyoloji dersi öğretim programının uygulama sürecinde bölge, okul ve sınıf düzeyinde farklılıklar olduğunu göstermiştir. Bu farklılıklar okulların fiziksel koşul ve olanakları, öğretmenlerin yaş, cinsiyet, öğretmenlik deneyimi ve hizmet içi eğitim programlarına katılımları gibi bir takım özellikleri ve onların biyoloji eğitimi, yeni öğretim programı ve öğrencileriyle ilgili görüş ve algılarından kaynaklanmaktadır. Bununla birlikte, tüm bu farklılıkların ortak özelliği olarak öğrenmenin öğretmen merkezlilikten öğrenci merkezliliğe dönüşmesi ve öğretim programı içeriğinin ve programın uygulanışı için belirlenen sürenin tekrar gözden geçirilmesi gerekmektedir.

Anahtar Kelimeler: biyoloji öğretimi, öğretim programı uygulaması, öğretmen özellikleri, öğretmen görüşleri

To My Parents

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CHAPTER 1

INTRODUCTION

Sometimes people do not succeed in changing even though they spend a great deal of time trying to do so. They do different things that they believe are new but the same old habits under-pin their actions. For example, in the area of science education numerous attempts have been made to bring change into the way science is taught (Davis, 2002). There have been many proposals for remodeling science teaching in various countries with a wide consensus regarding the need to adapt the constructivist view of learning (Sanchez and Valcarcel, 1999). First the curriculum, what is taught, was changed, then the focus was on teaching methods, then on making existing courses more rigorous, the school day and year was lengthened, class size was reduced, more homework was demanded, high school graduation requirements were increased, discipline standards were improved (De Jong, 2000; Hurd, 2000). However, the success of all these changing policies has been less than what was desired. In spite of the intensive call for instructional reform, there has been little actual change (Davis, 2002). The large amounts of money committed to curriculum development and to the production of new materials for the classroom have not brought about major changes in what students learn or how teachers teach (Bushnell 1970; De Rose 1978; Hinze 1977; Maloy and Jones 1987; Rhodes and Young 1981, cited in Scott, 1994).

Davis (2002) reports “traditional lecture-textbook methodologies” as the continuous focus of science instruction, and that in traditionally teacher-centered classrooms students have little status and voice regarding how they learn and what happens in the classroom. Similarly, Zohar, Degani and Vaaknin (2001) describe science classrooms as places where teachers still transmit knowledge and cover curriculum rather than guide students as they think and construct their own ways of learning.

Penick's (1995) review of previous science education research has also shown that although most of the science education reforms start with curricular changes that are intended to permit teachers to create rich learning contexts where students are challenged to become skillful thinkers and problem solvers, to work together, be creative, apply what they learn to their needs, and be flexible and adaptable to changes and discoveries (Davis, 2002), teachers continue doing what they have always done. For instance, the Biological Sciences Curriculum Study (BSCS) began producing good quality biology books in the late 1950s. The BSCS Green version was among the most innovative textbooks of its time and is still a positive force in the field (Penick, 1995). Its innovations, such as increasing the number of laboratory activities carried out by students, soon became the norm among textbooks, but as innovative as it might be, teachers can and still do lecture straight from the book and tell students to read chapter 3 and answer the questions at the end. This method of instruction is not what is needed in biology classes because it is not the way students learn to understand biology.

As Yager (2000) says, children learn science when they are able to witness and experience "science in action." Reading about scientific concepts or having a teacher explain them is not enough. However, most high school science and mathematics classes appear to be set up for students to rote learn facts and procedures. Bobbitt-Nolen (2003) calls attention to this focus on memorization of facts and procedures and believes that they might mislead students into thinking of science as dry, uninteresting, and irrelevant to larger social concerns. The results of the Tobin's (1987) study also indicate that academic work in science and mathematics classes is not as demanding as what might be popularly believed or hoped. In most instances, the work is algorithmic and repetitious with an emphasis on memorizing facts and procedures, which would enable correct answers to be obtained for stereotypic problems.

Similar to Tobin, Gallagher (2000) underlies memorization, not understanding as the prominent operational goal in most science classrooms. He says that the application of science knowledge is typically virtually nonexistent in these classrooms. Review of textbooks and course-related tests developed by teachers reinforce this view. Most instruction in science focuses on helping students amass information about scientific ideas, but does not foster an understanding of these ideas, nor does it help students learn how to apply the concepts outside the school in the real world in which they live. The emphasis in most science instruction is on helping students acquire a mass of memorized facts that have come to be accepted as a fundamental basis for all scientific knowledge. Many teachers see this acquisition of facts to be essential for students to develop an understanding of a science subject. In addition it is commonly accepted that, because there is so much scientific knowledge, and because learning these "fundamentals" of science takes so much time to acquire, students and teachers really do not have the time available to apply these principles. Understanding and application are left for students to accomplish on their own – if at all.

Tobin (1987) states that the requirements of preparing students for tests and examinations shapes the content of the curriculum and the activities are planned and implemented to fulfill this need. Much time is spent filling out worksheets consisting of factual items, tests consist mainly of rote-memorization items, and laboratory time is rarely used for bona fida experiments (Gallagher and Tobin, 1987; Mittman, Mergendoller, Packer and Marchman, 1984; cited in Gallagher and Tobin, 1987; Strage and Bol 1996). Relatively, little emphasis is placed on applications of scientific knowledge in daily life or on the development of higher order thinking skills. In most instances, teachers appear to be teaching according to well-established routines, which emphasized whole class instruction and seatwork activities and are more concerned with teaching basic facts and definitions of science as given in textbooks.

Current reconceptualizations of curricular frameworks place the curriculum content in more ecologically valid contexts, making it more inquiry-based, and urging the adoption of outcomes assessment measures which tap students' abilities to engage in guided discovery activities rather than test their abilities to regurgitate rote learnt facts (Strage and Bol, 1996). Such reconceptualizations also place greater emphasis on the need to develop students' critical thinking and problem solving skills so that they will be prepared for the challenges and opportunities of the new millennium (Bower, 1991; National Education Goals Panel, 1993; Subcommittee on Technology and Competitiveness, 1992; Yager and Blosser, 1991; cited in Strage and Bol, 1996). Students will be better able to respond to the changing political and sociocultural context if they are able to integrate what is learnt in the science classroom into their daily lives.

Lumpe, Haney, and Czerniak (2000) identified the following themes in the curriculum reform recommendations and efforts.

- constructivism,
- thematic approach,
- assessment and evaluation,
- equity,
- science-technology-society,
- educational technology,
- cooperative learning,
- hands-on activities, and
- the nature of science.

These themes form the points of origin for most of the reform practices presently designed to bring about change in science education all around the world.

These new approaches in the field have also affected science education in Turkey. The subject matter of the new high school biology curriculum is related especially to health and daily life issues with the aim of getting rid of rote learning, and providing students with the ability to comprehend and relate subject matter to everyday life. Thus enabling students to be active individuals, who can experience scientific reflection and inquiry and/or interpretation. Given the detailed explanations and suggestions provided in the new curriculum, classrooms are expected to be places where learning occurs not just by hearing, but also by seeing and doing things under the guidance of teachers (Journal of Announcements of Ministry of National Education, 1998).

Although the new biology curriculum is purported to be inquiry-based in this way, the case study carried by Öztürk (1999) in the first year of nationwide implementation of this new curriculum reported little, or no evidence of inquiry on the part of students and teachers, and although the results of her study are highly context specific they support the findings of previous science education research. As Blosser (1999) underlined in her study, teaching by telling was common in most of the classrooms she observed and subjects were generally presented in a lecture mode. In most classrooms, students were required to listen to the teacher and then copy a definition or an important conclusion into their notebooks, which are not intellectually demanding activities. As Tobin (1987) concludes instruction is usually repetitious with an emphasis on memorizing facts that will enable students to give correct answers to questions and this is not very intellectually demanding. Öztürk (1999) found that the teachers participating in her study did not implement the curriculum in their classrooms in manner the curriculum was designed to be implemented. In contrast to the student-centered preference of the curriculum, instruction was teacher-centered; mostly in a lecture mode and teachers generally did not use the instructional materials that characterized the intended curriculum.

The difference between what the developer intended and what came out in the classroom in Öztürk (1999)'s study points to Roberts' (1980, cited in Munby, 1984) concept of a "theory-practice interface" in which two quiet distinct worlds; the developer's world of developer's intentions for hypothetical students, a theoretical world leading to curriculum materials for generalized use, and the teacher's world of specific teaching designed for known, real and unique students, converge (Roberts, 1980). Munby (1984) uses this concept to explain the curriculum implementation "mismatch" that the teacher sees the developer's world through his or her own perspective, so that the developer's viewpoints about aims, the nature of learning and of knowledge may not be shared by the teacher, and are thus read differently, or may not even be seen in the curriculum materials.

Waxman (2001) also mentions that the discrepancy between what a curriculum proposal means to its designers and what it means to teachers who are being asked to use it is a common and continuing problem in curriculum implementation. For him, the demise of several innovative educational programs is the result of the researchers and curriculum developers' failure to focus on the implementers' needs and concerns. He calls attention to Doyle and Ponder's (1977) concept of "ethic of practicality" to be considered in each educational program because teachers adapt rather than adopt curriculum proposals due to structural and institutional constrains. According to Waxman (2001) the culture of the school and how it interacts with the stages of curriculum change are so important that curriculum leaders have to take them into consideration in designing new curricula.

There is a need for research that pays particular attention to the curriculum implementation process if further progress is to be made in curriculum design and if instructional practices are going to be improved because the way a new curriculum is implemented determine how the desired educational objectives are obtained. There is a need to alter the individual teacher knowledge, actions and attitudes (Ornstein and Hunkins, 1998) by focusing on what happens in practice. Yet this is difficult, the required restructuring and replacement (Ornstein and Hunkins, 1998) creates dilemmas for teachers and demands that they make significant changes in their values and beliefs (Anderson and Helms, 2001). All the carefully planned opportunities to use a new curriculum as a vehicle to implement new approaches and strategies in science teaching can become a challenge, and at best an opportunity to reflect on long-held ideas and beliefs about students, learning and teaching (Davis, 2002).

There is a need for considerable thought and effort to be given to what teachers know; how this changes over time and what processes bring about change in individual teacher practices, changes that must be accompanied by long lasting changes in science classrooms (Davis, 2002). However, to deal with this need we must look at the problems that educationalists are faced when attempting to implement the desired changes in the curriculum.

According to Fullan (1997) there are two reasons why focusing on implementation is crucial to success when implementing a new curriculum, the first is that it is not possible to know what has changed (if anything) without attempting to conceptualize and measure it directly. Fullan (1997) points that without knowing what's in the "black box" of implementation we do not know how to interpret the outcomes (or absence of outcomes): Is failure due to implementing poor ideas, or to the inability to implement good ideas? Is success due to a well-implemented innovation, or to some extraneous factor? In short, without implementation data particular changes cannot be linked to learning outcomes. The second reason why it is important to examine implementation is to understand some of the reasons why so many educational innovations and reforms fail.

The reasons for failure in a large number of curriculum projects over the last twenty years are summarized by Scott (1994) who found that this failure relates to organizational structure and school administration, lack of meaningful role in staff development decision making for teachers, and isolation of teachers.

He explains the lack of meaningful role in staff development decision making for teachers using Roberts (1980) and Munby's (1984) concept of "curriculum interface." Scott states teachers facing curriculum changes need to have their immediate classroom needs met, they need to be given assistance to learn the new skills, and the resources required to bring about the changes being promoted in the new curriculum, and this needs to be an integral part of the process of ongoing training for teachers.

Similarly Davis (2002) lists fundamental key elements for the development of new understandings and practices among teachers based on Anderson and Mitchener's study (1996). He reminds us of the key elements that have to be checked before asking teachers to revise their teaching. According to Davis (2002) reform efforts should enable teachers to reflect upon, and make explicit, their personal practical knowledge, including beliefs, attitudes, and concerns. Teachers' knowledge and practices should be considered as the starting point of change, and they should be provided with experience and training in reform-based strategies, and opportunities to see these approaches modeled. Supporting teachers in collaborative settings with other educators and providing them with access to experienced professionals as mentors and guides are also very important for any reform effort because teaching is an isolated profession.

Scott's (1994) definition of teaching as an isolated profession indicates that there is a lack of professional support for teachers and an absence of public recognition, teachers are often uncertain about what they have to teach and they have to work with vague, and often conflicting, educational goals. Scott emphasizes that without a climate of support and meaningful integration in the process of curriculum change teachers will remain autonomous and isolated in their classrooms.

Ornstein and Hunkins (1998) describe teachers as isolated with a daily routine that presents little opportunity for interaction with colleagues. This is partly a result of the way schools are organized into self-contained classrooms and partly due to teaching schedules. Therefore teachers commonly feel that they are on their own and that they must solve their own problems.

Prior to Scott (1994), and Ornstein and Hunkins (1998), Gallagher and Tobin (1987) had also highlighted teaching as an isolated profession with each teacher working on their own curriculum, albeit within local, state, and sometimes national guidelines. They call attention to research in classrooms to document what teachers and students actually do when the regular science curriculum is implemented because relatively little is known about the interactions that occur in high school science classrooms to produce learning.

With the aim of maximizing the efforts to bring about the proposed curricular reforms and to increase the success of the curriculum implementation process, Strage and Bol (1996) underline the need to make careful descriptions of what transpires in science classrooms on a daily basis and why this happens. This will allow educationalists to find ways to support teachers, as they are required to adopt retooled and reformed curricula. If this is not done teachers continue with their routines: their previous experiences, what has worked in the past and/or what seems to effective guides their actions in the classroom. As a result, change does not occur and the implementation of a new curriculum does not conform to the curriculum intended by curriculum designers.

Fetters, Czerniak, Fish and Shawberry (2002) explain this difference between the implemented curriculum and the one intended by curriculum designers with the help of the specific view points of curriculum developers, scientists and science educators on science and effective science instruction. They underline the complexity of sharing all of these different visions along with their associated language with a group of teachers in a short period of time. They also point out that this complexity is sometimes so frustrating for teachers that it causes them to resist change.

According to Hashweh (2003), there are certain requisites for teachers to change. First they have to be internally motivated to develop professionally, to develop their ideas and practices. Then they need to become aware of their implicit ideas and practices and to examine them critically and to use this to construct alternative knowledge, beliefs and practices, and resolve the conflicts between their prior set of ideas and practices and the new.

Edwards, Dunham and Dick (2000) also identify cognitive requirements on which the characteristics of reform in any given classroom depend. Similar to the factors that Hashweh (2003) listed, these requirements also include the past experiences of teachers, their beliefs about teaching, learning, and their subject area and pedagogical knowledge.

The focus on teachers in the above-mentioned requirements for change indicates the importance of their role to the success of curricular reform efforts. Although these efforts involve many complex and interconnected factors, teachers always play a central role as agents of change. Lumpe, Haney and Czerniak (2000) describe teachers' beliefs as the most precise agents of change and state that they play a key role in change processes.

Scott (1994) also mentions that the teachers are the ones who ultimately control not only the change but also the degree of change that takes place in any curriculum. However, previous research has already shown that they can be influenced by many factors when carrying out desirable curriculum implementation tasks. According to Fullan (1992) the list of these factors in any one situation can be quite large and variable. Therefore, he categorizes the factors commonly found to influence change in practice on the basis of research since 1965. The four broad categories of these factors are:

a) characteristics pertaining to the curriculum change being attempted
b) local contextual conditions at the school district and school levels

c) local strategies at the district and school levels used to foster implementation, and
d) external (to local) factors affecting the likelihood of implementation (Berman, 1981; Fullan, 1982; cited in Fullan, 1989).

Anderson and Helms (2001) broaden Fullan's categories into five groups of dilemmas experienced by teachers as time, ideal vs. reality, changing roles and work, the preparation ethic and equity. First change is not easy and teachers never have enough time to teach everything they think is important. Secondly, they find a tension between the ideal portrayed with the reform efforts and what they perceive to be the realities of their classrooms. Thirdly, current roles of students and the nature of the work they do appear to be deeply ingrained in the school culture and it is difficult for them to counter it and to adopt new roles for themselves, which in turn encourage the desired student roles and work. Fourthly, preparation for the next level of schooling is deeply ingrained in the culture of departments making it hard for them to implement many of the changes due to their perception that this preparation might suffer. Lastly related to the preparation ethic, there is a tension between teaching all students, including some they perceive to be uninterested or unable to achieve at desired levels, and providing to the more able or willing student the high level of instruction called for by the reforms.

In conclusion as Fullan and Pomfret indicated in 1977, the extent to which an innovation will be implemented as it is planned depends on teachers and various other factors. It depends upon the extent to which teachers are clear about the innovation, the degree to which they are competent to perform it, whether appropriate materials are available, whether organizational structures are congruent with the innovation, and the extent to which teachers are motivated.

1.1. Biology Curriculum Implementation in Turkey

As Fullan and Pomfret stated in 1977 focusing on implementation after a curricular change is important because it is not possible to know what has changed unless we attempt to conceptualize and measure it directly. Unfortunately there is a lack of curiosity about what has happened to an innovation between the time it was designed and various people agreed to carry it out, and the time that the consequences become evident. Most of the time, people assume that the actual use corresponds to planned or intended use without examining the actual use. Thus, their reform efforts frequently end with failure after a short period of time. They abolish the programs that were of high quality and educationally sound initiatives, and start to develop new ones without realizing that failure possibly resulted from poor implementation efforts.

Like other educational systems in the world, the Turkish educational system faces such problems. For example, early efforts to develop new and contemporary programs under the guidance of foreign educators ended with theoretical suggestions rather than any practical results. During this period (1923-1960), secondary science curricula were based on textbooks. Theoretical rather than practical knowledge dominated the implementation process. Foreign curricula (PSSC, CHEM Study and BSCS) were adapted and implemented in the 1960-1984 period. In addition to the significantly different social backgrounds that are assumed in these curricula, the economic conditions of Turkey were such that implementation of such advanced curricula was difficult. After the abolishment of attempts to implement foreign curricula, a Council was established at the Board of Education to develop new curricula. Unfortunately the new curricula were not developed on the basis of fieldwork in a Turkish context and their implementation suffered inadequacies such as poor teacher preparation, ineffective teaching methods, a lack of teaching aids, and overcrowded classrooms (Karagözoğlu, 1987; OECD, 1989, cited in Ayaş, Çepni and Akdeniz, 1993). Although, a curriculum model was developed in 1982 that was to be applied to any subject area (Ministry of National Education,

1982) the number of curricula prepared according to this model was limited. The need for an appropriate curriculum model for Turkish National Education System was recognized in the 1990's (Demirel, 1992). In 1993, the Educational Research and Development Directorate (ERDD) prepared a curriculum model as part of the National Education Development Project, which was jointly sponsored by the Ministry of National Education and the World Bank. This model was intended to be applied by all the Directorates, Departments and the Board of Education of the Ministry of National Education in curriculum development for any subject area at any grade level. This model is comprehensive in nature as it progresses systematically from a consideration of national goals and priorities to the development of classroom activities for teaching and learning. A comprehensive needs assessment is necessary for this model to be used to develop a curriculum. Goals and objectives, subjects, methods, instructional materials, and other dimensions must be determined systematically and related in a consistent way based on the results of the needs-analysis. Following its development, the new curriculum must be tested in the field, and if necessary changes must be made to the curriculum (ERDD, 1993).

"The High School Biology Curriculum" was the first curriculum developed based on this model, and it followed a two-year study to meet the need for making the subject matter of high school biology lessons more contemporary, meaningful and interesting for the students, while still reflecting the developments in the field to the curriculum and relating lessons to daily life and health issues. The basic philosophy underlying this new curriculum is "to provide students with the knowledge about their own body structure and environment, getting them to gain the ability to use scientific knowledge in daily life, share this knowledge with others, develop a positive attitude towards biology, gain an understanding of a wholesome life and to have scientific curiosity about biology." It was stated in the curriculum guide (Ministry of National Education, 1998) that all of the goals and objectives were prepared for the student who could meaningfully use and evaluate scientific knowledge, and who do not focus on memorizing the content. The objectives, teaching and learning strategies, experiments, field trips, observations, projects and evaluation strategies are explained in detail. Films, transparencies, videocassettes and other instructional materials are suggested at relevant places in the unit plans. Given all the explanations and suggestions provided in the new curriculum, classrooms are expected to be the places where students are active learners; learning not just by hearing, but also by seeing and doing things, and living and searching instead of being the "empty can" wherein knowledge is stored. Student-centered activities such as group discussions; group learning or projects are suggested and outlined in the curriculum. Instructional techniques incorporated into the curriculum include lecturing, questioning, discussion, observation, demonstration and experimentation (Ministry of National Education, 1998). The intended role for the teacher is stated in the guide to be that of a facilitator or a guide who enables students to comprehend the subject matter optimally using all their senses, and not just listening, learning by interpreting, integrating, and questioning. The teacher is expected to employ instructional methods and strategies appropriate to the goals and objectives of the curriculum using educational aids (transparencies, figures, charts, models, examples, more than one written source, etc.) during the lessons as frequently as possible. The teacher is also expected to try and get the students to be active learners by encouraging them to do research and experiments. The teacher will provide the students with interesting concepts and issues and give them interesting assignments and projects on the subject matter. The teacher motivates the students to study individually, and sometimes prepares the laboratory for group work so students can do the experiments required for each biology unit. The teacher - facilitator/guide shows videocassettes about subject matter prior to giving an explanation and asking students to discuss the films. Using observations and field trips, the guide encourages the students to see, examine and interpret the things in their original settings, things that they learnt in the classroom. In this way, he/she ensures that the learners relate subject matter to everyday life and health issues. One of the teachers' aims is to help students to develop a consciousness of the environment, and to be sensitive to the preservation of nature. Finally, teacher is there to evaluate the learners' success.

Although everything is explained in detail and suggestions are made for the implementation process of the new high school biology curriculum in the curriculum guide, there has been only one study carried out to describe what happens in biology classes in the fourth year of nationwide implementation (Öztürk's 1999). Öztürk reports that the implementation of the curriculum does not correspond to the intended use thus there is a need for a comprehensive nationwide study to see how the biology curriculum is implemented across the country, how it is used in practice in specific situations, and what factors influence its implementation.

1.2. Purpose of the Study

The aim of this study was to determine how the new Turkish high school biology curriculum is implemented in biology classes and to identify the factors influencing its implementation. The two research questions are:

1) How are the new biology curriculum intentions being implemented in biology classes?

2) What local, school and classroom level factors influence the implementation process of the new high school biology curriculum?

1.3. Significance of the Study

This study provides detailed information about the implementation process of new high school biology curriculum in different settings. It helps us to visualize how curriculum developers' decisions are interpreted and practiced by teachers in classrooms. The rich information collected through the survey questionnaire also helps us to identify the forces applying to the process of implementation. In turn what does or does not get implemented in the curriculum can be determined and the reasons for the differences between intended and implemented biology curricula can be recognized.

This study also helps to identify the practical problems faced by teachers. When taken into consideration, the results of this study can help teachers to improve their performance and instructional practices, and can be used as a reference study in biology teaching methods courses. This valuable information in turn can help decision makers to develop better-designed materials and make further progress in the curriculum design.

As one of the few comprehensive studies of curriculum implementation in Turkey, this study also contributes to the literature. It provides a close look to the curriculum implementation in Turkish context where new approaches in the field of science education are closely followed. It helps us to comprehend the process of, and the problems experienced during curriculum implementation in a big country where the education system is centralized. The findings of this study can also form a basis for further research in which the curriculum implementation process is examined and compared in centralized and decentralized education systems.

1.4. Definition of Terms

Intended Curriculum: According to Crocker and Banfield (1986) intended curriculum is simply what has been set out in guidelines or syllabus documents prepared by the relevant educational authorities. Similarly intended curriculum in the Turkish context is defined as "the objectives to be achieved, subject matter content to be learned, and recommendations of a wide array of teaching/learning strategies and materials that has been set out in guidelines" (MONE, 1998).

Implemented Curriculum: The American National Council (1996) defines implemented curriculum as the intended curriculum modified and shaped by the interactions of students, teachers, materials and daily life in the classroom. It is the actual instructional processes that take place in the classroom through the interactions of teachers, students, and the learning environment.

CHAPTER 2

REVIEW OF LITERATURE

It is necessary to examine the curriculum's actual use and identify the factors influencing this process to improve biology education in Turkey and maximize the impact of the new high school biology curriculum. The following review of literature is conducted under four subtitles: "Curriculum Implementation Research in 1970's," "Determinants of Implementation," "Curriculum Implementation Research after 1970's," and "Biology Education and Curriculum Implementation in Turkey." The relationships between teachers, the classroom environment and curriculum implementation are separately examined under the third subtitle of this review.

2.1. Curriculum Implementation Research in 1970's

The critical importance of examining implementation depends on the means use to accomplish desired educational objectives. According to Fullan and Pomfret (1977), implementation is not simply an extension of planning and adoption processes, but a phenomenon in its own right that should carefully be examined. The questions in relation to the characteristics of innovation, its intended goals or consequences and what happened to the innovation between the time it was designed and various people agreed to carry it out, and the time that the consequences became evident must be answered to know what has changed.

Implementation must be examined to identify some of the most problematic aspects of bringing about change. If it is not examined, it can be ignored, or it can be confused with other aspects of the change process and determinants of implementation. Not taking implementation into account makes it difficult to interpret learning outcomes and to relate them to possible determinants (Fullan and Pomfret, 1977).

The two main orientations of the studies carried out this in mind in the 1970's deal with fidelity of implementation and mutual adaptation during the process of implementation (Fullan and Pomfret, 1977). The first orientation deals with determining the degree of implementation of an innovation in terms of the extent to which actual use of the innovation corresponds to intended or planned use. Fullan and Pomfret (1977) identify two types of studies with this perspective: those that focus on organizational change and those that examine specific curriculum innovations. The other orientation, labeled as mutual adaptation, is directed at analyzing the complexities of the change process of implementation because curriculum change usually necessitates certain organizational changes, particularly in the roles and role relationships of those organizational members most directly involved in putting the innovation into practice.

Fullan and Pomfret (1977) give examples for implementation studies displaying these two orientations in their review of curriculum and instruction implementation research. In the first section of this review they also present reasons for studying implementation. For example, they mention the formative evaluation of the Biological Sciences Curriculum Study (1970) in which people focused on learning outcomes without adequately conceptualizing and measuring the degree of implementation, excluded the evaluation of the process of change and the teachers' implementation behavior. Fullan and Pomfret state that although this may be explained by a variety of situational factors such as a teacher's experience or students' socioeconomic status, differing degrees of implementation may also be a factor. Another reason for studying implementation is given in Hess and Buckhldt's (1974; cited in Fullan and Pomfret, 1977) study in which they measured implementation, and found a positive relationship between the degree of implementation and student achievement scores.

Fullan and Pomfret (1977) present Gross, Giacquinta and Bernstein's (1971) case study of an inner city elementary school trying to implement a major change in the role of the teacher as one of the earliest and clearest examples of an attempt to measure the degree of implementation of an organizational change. The dependent variable of this study, the degree of implementation, was defined as "the extent to which organizational members have changed their behavior so that it is congruent with the behavior patterns required by the innovation". Quality of implementation was measured with teacher observations and ratings on a five-point scale ranging from "not at all" to "completely" on twelve behavioral criteria that the researchers felt the teacher should display if the role was being implemented. The second measure, "the quantity of implementation," was assessed through observation by recording the frequency with which the teacher engaged in attempting the new role model that was described in the curriculum documents. Findings on the overall quantity of innovation effort were very low; that teachers displayed behavior congruent with the innovation about 16% of the time. Findings on the quality of use also indicated that some components of the innovation were more difficult to implement than others like the criterion of "permitting" students to do certain things ranked highest whereas the criteria that required the greatest teacher initiative, such as acting as a catalyst, ranked lowest.

Other studies given as examples displaying fidelity orientation in the Fullan and Pomfret's (1977) comprehensive review of curriculum and instruction implementation research include Crowther (1972), Downey et al. (1975), Solomon et al. (1977), Ashley and Butts (1970), Hess and Buckholdt (1974), Leinhardt (1974), Naumann-Etienne (1974), Lukas and Wohlleb (1973), Evans and Scheffler (1974), Cole (1971), and Hall and Loucks (1976).

Crowther (1972; cited in Fullan and Pomfret, 1977) examined the implementation of an elementary social studies curriculum. In order to measure the degree of implementation, an 11-item inventory reflecting the major distinguishing features of the curriculum was used. Teachers were asked to indicate on a five-point scale the degree of emphasis that they gave to discussions of value issues and decision-making by students. Teachers were also asked to rate their own degree of implementation of the curriculum. Provided that it is specific and validated with other methods, interviews and testing of the content validity by experts, this study demonstrates the use of the questionnaire method to assess degree of implementation in a large sample (322 teachers).

Downey et al. carried out a larger, more comprehensive study in 1975 with the same social studies curriculum (cited in Fullan and Pomfret, 1977). The appropriateness of and knowledge about the curriculum guideline developed by the Provincial Department of Education, the appropriateness and effectiveness of programs developed at the local and at the typical school/classroom level were the three major levels of implementation investigated in this study. Documentary analysis of the provincal curriculum guide, a questionnaire survey of a random sample of social studies teachers, students and parents at elementary, junior-high, and secondary levels, and site visits to a sample of schools for the purposes of interviewing teachers, students and parents, of observing classrooms, and of examining resources and materials were the methods that were used to assess implementation in this study. An in-depth content analysis of locally developed programs was also carried out to determine the extent to which these programs followed or failed to follow the principles, policies, and guidelines of the provincal curriculum guide. Reiterating a common finding that implementation at the user level reflects considerable discrepancies from intended plans, this study illustrates some new and comprehensive methods of assessing implementation in the mid 70s.

Solomon et al. (1977; cited in Fullan and Pomfret, 1977) used a 95-item scale to assess the degree of implementation of a prepackaged preschool curriculum. Data were collected on through documentary analysis, teacher interviews, and classroom observations. Teachers were rated on nine dimensions, such as the role of teachers in their teams, reinforcement and behavior management, unit use, and parent involvement. Findings showed that some of the items like grouping, organization, use of time, physical setting and student participation had higher scores than others like planning and evaluation, teacher roles, unit approach, and parent involvement. It was seen that the elements involving mainly structural changes were most effectively implemented whereas those least implemented tended to involve role changes.

Classroom behavior of teachers was used as the main measure of degree of implementation in Ashley and Butts' (1970; cited in Fullan and Pomfret, 1977) study. While examining a K-6 science program, they assessed teacher behavior with an observation form that was developed through consultations with 150 teachers that believed that they were already using the curriculum effectively. The categories in this observation form were related to teacher-student interaction and student behavior, teacher responses and action, specific personal teacher traits such as discipline, self control, enthusiasm, and lastly to the physical aspects of the classroom environment. Conceptualization of the behavioral changes required by the curriculum is this study's main value.

Classroom observation method was used by Hess and Buckholdt (1974; cited in Fullan and Pomfret, 1977) to examine the degree of implementation of a language and thinking program (LAT). The six components of observation criteria were teacher preparedness, correct following of procedures as specified in the teacher's guide, proper use of materials as suggested in the guide, teacher effectiveness in maintaining student attention and elicitation of student responses, amount of positive reinforcement given to students, and teacher affect (enthusiasm) towards the lesson. Observers using a three-point scale rated these components and three groups participated in the study. The first group received the complete set of LAT package materials plus training in the use of materials. The second group did not receive any LAT materials, but received the complete set of sequential LAT objectives and training in the use of the criterion tests. The third group did not receive any LAT materials, and were designated a control group. On the basis of observation ratings, teachers in the first group were divided into groups of high, moderate, and low implementers. Students with teachers that followed the curriculum well, the high implementers, were found to have a very good grasp of the objectives of the new curricula. Variance in implementation even among those who received identical materials and training was also reported in this study.

Allocation of time, allocation of space, assignment procedures, classroom management, and student independence were examined as components of implementation in Leinhardt's (1974; cited in Fullan and Pomfret, 1977) study. In contrast to earlier studies that focused on the teacher's role and behavior to investigate the degree of implementation, Naumann-Etienne's (1974; cited in Fullan and Pomfret, 1977) study included aspects of organizational behavior in the measuring instrument that required direct classroom observation.

On a wider scale, Lukas and Wohlleb (1973; cited in Fullan and Pomfret, 1977) illustrated the problems of defining and measuring the degree of implementation of a curriculum at 31 different sites involving over 100 classrooms. Similar to Hess and Buckholdt (1974; cited in Fullan and Pomfret, 1977), their findings showed some teachers implementing the treatments better than others and classes having different experiences under the same treatment. There are definite variations in the degree to which the same innovation is implemented by different individuals and organizations, and the degree to which some components of an innovation are implemented more effectively than others.

In order to identify an innovation's most difficult aspects to implement, Evans and Scheffler (1974; cited in Fullan and Pomfret, 1977) used an eleven-item scale consisting of numerous sub-items to measure the degree of implementation of a prepackaged, individualized math curriculum. Similar to

Solomon et al. (1977; cited in Fullan and Pomfret, 1977) and Gross, Giacquinta and Bernstein (1971; cited in Fullan and Pomfret, 1977), they report instructional aspects involving role relationship changes as the most difficult ones to implement.

In a study of a social science curriculum emphasizing process and inquiry-oriented education, Cole (1971; cited in Fullan and Pomfret, 1977) indicated the need for teacher-pupil role relationship changes. According to Cole, teachers needed to "become active learners and inquirers" to use the curriculum effectively. Their knowledge of the curriculum and reported behavior in the classroom are the measure of implementation. When they were asked to respond to a set of statements, which tested their knowledge of the assumptions, principles and instructional strategies of the curriculum, it was found that teachers scored very high on their knowledge of the curriculum. Other instruments and interviews with administrators, teachers, and students, were also used in Cole's study. All the results indicated the quality of use of the curriculum was for perceived as a success by all the involved groups.

According to Fullan and Pomfret (1977) the most sophisticated and explicit conceptualization of the "fidelity" orientation to assess the degree of implementation was developed by Hall and Loucks (1976) who suggest different levels of use or degrees of implementation. The six levels formulated by them are nonuse, orientation (initial information), preparation to use, mechanical use, routine and refinement, integration and lastly renewal. Determining these levels according to pre-specified criteria can help to assess the implementation of innovations.

2.2. Determinants of Implementation

Although they differed in kind and/or in emphasis depending on the approach followed, studies investigating implementation during the 1970's had certain common factors. Using these various factors Fullan and Pomfret (1977) have identified various determinants of curriculum implementation and grouped them into four categories.

The first category encompasses the characteristics of the innovation: its explicitness or plans for explicitness associated with the innovation and the complexity or degree and difficulty of change required by the innovation.

Concerning explicitness, Gross et al. (1971; cited in Fullan and Pomfret, 1977) reported that the majority of teachers in their case study were unable to identify the essential features of the innovation they were using. In summarizing four case studies of differentiated staffing, Charters and Peelgrin (1973; cited in Fullan and Pomfret, 1977) also pointed out to the ambiguity of innovations, which are described in abstract general terms, on the part of teachers. Similar findings were reported by Crowther (1972), Downey et al. (1975), Lukas and Wohlleb (1973), and Naumann-Etienne (1974; cited in Fullan and Pomfret, 1977).

According to Fullan and Pomfret (1977) low explicitness ends with user confusion, lack of clarity and frustration, which together cause a low degree of implementation. They identify two ways to address this problem, which call for greater specification of the implementation characteristics (structure, behavior, knowledge and understanding, valuing and commitment) by sponsors or developers of innovations, and the setting up of procedures for continually moving toward greater explicitness during initial implementation. They underline the necessity of some processes for developing greater explicitness or specification for implementation to occur.

The second important characteristic of an innovation is its degree of complexity or difficulty in usage. Some researchers (e.g., Rogers and Shoemaker, 1971; cited in Fullan and Pomfret, 1977) believe that the complexity of an innovation can be measured as perceived complexity by potential users. However, Fullan and Pomfret (1977) suggest more objective measures of complexity to be used in connection with implementation because it depends on the capacity (skill, new normative internalization) of users to perform in new ways, not just on acceptance of the change. They state that the more difficult the change, or the greater the degree of new learning entailed by it, the more likely that degree of implementation will vary across groups of users.

The results of the studies carried during 1970’s also show that complex changes in teachers’ behavior (teaching style, skills, new norms) in inquiry-based curriculum innovation were difficult to bring about, and consequently the new curriculum was unlikely to be implemented satisfactorily unless special steps were taken. Gross et al. (1971) Evans and Scheffler (1974) and Solomon et al. (1977; cited in Fullan and Pomfret, 1977) all found that implementation characteristics involving new teaching strategies and role relationships with students showed lower levels of implementation than those characteristics involving change in structure, administrative procedures, and use of materials. Crowther (1972; cited in Fullan and Pomfret, 1977) also report a significant relationship between complexity of an innovation and the degree of implementation of a social science curriculum. Although teachers are generally in favor of the new curriculum they see serious problems in being able to develop and apply the new teaching strategies.

Fullan and Pomfret (1977) call researchers and practitioners’ attention to the need to orient themselves and address continuously the program explicitness and degree of complexity of educational innovations that they are attempting to use.

The second category of factors that have a plausible influence on implementation encompasses strategies and tactics including in-service training, resource support (e.g., time, materials), feedback mechanisms, and participation in decision-making. Fullan and Pomfret (1977) underline these factors’ interactive nature and state that they may mutually reinforce each other over time and the presence of any one without the others would probably limit if not eliminate its effectiveness.

Related to effect of in-service training on implementation Solomon et al. (1977; cited in Fullan and Pomfret, 1977) report ten percent higher scores for teachers who received maximum training (pre-service, in-service, and materials) on degree of implementation than teachers who were given minimum training (materials only). Crowther (1972; cited in Fullan and Pomfret, 1977) also points to the significant relation of in-service training prior to implementation to the degree of implementation. After studying a sample of 29 teachers, all of whom received in-service training, Ashley and Butts (1970; cited in Fullan and Pomfret, 1977) report a shift towards behaviors consistent with implementation of the curriculum. Cole (1971; cited in Fullan and Pomfret, 1977) also cites intensive pre-service and in-service training as the main reasons of success in curriculum usage. It appears that intensive in-service training is an important strategy for implementation.

The provision of time, materials, and other facilities during implementation are the concerns of resource support. Lack of time and inadequate materials are identified as barriers to implementation by Gross et al. (1971), Charters and Pellegrin (1973), Crowther (1972) and Downey et al. (1975). In Berman and Pauly's (1975) study inadequate materials, space, and equipment were also mentioned as major problems of implementation (328 times) by teachers. Time and access to materials were identified as important factors contributing to success in the study by Cole (1971) and in a project in which teachers produced the curriculum (Miller and Dhand, 1973; cited in Fullan and Pomfret, 1977).

Feedback mechanisms are a means for identifying problems encountered during implementation and providing support to address such problems. Fullan and Pomfret (1977) mention the absence of feedback networks during implementation as a critical problem. Feedback between users and managers, or users and consultants, peer feedback and discussions are vital for working through the problems of implementation (Fullan and Pomfret, 1977). Regular and frequent staff meetings were also reported as important determinants of implementation outcomes by Berman and Pauly (1975) and House (1974; cited in Fullan and Pomfret, 1977) for all levels of schools and for all types of programs. Since problems during initial implementation are inevitable, Fullan and Pomfret (1977) emphasize the essentiality of feedback mechanisms when any serious social change is attempted.

Similarly, participation in the innovative process for those expected to implement the new program is identified by Fullan and Pomfret (1977) as an effective strategy. These studies enable making inferences about the possible effects on implementation. For instance, in a study of 112 teachers, Duet (1972; cited in Fullan and Pomfret, 1977) found a significant relationship between teachers' reported degree of participation in curriculum development activities and their reported degree of implementation of curriculum guides (Fullan and Pomfret, 1977). Similarly Lamont (1964; cited in Fullan and Pomfret, 1977) reports more different uses and greater knowledge of the purposes and uses of curriculum guides by teachers who participated in the development activities than the comparable group who did not.

The characteristics of adopting units encompass the third category of factors influencing implementation. This concerns the process of adoption, organizational climate, environment support and demographic characteristics of adopting units.

Fullan and Pomfret (1977) report Rand research (1976) as the only study that examines adoption in relation to implementation. Two contrasting types of adoption process identified in this study are opportunism and problem solving. Berman and McLaughing (1976; cited in Fullan and Pomfret, 1977) report projects characterized by opportunism as involving a response to the availability of funds and evidence little local commitment, while the problem-solving mode emerges from locally identified needs.

According to Fullan and Pomfret (1977) the existing organizational climate of the adopting units plays a critical role in implementation. They report high morale of teachers at school, active support of principals and general support of superintendents to increase the chances of teacher change and perceived success. The supportive findings of Naumann-Etienne's (1974; cited in Fullan and Pomfret, 1977) study also show that teachers in schools with greater implementation perceive a more participatory system that includes a greater teacher involvement in decision-making and greater peer communication and team building. Evans and Sheffler's (1974; cited in Fullan and Pomfret, 1977) findings also show 0.51 correlation between administrative support and degree of implementation.

The last set of factors related to the third category is basic demographic characteristics of the adopting units and their environments. Social class, rural-urban, levels of schooling and individual characteristics are examined under this category (Fullan and Pomfret, 1977).

Although research examining the relationship of social class or rural-urban differences to implementation is limited, both House (1974) and Downey et al. (1975; cited in Fullan and Pomfret, 1977) report large differences in the adoption of innovations between urban centers and rural areas. Related to these differences some implementation problems and strategies of change also differ. Preparedness of students and staff to implement, conflict, apathy, values, needs, nature and extent of participation by community and staff in decision making, and access to information and resources are some of the variables. However, there is a need for more comparative studies of social class and urban differences.

Level of schooling is the other characteristic included in this category. Due to important differences at the secondary level, Fullan (1977) calls attention to tentative generalizations to secondary schools. Fullan and Eastabrook's research (1973; cited in Fullan and Pomfret, 1977) also indicates important differences in orientation to change between elementary and secondary schools. Berman and Pauly (1975) report perceived success of implementation to be greater for elementary school projects than for junior or senior high school projects. They point to organizational differences and the educational and training background of teachers at the two levels influencing the implementation process. The role of students is vastly different at the two levels. The findings of Fullan and Eastabrook's (1973) research also shows that elementary school level students are relatively passive, content and receptive to teachers and the school in general, whereas high school students are more cynical about or apathetic to school life. Fullan and Eastabrook (1973) point to a need to examine the potential role of students at different age levels in relation to the implementation process.

The last set of variables in basic demographic characteristics of adopting units and their environments encompasses the role of individual staff characteristics. As Crowther (1972), and Lukas and Wohlleb (1973; cited in Fullan and Pomfret, 1977) infer not all teachers have the same propensity to implement any given innovation. Value orientation in relation to the innovation, type of previous training, and ability to use the innovation are some of the characteristics causing differences between teachers (Lukas and Wohlleb, 1973). Charters and Pellegrin (1973), Crowther (1972) and Gross et al. (1971; cited in Fullan and Pomfret, 1977) report the capacity to use an innovation as one of the most problematic aspects of implementation. According to Downey et al. (1975; cited in Fullan and Pomfret, 1977) basic teacher preparation (and development) is another critical factor in the implementation, non-implementation, or mis-implementation of a new program. For Crowther (1972), Evans and Scheffler (1974) age and level of education per se are not related to effective implementation.

The fourth and the last category of factors possibly influencing the implementation process encompasses the characteristics of the macro sociopolitical units, by this we mean the role of political agencies outside the adopting unit. These range from local school system boards, local government, and community agencies, to national and federal organizations. When the scale of the program is larger, the role of these factors becomes more prominent.

2.3. Curriculum Implementation Research After 1970's

Interest in implementation problems is still a worldwide phenomenon. Similar to most of the studies investigating implementation process in 1970's, studies carried in the last 30 years also focus on teachers and their classroom behavior as the major dimension of implementation to be examined. In addition to studying the same dimensions as the previous ones the results of these studies also report similar findings. Since teachers and their classroom behavior are the main focus of interest in the implementation process the first section of this part of the literature review will deal with teachers and curriculum implementation.

2.3.1. Teachers and Curriculum Implementation

It has long been recognized that teachers have a major role in determining and implementing the curriculum. They interpret and give life to the curriculum specifications of governments and ministries, and translate curriculum intentions into classroom practices (Norris, 1998). As Scott (1994) mentions, they not only control the rate but also the degree of change of any curriculum.

According to Kimpston (1985) studies focusing on teachers' beliefs about their roles in the curriculum implementation process are the most efficient way to answer the question of what does or does not get implemented in the curriculum. The most important conditions for developing better designed curriculum materials are provided by analyzing teacher roles (Van Den-Akker, 1988).

Dreyfus, Jungwith and Tamir (1985) define the successful implementation of a curriculum as its spirit being conveyed to the pupils by the teachers. Accordingly what a given teacher believes, knows and does determines the form of education given to a student. If enough were known about the curriculum implementation process and how teachers influence this process, research findings and developments would be more likely to be actually used by practitioners (Connely and Ben-Peretz, 1980, cited in Cronin-Jones, 1991).

On the basis of Heron's (1971) conclusion and the results of earlier studies, Mitchener and Anderson (1989) point to the importance of the teacher role and state that they determine the success or failure of a new curriculum. Similarly, Crocker and Banfield (1986) underline the necessity of a fuller understanding of teacher thoughts, judgments, and decisions relative to curriculum if further progress is to be made in curriculum characteristics and instructional practices. Views of teachers on a range of factors within the school and classroom setting are likely to be important determinants of curriculum translation. Cronin-Jones (1991) also points out that teachers' perceptions and beliefs play a critical role in the curriculum implementation process. The incompatibility of the objectives and activities in the programs with teacher views of curriculum characteristics and instructional practices are identified by Crocker and Banfield (1986) as one of the major reasons of failure in many curriculum projects in the 1960's.

In a case study of curriculum implementation processes in a fifth grade science class, Smith and Anderson (1984) found a marked difference between intended and implemented curricula due to the different views of teachers and curriculum developers about the concept of learning and the nature of science (cited in Cronin-Jones, 1991). The results of Cronin-Jones' (1991) study also show teachers significantly altering curricula to make them more congruent with their own teaching contexts and belief systems. In the light of studies carried out by Smith and Anderson (1984) and Clark and Elmore (1981), which report teachers adapting curricula to fit their knowledge, priorities and unique classroom settings, Cronin-Jones (1991) indicates that teachers do not implement curricula in their classrooms in the same way that these curricula are designed to be implemented; the implementation is often quite different from that intended in the curricula. In her case study, she states teachers' beliefs as the main reason of this difference. She puts teacher beliefs into four categories covering the ways students learn, teacher roles in the classroom, the ability levels of students in a particular age group, and the relative importance of content topics. She supports her findings with Olson's (1981) study in which the intended curriculum advocated a discovery approach whereas common practice of the teachers involved a lecture and some question-answer activity. This difference results from how teachers deal with proposed changes and how they construe their role in the classroom.

Cronin-Jones (1991) gives a second reason of the difference between intended and implemented curricula, teacher attitudes toward curriculum packages. She underlines Connelly and Ben-Peretz's (1980) claim that teachers need to believe in an intended curriculum to properly implement it. She supports her ideas with the findings of Buchmann and Schmidt's (1983) study in which teachers' allocations of time to various subject matters are reported to depend on the teachers' attitudes toward the subject matter and the degree of enjoyment they experience in teaching it. She states that teacher beliefs about the ability levels of students in a given age group and beliefs about which student outcomes are most important exert a powerful and potentially negative influences on the curriculum implementation process.

In an earlier study Duschl and Wright (1989) report a similar finding, the focused observations in their study revealed a significant difference in teachers' objectives between high level and low level classes. According to students' ability, teachers' considerations for advancing development and for understanding science content differ. In high level classes teachers display behaviors and voice opinions indicating the primary goal of instruction as students acquiring a discipline's prepositional knowledge or simply its content. Similarly, Smerdon and Burkam (1999) report that many teachers believe in didactic instruction, drill and practice, to be more effective for students with lower intellectual abilities. They are less likely to use innovative instructional techniques when they believe their students need training in basic skills so that their instruction is often characterized by rote memorization, drill and practice. In contrast, teachers of upper-level courses emphasise higher-order thinking and present more-interesting materials.

In a research program into the academic work of science classrooms, Tobin and Gallagher (1987) also report teachers' knowledge of science and pedagogy and beliefs about teaching and learning as factors which influence the implemented curriculum. In addition they identify teacher expectancies as one of the other factors that influence the implemented curriculum. Their results illustrate how teachers tend to involve target students and males in whole class interactions to a greater extent than non-target students and females. Teacher expectations also appear to influence the science curriculum for high and low ability classes in their study. In another study Tobin (1987) again reports teacher expectations as exerting a powerful force on the implemented curriculum. He stresses teacher beliefs about how students learn and what they ought to learn have the greatest impact following the potent force of teachers' knowledge on the implemented curriculum. Hawthorne (1992) also emphasizes that the curriculum enacted in each classroom results largely from the individual teacher's preferences, professional understandings, and perceptions of student needs and interests.

Although their beliefs, perceptions, attitudes, knowledge and expectations are reported to have the greatest impact on the implemented curriculum, teachers also complain about several constraints that hamper them in carrying out the desirable curriculum tasks. In Kimpston's (1985) study lack of time was identified as the overriding constraint, followed by a teacher's own lack of capability and the absence of an established process in the district for carrying out the task. Tobin (1987) indicates the relatively large amount of content teachers feel obliged to cover as another constraint that prevents teachers from achieving the curricula objectives in the intended manner. He reports that most of the teachers participating in his study found class time to be insufficient to provide students with opportunities to discuss their understanding of a topic and apply their knowledge in a range of contexts. However, he questions how teachers would change their strategies if the amount of content were substantially reduced or the amount of instructional time increased. Tobin identifies classroom management, examinations and textbooks as other factors that constraint teachers when they try to implement the curriculum in the desired ways.

Lederman (1999) points out to classroom management as a perennial concern of novice teachers that have not developed a wide variety of instructional routines and schemes that allow them to feel comfortable with the instruction. Mitchener and Anderson (1989) highlight the teachers' concerns regarding loosing class control as a cause of passive resistance to role changes, this is a new characteristic of current curricular reforms. For instance, teachers feel uncomfortable with the facilitator role compared to their traditional lecturer-expert role.

Scott's (1994) study also points to the limiting factors identified by teachers to implement the curriculum in the intended ways. These factors are time constraints, lack of resources and facilities, own limited knowledge, need to cover a variety of contexts, pressure of exams, lack of interest by students, too much in syllabus and different backgrounds of students.

Researchers in the field also give some characteristics of teachers that may possibly influence what they do in the classroom; how they translate curriculum intentions into classroom practices. For instance, Evans (1986) indicates age, sex, years of experience and educational background of teachers are all potentially important determinants of the implementation process. The findings of his study show that as degree of implementation increases, attitude scale and more cognitive measures and years of experience decrease. He reports that high implementers are more likely to display a favorable attitude toward the materials and program yet they tend to be less experienced, and are likely to score lower on achievement or more cognitive measures. The low implementers who are slightly more experienced tend to have higher scores on achievement measures and to display a less favorable attitude toward the program.

Similarly, years of teaching experience was reported by Lederman (1999) to cause clear differences between the classroom practices of teachers. The results of his study indicate that experienced teachers (14 and 15 years of experience) exhibited classroom practices consistent with their professed views about the nature of science: they included many inquiry oriented activities (i.e., demonstration and laboratory practices) that required students to collect data and infer explanations for the data that had been collected. Novice teachers, less than 5 years of experience, struggled to develop an overall organizational plan for their courses and were a bit frustrated by the discrepancy between what they wanted to accomplish versus what they were capable of accomplishing with their students.

Cho's (2001) findings also show that years of teaching experience affect teachers' view of the value of the curriculum. Therefore, they demonstrate different meanings of fidelity of implementation in their everyday classroom situations. For instance, Cho reports that the novice teacher in the study faithfully used the new curriculum materials based primarily upon the intent of the curriculum developer. What worked best for student learning in her classroom was guaranteeing the right things covered at right times and in an organized manner because the teacher herself felt a need to learn new skills and build on her knowledge for teaching. In contrast, the experienced teacher considered the new curriculum materials to be teaching tools and adaptively used the ideas of the curriculum developer. The critical decisions she made were directly related to her interpretation of students' needs as she perceived them.

Lastly, Mitchener and Anderson (1989) note that a teacher's daily practice is heavily influenced by their colleagues' and students' impressions and behaviors. They report that teachers are attempting to adjust to new situations and new roles that come with curriculum changes. However, many studies investigating implementation process highlight the teachers' usual resistance to curricular and instructional innovations.

The history of implementation research shows that planned change attempts rarely succeed as intended (Fullan and Steigelbauer, 1991; cited in De Jong, 2000). Smith (1996, cited in De Jong, 2000) reports high failure rates with teachers who must learn new skills while maintaining their daily work schedules and responsibilities. Yee and Kirst (1994) indicate that teachers use the new materials without a through understanding of the required changes most of the time, they also mention the developers' failure to account for the structural constraints to changing teachers' practices for example, that many of the materials require longer class periods, that they require changes in classrooms and in school wide organization, significant amounts of time to prepare materials and the construction of new laboratory facilities. For this reason Shkedi (1998) asks curriculum developers to rethink the ways in which teachers encounter the curriculum. He underlines the need to devise means that suits the teachers' narrative world of knowledge and thought, and one that is communicative to them and speaks in their professional language. He indicates the need for a curriculum guide to be developed that uses a language that represents the teachers' world and the complexity of everyday classroom life. From another perspective, Van Den Akker (1988) calls for the desirability of curriculum materials to contain a large amount of "procedural specification" for a teacher' s initial use that is very accurate as to how its advice is focused on essential but apparently vulnerable elements of the curriculum. With the help of such specific materials teachers are stimulated to take a task orientation and to perform a concrete role in the introduction of new curricula, using their experiences and being supported with practical advice, to produce successful lessons. However, at the end of a review of literature Coles McRadu, Allison and Gray's (1985) report centrally developed curriculum guides to have limited influence in determining the programs and activities of teachers. Similarly, findings of their own study confirm limited usage of curriculum guides by teachers except for long range planning.

In order to increase the usage of curriculum guides by teachers in every part of their instructional planning, Shkedi (1998) stresses the need for the guides to have a different character, one that corresponds to the language, thought, and knowledge of teachers. The curriculum guide has to transmit its message using the appropriate medium, and it is not necessarily via the written word and should be designed to reflect both the teachers' and developers' intentions.

Olson (1982), Aikenhead (1984), and Mitchener and Anderson (1989) state that curriculum developers working cooperatively with classroom teachers gain a better understanding of the operant issues when implementing theories into practice. Writers in the curriculum field who have focused their concern on theoretical perspectives relating to curriculum implementation also tend to agree that teachers who believe they are involved and effective in curriculum development show greater congruence between intended and actual use of a curriculum (Kimpston, 1985). Therefore rather than looking at teachers as passive transmitters of information and new curriculum as a thing ready to elicit a certain type of adoption behavior, attention should be given to the intentions of and the practical problems faced by individual teachers in the implementation process.

2.3.1.1. Change and Teacher Development

It is widely acknowledged that teachers can no longer adhere to their traditional role of transmitting knowledge (Kwakman, 2003) when implementing reform-based curriculum designed to support students' construction of knowledge in science (Schneider and Krajcik, 2002). For many teachers this means substantial change in their instructional practices: they must create a stimulating learning environment and change their role from lecturer to facilitator of the students' learning processes (Kwakman, 2003).

In most of the cases teachers need to learn a great deal to be able to enact reform-based curriculum. Traditionally they attend courses, training, or conferences and read professional journals to refresh and update their knowledge and skills. Educative curriculum materials designed to address their learning is another vehicle to support them on a large scale. However, Kwakman (2003) points out that these traditional professional development activities fall short of helping teachers to teach for understanding rather than rote learning.

When learning new concepts of content and pedagogy, and when taking on new roles, the traditional ways of learning that are characterized by transmission of knowledge do not help teachers. Instead they need to acquire competencies to fulfill their new roles. Kwakman (2003) proposes that the working context is the most suitable place in this respect, as new teaching competencies can only be acquired in practice.

Davis (2002) also emphasizes the importance of experiencing new ways of teaching by actually teaching as the most efficient way for teachers to develop and increase their understanding of the new instructional approaches. Although Feldman (2000, cited in Davis, 2002) proposes a model of certain conditions that need to be met to change teaching theories (Davis, 2002), it is also possible for teachers' beliefs and attitudes to change as a result of practicing new behaviors.

In addition to practicing new behaviors, communication plays a key role in teacher learning and implementation of reform. The opportunities to talk with other educators about the problems they are experiencing and to hear and to talk about the solutions that other teachers have discovered is extremely valuable for teachers. They can share and build on each other's ideas, examine diverse approaches, discuss their beliefs about learning and teaching, and workings and failures of new curricula, teaching practices and instructional materials. As a result of such settings they can further develop effective classroom strategies and approaches, and in turn implement reforms more effectively (Davis, 2002). Therefore communication opportunities and new decision making structures need to be created, encouraged, and supported for teachers.

Anderson and Helms (2001) also cite the need for contexts in broader education change endeavors and for moving away from traditional in-service education carried out in isolation. Likewise, Sanchez and Valcarcel (1999) state that a special attention has to be paid to designing activities, which lead teachers to reflect on, and question their views and practices. They mention the difficulty of proposing in-service training sessions to teachers who have insufficient motivation to take up such activities.

According to Gwimbi and Monk (2003) in-service education can change a teacher's pedagogical knowledge but this new knowledge may not be directly expressed in changed classroom practice. For this reason Fetters, Czerniak, Fish and Shawberry (2002) emphasize the need for teachers to pilot new active learning strategies in their classrooms and to be supported by evaluative feedback from a variety of sources including peers.

Defining curriculum implementation as a collaborative and emotional effort, Ornstein and Hunkins (1998) also point out to the vital need for peer support for successful implementation process. They mention opportunities for teachers to work together, share ideas, jointly solve problems, and cooperatively create materials to greatly enhance the probability of successful curriculum implementation. Consequently, Davis (2002) stresses teachers should be empowered to create new structures, policies, and practices within their school settings to support their collaborations with colleagues and students, the development of goals for change, and their design of and experimentation with innovative instructional and learning practices and assessments.

The studies of Kwakman (2003), Schneider and Krajcik (2002), Davis (2002), Anderson and Helms (2001), Sanchez and Valcarcel (1999), Gwimbi and Monk (2003), Ornstein and Hunkins (1998), and Fetters, Czerniak, Fish and Shawberry (2002) highlight the need to provide teachers with something other than traditional in-service training to bring about change in their classrooms and coordinate curriculum. In addition to teacher development studies, the results of these studies contribute a lot to curriculum implementation studies due to the inextricable link between the two (Hall, 1997). It should always be kept in mind that weak teacher development produces little change in curriculum implementation.

2.3.2. Classroom Environment and Curriculum Implementation

The focal point of many of the studies investigating implementation is the classroom environment as this can positively or negatively influence the process of implementation. As Fraser (1990, cited in Suarez, Pias and Membiela, 1998), Suarez, Pias and Membiela (1998) indicate the classroom environment can cause differences in implementation in different classrooms and in different schools. Some school level environmental factors identified by Shymansky and Kyle (1992) are content selected, available facilities, availability of resources and materials, management of materials, access to existing and emerging technologies, instructional practices, scheduling of teacher time and assessment protocols. Similarly number of students, context and subject matter related factors are listed by Strage and Bol (1996) as influencing the realization of instructional recommendations made by the curriculum innovators.

Previous research has shown that the ultimate success of curriculum reform rests upon how it is implemented in the classroom. The perceptions of students and teachers regarding the classroom environment provide an important source of data for the direct evaluation of the curriculum implementation process. For example, an analysis of students and teachers' perceptions allowed Suarez, Pias, Membiela and Dapia (1998) to study the influence of the classroom environment on the implementation process of an innovative project in science education.

Gwimbi and Monk (2003) propose a possible association between teachers' perceptions of their classroom contexts and their classroom practices. They identify teachers' perception of the nature of their school context as a more reliable guide to understanding their actions than objective measures. The findings of their study highlight the constraints placed on teachers in less well-resourced school contexts, i.e. less prepared students, poorer laboratory facilities, larger classes, heavier teaching loads, poorer library facilities.

Although a move away from traditional, a teacher-centered, direct instruction towards a more student centered, understanding based form of teaching that focuses on exploration and experimentation is fundamental to many contemporary reforms in science education, researchs report teachers continuing to teach in the same way they were taught. In Smerdon and Burkam's (1999) study, it was found that teachers still view lecturing as the most expeditious method for covering a large volume of material. Therefore students continue to listen, copy notes and watch demonstrations of experiments in science classes while their teachers lecture. Treagust (1991) also shows that much of what students are required to do in science classrooms can be tedious and is not intellectually demanding.

Gallagher and Tobin (1987) observed an emphasis on completion of tasks and activities in science classrooms. They report identical teacher beliefs on task completion and learning, teachers in their study believed that a teacher's job is to cover the material in the text and laboratory guide. When these tasks are completed, their responsibilities towards the students regarding the specified content of the curriculum are fulfilled. Therefore the teachers devoted a majority of class time to whole class interaction during which the pace of instruction depends on the responses of 5-7 more able students (target students). The level of cognitive demand placed on students tends to be relatively low. Rote memorization of factual information is more emphasized in classes and during conclusions in laboratories than comprehension, applications, logical reasoning, and processes of science. Tobin and Gallagher (1987) found an exception in classes where students are preparing for external examinations because these examinations require a higher level of reasoning. Tobin and Gallagher's study (1987) also found that students with poor achievement and motivation are more problematic and that teachers tend to offer watered-down versions of regular classes and appear ill-prepared to teach these students. Moreover they do not enjoy working with these students. Similarly low-achieving, low motivation students do not enjoy science classes and fail to see the utility of science. Finally, Tobin and Gallagher (1987) report that preparation for examinations was seen by teachers to be as the main purpose behind instruction, class work, homework, and laboratory work.

In another study, Tobin (1987) states that teaching is a demanding profession and that each class has its distinctive characteristics and that this necessitates separate planning for individual classes. This combination of characteristics means that the events that unfold during instruction result in a unique implemented curriculum. Together with the interactive nature of instruction, the demands of the teachers' job produce other events which can be regarded as forces that also interact with process of implementing the curriculum. For instance, Tobin (1987) reports three types of management problems that negatively affect the quality of instruction: (1) the need to maintain effective discipline, (2) the need to manage instructional program and (3) the need to keep the attention of higher ability students engaged in the lesson. Tobin shows that teachers that have difficulty in managing the classroom also have problems with instruction. He also points to the usage of assessment systems to motivate students in classroom. In addition to the focusing effect that assessment systems have on the implemented curriculum, Tobin (1987) also highlights the strong influence of textbook activities on academic work with the example of teachers teaching a topic outside of their field of expertise, and resorting to the textbook rather than attempting to explain science content that they do not fully understand. Therefore students are left to memorize facts from the textbook rather challenged to relate new information to prior knowledge.

The above-mentioned findings and suggestions made in the literature can help reformers to improve the effectiveness of the educational environment in classrooms. However, the interactive nature of instruction should always be considered before making decisions. Instructional strategies may be best applied in the classroom through the interaction of teachers with their peers and students. As Hofstein and Lazarowitz (1986) state information about students' perception of their classroom learning environment can be used effectively to guide both teachers and curriculum developers in changing and improving teaching/learning methods.

Similar to the studies they reviewed, Gess-Newsome and Lederman (1995) also report that students exert a strong influence on the classroom teacher in terms of what and how the content is taught. The findings of five case studies carried with experienced biology teachers demonstrate this influences. For instance, teachers, who are sensitive to student frustration and interest, change from more rigorous academic content to optional units when the student attention decreases. Other teachers specifically change their content sequence to increase student comfort.

Besides students' interest and level of frustration influencing the content and ways of teaching, Smerdon and Burkam (1999) list students' liking of the subject, their performance in the class, and their relationships with the teacher, and their classroom peers as the factors affecting a student's judgment about instruction in their science classes. According to Talton and Simpson (1987) the characteristics of teachers, peers and classroom environment inevitably affect a student's affective and cognitive learning outcomes. They suggest examining students' feelings about the emotional climate and physical environment of the classroom, activities within the science classroom, and student interactions with their classmates to learn how individuals feel about science. This way science curricula and activities that enhancing the students' interest in science can be developed, and classrooms can be turned into stimulating and supportive learning environments in which students question and develop their interests in science.

Hofstein and Lazarowitz, (1986) also call for the importance of feedback based on classroom environment perceptions of teachers and students to be used to guide educators' attempts to improve the classroom environment. This feedback should also be used to serve as a guide for future curriculum developers.

2.4. Biology Education and Curriculum Implementation in Turkey

Since this study aims to describe the implementation process of the new high school biology curriculum in Turkish schools and to identify the potential forces applying to it, studies investigating the situation in biology classes in Turkey for the last ten years are presented in this last part of the literature review. Although some of these studies are indirectly related to the implementation process, they will help us describe the current situation of biology education in our country.

Yılmaz (1998) has examined high school biology education in Turkey to determine the influence of changing educational systems on it by using various documents and reports prepared by the Ministry of Education, Science and Technology Council and Turkish Education Foundation. Yılmaz reports a continuous process that began in 1960s, lost acceleration at the end of 70's and in the early 80's, and ended up as an elective biology course with reduced class hours given to the subject in the credit and grade passing systems of the last twenty years.

In addition to the developments in the last four decades, Yılmaz (1998) also reports on the emphasis given to biology education in the early years of the Republic. Biology has been taught in high schools for thirty-six years starting in 1924 under different names, for example "Nature" "Animal Physiology" and "Natural Sciences." Despite this the curriculum remained the same until the 1960s when foreign science curricula were first implemented. During the period of foreign curricula, hands-on learning and observation gained priority as the important science education methods. In addition to the changes in methodology, class hours allocated for biology courses also showed changes in time. These changes continued until the 1990s when a new education system was introduced in Turkish high schools. At the end of the following five years, the credit system was abolished and a grade-passing system started to be implemented. Biology has been a compulsory course for ninth graders since 1995, and an elective course for tenth and eleventh graders, with 2 class hours per week allocated to biology for each grade.

Yılmaz (1998) interprets the underlying reasons for these continuous changes as the need to meet the needs of the country in a quickly changing world where citizens increasingly need scientific knowledge. This is one of the main reasons for an emphasis on science education and the reason why various teaching-learning methodologies have been tried in the schools, and several curricula have been developed, adopted or revised since the early years of the Republic. Science education in Turkey has always experienced problems due to a lack of qualified science teachers, a loaded curriculum content, inadequate class hours, crowded classrooms, insufficient laboratory resources, and orientation towards rote learning among students (Turgut, 1990, Yılmaz, 1998).

Solutions to the above-mentioned problems have been sought for more than sixty years (Ekici, 1996) starting with the first Education Council in 1939. When the proposed solutions are examined, the emphasis given to the development of good-quality science curricula and teacher education can clearly be seen. Accordingly, science teachers are expected to help their students to realize the learning goals of the curricula, and to do this the teachers are expected to have rich subject area knowledge and a rich repertoire of teaching methodologies that they can use to transmit this knowledge to their students.

Following these ideas, Ekici (1996) looked at the reasons why teachers use specific teaching methodologies and the problems they face during instruction. 138 biology teachers from public, Anatolian and science high schools in Ankara participated in the survey, and semi-structured teacher interviews were conducted. At the end of the study, it was seen that teachers lecture most of the time, and that questioning, problem solving, project and group work were the other teaching methods used during instruction. Teachers expect their students to comprehend the subject matter, synthesize and evaluate the new knowledge, and to have an interest in biology. Age and the years of teaching experience are the two major determinants of the teaching methodology used by teachers. Young teachers between the ages of 20-29 and the ones with less teaching experience (1 to 10) used lectures more, while teachers over 30, and having more than 10 years of teaching experience, used questions most of the time during instruction. Neither of the groups spent much time on laboratory sessions with their students.

In addition to age and years of teaching experience, attendance at in-service training programs was identified, in Ekici's (1996) study, as another important factor influencing teachers to use different methods during instruction. It was found that teachers attending at in-service training use questioning and laboratory studies more than lecturing. However, there was no significant difference in the teaching methods used by teachers who attended in-service training and those who did not.

Characteristics of the subject matter, average student number in the classroom, physical facilities of the schools, a budget dedicated to biology courses, and familiarity with the teaching methodology are the other factors identified by Ekici (1998) as influence on teachers' preferences for teaching, 84% of the teachers participating in her study stated that they use traditional teaching methods in their classes because they are used to doing this and they believe that students learnt more efficiently using these methods. Only 19% of the teachers mentioned that they required in-service training programs to learn more about contemporary teaching methodologies and the subject matter they teach. More than half of the teachers stated that they face problems with crowded classrooms and insufficient facilities and the physical condition of their schools. These problems are more serious in public high schools than in Anatolian and science high schools.

Similar to Ekici, Yaman (1998) also reports lecturing and questioning to be the most commonly used teaching methodologies in biology classes, laboratory studies are rarely carried out due to insufficient facilities and the physical condition of schools. The other results of Yaman's study (1998), in which 254 teachers and 621 students all around the country participated, show that textbooks are the main sources of guidance for teachers and students during instruction, audio-visual instructional materials are rarely used in classrooms, and students do not participate actively in the lessons.

Turan (1996) also points to insufficient facilities and the physical condition of schools preventing effective biology education, noting that lessons are teacher-centered with students oriented to rote learning. She states that the class hours allocated for biology courses are not enough that laboratory studies are rarely carried out.

Similarly, insufficient laboratory conditions, crowded classrooms and time limitations were found to be the main reasons for using a laboratory once or twice a month in Erten's (1993) study. This study looked at sufficiency of biology laboratories and frequency of their usage in high schools. Questionnaires were filled out by 21 biology teachers and their 200 9^{th} grade biology students in three public schools in Ankara. It was reported that half of the participating teachers thought laboratory method to be the most efficient teaching method for biology education. Likewise, half of the participating students pointed out that laboratory studies help them to comprehend theoretical knowledge of biology in an efficient way. However, they also indicate there was not enough time to carry out experimental studies. They stated that charts, tables, and slides were used when laboratory studies could not be carried out in their biology classes.

In a previous study Akaydın and Soran (1992) looked at usage frequency for instructional materials in 9^{th} grade biology classes. Questionnaires were used to collect information from 60 biology teachers in 16 different cities. Researchers categorized instructional materials into nine groups; from live, concrete to abstract, verbal materials. The first group included live animals and concrete materials. The second group included models and special laboratory equipment. Motion pictures, pictures and photographs were included in the third and fourth groups. The fifth and sixth groups included slides, films, diagrams, graphs and maps, whereas the seventh, eighth and ninth groups included textbooks, and the blackboard. Akaydın and Soran (1992) use this categorization to explain the degree of application of biological knowledge in classrooms. They note the type of instructional materials used by teachers, give clues about the instructional methods employed by teachers in classrooms to teach biology. They reported that sixth, seventh, eighth and ninth group materials were the most frequently used, while third, fourth and fifth group materials were the least preferred instructional materials by the participating teachers. On the basis of these findings Akaydın and Soran conclude that teachers lecture most of the time in their biology classes.

Özbaş and Soran (1993) compared different dimensions of biology education in public, private and Anatolian high schools. 50 biology teachers (21 from public, 12 from private, 17 from Anatolian high schools) participated in their study from a randomly selected sample of 5 public, 5 private and 8 Anatolian high schools. At the end it was reported that private schools are in a better situation in terms of average student number in classrooms and laboratory conditions, in terms of their number and the sufficiency of equipment, than public and Anatolian high schools. Researchers explain the presence of insufficient instructional materials in public and Anatolian high schools by their limited budgets compared to private schools. The researchers also mentioned crowded classrooms, more than 35 students in a typical class, in public and Anatolian high schools as the main reason preventing teachers in these schools from using laboratory studies and causing them rather to orient them to lecture and use demonstrated experiments. Özbaş and Soran also indicate that a loaded curriculum content and lack of time are common problems for teachers in all school types.

Similarly, in a more recent study in which 500 students from 25 public high schools in Ankara participated, Dindar (2001) reports insufficient laboratory equipment, frequent changes in the textbooks, no experimentation in the laboratories, nothing contemporary about biology in the curriculum and lots of Latin words as the problems being faced by biology students.

Among those investigating biology education in Turkey, Öztürk's (1999) study is the one that is most directly related to the new high school biology curriculum and its implementation. The role of teachers in curriculum implementation was evaluated in this study. The implementation process was examined in a private high school where biology instruction was supported with rich resources and materials, and where class sizes were small for the Turkish context (30 students on the average). This should allow the curriculum to be implemented the way it was intended, and teachers should be able to be the ultimate determiners of the curriculum. However, it was found that there were differences between what was intended in the curriculum and what came out in the classroom.

Similar to the other studies Öztürk (1999) points to the teachers' view of curriculum in terms of large amounts of content to be covered and time as the overriding constraint to carry out the desirable implementation tasks like laboratory studies. She reports curriculum presented in a traditional and expository manner and intended curriculum activities to be rarely observed throughout the study. In addition to time as the overriding constraint, she also mentions the teachers' emphasis on the negative effect of university entrance examination on their instruction to their classes.

Other findings of her study show that classroom management affected the quality of instruction. Managing the classroom and combining it with instruction was hard for some teachers, especially for the ones with five years or less of teaching experience. She states that instruction was negatively influenced in novice teachers' classrooms and they had difficulties in maintaining academic focus. One of the most frequently used behavior management techniques she observed in these teachers' classrooms was dictation and writing on the board, and then the students would copy, usually without speaking, and as a result the students would become "engaged in the lesson". In the classes of teachers who were effective managers, a greater portion of class time was allocated to instruction, and each teacher had particular lesson formats with in which he/she could easily maintain classroom control and manage the instruction.

Öztürk (1999) concludes that the curriculum was implemented in different classrooms in different and unique ways. Teachers' decisions about subjects and classroom activities, teaching performance, attitudes and interactions with students, all affected curriculum implementation process in different ways. The implemented curriculum in different classrooms differed from each other and from the intended curriculum.

Öztürk (1999) also indicates that teachers taking part in her study naturally had different abilities and backgrounds and that these differences, of course, influenced the curriculum implementation process in different ways. Yet, she states one feature of instruction was common for all the teachers, the intended curriculum objectives required changes in the teaching behaviors of the participating teachers. The crucial change was the need to move from being teacher-centered towards being learner-centered. The main reason for this was that, being the central authority in the teacher-centered classroom, these teachers just transferred knowledge. However, simple transfer of knowledge does not help students to learn and integrate into their lives what they learn, and to understand the implications of biology for daily life.

2.5. Conclusion

The representative studies reviewed here focus mainly on teachers' classroom behaviors, their beliefs and perceptions and various instructional aspects while examining curriculum implementation. Observation techniques, focused interviews, questionnaires, and document analysis are the most commonly used methods in these studies.

Results of these studies show variations in the process of curriculum implementation by different teachers and in different schools. In most of the cases considerable discrepancies, mainly originating from teachers, are observed between intended and implemented curricula. However, a number of problems and issues are also reported to influence the process of implementation.

Gropued into four categories by Fullan and Pomfret in the late 1970's, various determinants of curriculum implementation are mainly about characteristics of the curriculum, strategies and tactics for implementation of the curriculum, characteristics of adopting units and characteristics of the macro sociopolitical units. Specifically research investigating curriculum implementation in the last four decades reports variety of situational factors such as physical setting of schools, availability of resources and facilities, access to existing and emerging technologies, physical aspects of the classroom environment, allocation and use of time, pressure of exams, textbooks, some teacher characteristics such as age, sex, years of teaching experience and educational background, some specific personal traits of teachers such as enthusiasm, preparedness, effectiveness in maintaining student attention, knowledge of science and pedagogy, beliefs, perceptions, attitudes, expectancies and priorities, teacher responses and action in the classroom, teacher – student interactions, student behavior and performance in the classroom and planning and evaluation as influencing the process of curriculum implementation.

The findings and suggestions made in the studies reviewed here guided this study in identifying the major points of focus and determining an appropriate mean to collect data about implementation process of the new high school biology curriculum. Similar to the other studies investigating curriculum implementation, this study focused on the teachers and their classroom behaviors and a survey questionnaire is developed in the light of the findings and suggestions of the studies reviewed here. The next chapter explains the methods used in this assessment study of high school biology curriculum implementation and influencing factors.

CHAPTER 3

METHOD

The overall design of the study, the research questions, research population and sample selection, the data collection instrument, and the methods used to collect and analyze the data are described in this chapter.

3.1. Overall Design of the Study

The aim of this study was to investigate the implementation process of the new high school biology curriculum in Turkey. An attempt is made to describe how the new curriculum has been implemented, how it is practiced in specific situations and to determine what factors have influenced or are influencing the implementation process. The major points of focus were teaching methods and techniques, and the instructional materials used during lessons, the physical structure and facilities of the schools, and local, school and classroom level factors that influence the process of curriculum implementation. Teacher characteristics, i.e. age, sex, years of teaching experience and attendance at in-service training programs, workshops and/or seminars, and beliefs and perceptions of curriculum and students, differences at school and local levels were examined specifically.

A survey questionnaire was used to obtain information about the implementation process and the factors influencing this process. Related literature was examined to prepare the questions for this questionnaire and a group of experts were consulted to validate the prepared questions. A representative sample of biology teachers selected using a two-step sampling strategy was then asked to answer the questions presented in the survey questionnaire.

Since the intention was to describe the process of implementation, to identify the factors influencing this process, and to examine the relationships between these factors and the process of curriculum implementation, both between these factors and the process of curriculum implementation descriptive and inferential analyses were conducted on questionnaire returns.

3.2. Research Questions

The specific research questions used in the study were:

1) How are the curriculum intentions implemented in biology classes?
   a) Which teaching methods and techniques are used to teach biology?
   b) Which instructional materials are used during instruction in biology classes?
   c) Are the physical structures and facilities of the schools appropriate for the curriculum to be implemented in the way it is intended?

2) What local, school and classroom level factors influence the implementation process of the new high school biology curriculum?

   a) Do teacher characteristics, i.e. age, sex, years of teaching experience, attendance at in-service training programs, influence the process of curriculum implementation that is teaching methods and techniques, and instructional materials used during instruction, frequency of laboratory usage and strategies followed during laboratory studies?

   b) Do teachers' beliefs and perceptions regarding the new curriculum and their students influence the process of curriculum implementation, i.e. teaching methods and techniques, and instructional materials used during instruction, frequency of laboratory usage and strategies followed during laboratory studies?

c) Is there any difference in the process of curriculum implementation, i.e. teaching methods and techniques, and instructional materials used during instruction, and the problems faced during instruction in public, Anatolian, and private/foundation schools?

d) Is there any difference in the problems faced during instruction in schools belonging to different strata of schooling levels?

3.3. Population and Selection of Sample

In our centralized Turkish educational system every teacher in any subject area is responsible for following the curriculum guidelines developed for their subject by the Ministry of National Education and for adapting these guidelines to the needs and interests of their students. Because teachers are the ones interpreting and giving life to the curriculum specifications of the Ministry, and translating the curriculum intentions into classroom practices, examining the process through the eyes of the teachers provides rich and valuable information about the implementation process for the new high school biology curriculum. The sample population for this study consisted of all the biology teachers working in public, Anatolian and private/foundation schools throughout Turkey.

Considering the number of schools (2328 schools in total; 1559 public, 352 private/foundation, and 417 Anatolian high schools) and making the assumption that there are at least two biology teachers working in each school, the size of the sample population was estimated to be 4656 teachers. Since it was thought to be hard to reach all the teachers a two-step sampling strategy was followed.

Sample size was set to 600 biology teachers taking into account return rates for questionnaires and the statistical analyses needed to be conducted using the data collected. This required that questionnaires were sent to 300 schools. The numbers of public, Anatolian and private/foundation schools within these 300 schools were determined using their representation proportions in the population. Since 67% of schools in Turkey are public, 18% are Anatolian and 15% are private/foundation schools, the sample consisted of 402 biology teachers working in 201 public, 108 biology teachers working in 54 Anatolian, and 90 biology teachers working in 45 private/foundation schools.

Stratified random and cluster random sampling strategies were followed to select the schools and to reach 600 biology teachers. Schooling level (DPT Report, 1998) was used as the main criteria to build five strata from which fifteen cities, Van, Şanlıurfa, Çorum, Antalya, Manisa, Kahramanmaraş, Çanakkale, Elazığ, Denizli, Trabzon, Kütahya, Kocaeli, Bursa, Ankara and Eskişehir, were randomly selected. Then questionnaires were sent to randomly selected public, Anatolian and private/foundation schools in these cities. Education Research and the Development Directorate (ERDD) facilitated this process.

Table 1 shows the number of public, Anatolian and private/foundation schools in randomly selected cities for each stratum. The first column of the table represents five strata built on the schooling level criteria the second column shows the number of schools in each stratum. Similarly other columns of the table show the number of public, Anatolian and private/foundation schools in each stratum and related columns entitled “percentage in population” indicate the proportion of these schools in the population.

Table 1. Sampling Strategy: Number and Distribution of Schools in Schooling Strata

POPULATION									SAMPLE				
Schooling Level	Number of Schools	% in Population	Public High Schools	% in Population	Anatolian High Schools	% in Population	Private/Found. Schools	% in Population	RANDOMLY SELECTED CITIES	Public High Schools	Anatolian High Schools	Private/Found. Schools	Total
20-29%	180	8	139	9	30	7	11	3	Van Şanlıurfa	8 12	1 4	1 1	10 17
30-39%	595	25	428	27	110	26	57	16	K.Maraş Çorum Manisa Antalya	15 10 13 17	3 2 4 5	1 1 3 4	19 13 20 26
40-49%	467	20	326	21	95	23	46	13	Denizli Kütahya Elazığ Trabzon Çanakkale	10 7 9 10 7	4 3 1 3 2	3 1 1 1 1	17 11 11 14 10
50-59%	384	16	258	16	74	18	52	15	Bursa Kocaeli	16 18	6 4	5 3	27 25
60-69%	658	28	379	24	99	24	180	51	Ankara Eskişehir	39 10	11 2	21 4	71 16
Total	2328		1559	67	417	18	352	15	15	201	55	51	306

The population percentages were used to select the required number of schools in each city and in each stratum. For instance, 258 public, 74 Anatolian, and 52 private/foundation schools in the fifth stratum stand for 16% of public, 18% of Anatolian, and 15% of foundation/private schools in the population (1559 public, 417 Anatolian, 352 private/foundation schools). Therefore, 32 public schools forming 16% of 201 public schools in the sample, 10 Anatolian schools forming 18% of 54 Anatolian schools in the sample, and 7 private/foundation schools forming 15% of 45 private/foundation schools in the sample were selected from this stratum.

The return rates for the questionnaires that were sent to schools selected through this sampling strategy show that the questionnaires were copied and answered by more teachers than expected in public and Anatolian high schools (return rates: 117.9% and 106.3%). Teachers in private/foundation schools were less likely to answer the questionnaires (return rate: 53.9%).

3.4. Data Collection Instrument

A survey questionnaire was used in this study to obtain information on the implementation of new high school biology curriculum and the factors influencing this process. The questionnaire entitled “Biology Curriculum and Instruction Evaluation Questionnaire” (see Appendix A) was developed by the researcher on the basis of review of related literature and curriculum characteristics, including four items derived from the literature in the third part.

The Biology Curriculum and Instruction Evaluation Questionnaire consisted of five parts and included 34 items. In the first part demographic questions were directed to collect general information about the teachers and the schools in which they worked. The second part included questions designed to assess the physical structure and facilities available in the schools for curriculum implementation, and to identify the teachers’ perceptions of the new curriculum. The questions in the third and fourth parts were related to the teaching methods, techniques and instructional materials used during instruction, and teachers’ beliefs and thoughts about the impact of biology lessons on their students. The last part of the questionnaire included open-ended questions about biology education and the implementation of the curriculum in general.

Prior to administration, the “Biology Curriculum and Instruction Evaluation Questionnaire” was submitted to a group of six experts in the field of ‘Curriculum and Instruction’ and ‘Biology Education’ for an assessment of its content validity. These experts were knowledgeable about the purpose of the new high school biology curriculum and purpose of the questionnaire. They were asked to review and judge the items in the questionnaire and to determine if they adequately sampled the domain of interest and how closely their content corresponded to the objectives and explanations for the implementation of the new biology curriculum.

After being revised in the light of experts' suggestions, the questionnaire was pilot tested in one public, two private and two Anatolian high schools in Ankara. Eighteen biology teachers in these schools were asked if the items on the questionnaire were clear and understandable, and if there was any necessary changes that needed to be made to the questionnaire as a whole. In order to check the reliability short interviews with the teachers were conducted immediately after the application of the questionaire and teachers' written and oral responses were compared. Following the final changes, the questionnaire was sent to randomly selected public, Anatolian and private/foundation schools in fifteen cities with the help of Educational Research and Development Directorate (ERDD).

3.5. Data Analysis

Closed and open-ended questions in the questionnaire allowed qualitative and quantitative data to be collected from the teachers. To analyze the qualitative data obtained from open-ended questions in the questionnaire, thematic categories for commonalities were used and coding was established. The qualitative data were then coded under these thematic categories and converted to frequencies that were used to help the researcher reach conclusions about teachers' beliefs and perceptions of the new high school biology curriculum, their students, and biology education in general.

Descriptive and inferential statistics were used to analyze quantitative data collected using closed questions in the questionnaire. Using descriptive statistics frequency distributions, means and standard deviations of teachers' responses were calculated. Using inferential statistics, cross-tabulations and chisquare tests, the implementation process of the new high school biology curriculum were compared across five schooling strata and through public, Anatolian and private/foundation schools. Inferential statistics were also used to compare classroom level differences like the effect of teacher characteristics, i.e. age, sex, years of teaching experience, attendance at in-service training programs, workshops and/or seminars, teachers beliefs and perceptions of the curriculum and their students regarding the implementation process.

3.6. Limitations of the Study

Questionnaires have the potential for reaching large samples. When specific questions are asked and open-ended questions are used to assess various aspects of respondents' thinking and approaches to the curriculum, questionnaires also become as effective as the other methods for determining about an implementation process (Fullan and Pomfret, 1977). Employing these characteristics, this study used a survey questionnaire en-titled "Biology Curriculum and Instruction Evaluation Questionnaire" to understand the implementation process of the new high school biology curriculum in Turkey.

A large sample of randomly selected teachers excludes external validity threats from the study. However, lack of demographic information about the population and lack of information about representation ratio of the sample group to the population create a threat for the representability of the study's sample.

Lack of students is one constraint of the study, because students are the ones who actively participate in the implementation process together with teachers and their beliefs, thoughts and perceptions are as important as teachers' beliefs and perceptions to describe the process of implementation. To reduce this constraint rich interpretative information drawn from teachers regarding their classroom activities and their students were collected using the questionnaire.

Another constraint of the study can be seen as the situations in which the questionnaires are applied because these can influence and differentiate teachers' responses. Although the rate of response in private/foundation schools was higher than 50%, this response can also be interpreted as the last constraint of the study that limits the generalization of the results to the implementation of the new high school biology curriculum in private/foundation schools across the Turkey.

CHAPTER 4

RESULTS

The information collected through the “Biology Curriculum and Instruction Evaluation Questionnaire” was used to describe the process of new high school biology curriculum implementation in this study. Addressing each research question, the findings are presented under the subtitles of “Demographic Information about Teachers” “Physical Structure and Facilities of Schools” “Perceptions of Biology Curriculum” “Student Attitudes and Influences on Curriculum Implementation” and “Instruction.” The first two sections give general information about teachers and the schools in which they work. The third and fourth sections examine teachers’ beliefs and perceptions of the new curriculum and students. The last section presents teaching methods, techniques and instructional materials used, and problems faced during instruction. The relationships between teacher characteristics, beliefs and perceptions, and teaching methods, techniques and instructional materials used during instruction, and laboratory studies carried out in biology classes are also explored in the last section.

4.1. Demographic Information About Teachers

Taking into account return rates and statistical analyses required 600 questionnaires were mailed to 300 high schools in the beginning of May 2002. Two months later 685 questionnaires had been returned showing that the questionnaires were copied and answered by more teachers than expected in public and Anatolian high schools. The overall return rate for the questionnaires was 114%. It was 117.9% in public high schools and 106.3% in Anatolian high schools; it decreased to 53.9% in private/foundation schools.

The related demographic information about teachers answering the questionnaires is presented in Table 2. The variance in the number of respondents (N) is due to missing data.

Table 2. Distribution of Respondents According to Background Variables

Background Variables		Frequency	Percentage
Age	30 and below	137	20.0
	31-35	161	23.5
	36-40	168	24.5
	41 and over	220	32.1
		N=686	
Sex	Female	405	60.9
	Male	260	39.1
		N=685	
Teaching experience	1-5 years	55	8.1
	6-9 years	181	26.5
	10-15 years	205	30.0
	16-20 years	118	17.3
	21 years and over	124	18.2
		N=683	
School type	Anatolian H.S.	122	17.9
	Private/Found.H.S.	63	9.2
	Public High School	498	72.9
		N=683	
Biology courses taught in the last three years	All	425	62.3
	Only one	101	14,8
	Only two	156	22.9
		N=682	
Work load (class hours per week)	15 hours and below	58	8.5
	16-20 hours	197	29.0
	21-25 hours	254	37.4
	26 hours and over	171	25.1
		N=680	

Table 2 (continued).

Attendance at in-service training programs	Never	338	49.3
	Once	166	24.2
	Twice	70	10.2
	More than 2 times	111	16.2
		N=685	
Evaluation of in-service training programs	Very helpful	79	21.9
	Moderately helpful	240	66.5
	Not helpful	42	11.6
		N=361	
Following news about biology in the media	Yes	320	46.7
	Moderately	344	50.2
	No	21	3.1
		N=685	
Committee Meeting	Never	148	22.7
	1-2/month	424	64.9
	3-4/month	61	9.3
	5-/month	20	3.1
		N=653	

N's vary somewhat due to missing data

As Table 2 displays, teachers working in public high schools form the largest group of respondents (72.9%) whereas teachers working in Anatolian high schools and private/foundation schools are represented at 17.9% and 9.2% respectively. The majority of these teachers was female (60.9%) and had 10-15 years of teaching experience (30%). One third fell in the age range of 41 and over (32.1%). Close to three-fifths of the teachers responding to the questionnaire had taught all of the biology courses (Biology 1, Biology 2, and Biology 3) in the last three years. Two fifths had a 21-25 class hours workload per week. 64.9% of the teachers participate in biology committee meetings once or twice per month. However, 22.7% of the teachers stated that they never participate in such meetings. More than half of the respondent teachers had attended in-service training programs, workshops and/or seminars for one, two or more than two times. However, a considerable percentage (49.3%) had never attended at such programs. 66.5% of the ones who attended at such programs evaluated these programs as moderately helpful. Similarly half of the teachers responding to the questionnaire stated that they moderately follow the news about biology in the media.

When teachers' opinions about in-service training programs, workshops and/or seminars are examined (see Table 3), it is seen that the teachers, who find these programs helpful, believe in the importance of being informed about the recent developments in biology and biology education, learning and discussing new and different teaching methods and techniques, and sharing ideas and opinions with teachers working in different schools and cities. Some of these teachers also mention how in-service training programs help them in preparing and practicing laboratory studies, and inform them about the usage of instructional materials and curriculum implementation. On the other hand, teachers who find in-service training programs, workshops and/or seminars moderately helpful or not helpful state that practical or laboratory studies are not carried out in these programs that old and known subjects are repeated, and most of the time is not appropriate to them. Similarly, they also complain about mentors, limited time and participation, facilities of places where these programs are held, and some other problems in organization. As shown in Table 3, they point to implementation in that they cannot implement the things they learn on these courses due to insufficient conditions in schools.

Table 3. Teachers' Perceptions of In-service Training Programs, Workshops, Seminars

HELPFUL	
Being informed about the recent developments in biology and in biology education	91
Learning and discussing new and different teaching methods and techniques	75
Sharing ideas and opinions with teachers working in different schools and cities	49
Being introduced and informed about the usage of instructional materials	14
Laboratory studies (preparing and practicing)	13
Being informed about curriculum implementation	7

Table 3 (continued).

MODERATELY HELPFUL/NOT HELPFUL	
Subject Matter	
Practical or laboratory studies are not carried	37
Old and known subjects are repeated	32
Subject matters are more appropriate for primary school science courses	25
Organization	
Mentors are inefficient	30
Participation and time is limited	21
Physical facilities (accommodation, technical support, etc.) are insufficient	17
Things are done without determining needs and planning activities	17
Time schedules of the sessions are inappropriate	11
Implementation	
Things that are learned cannot be implemented due to insufficient conditions in schools	13
Decisions taken in the meetings are not implemented	11

4.2. Physical Structure and Facilities of Schools

Since the physical structure and facilities of a school play an important role in the implementation process of any curriculum, questions assessing these features of public, Anatolian and private/foundation schools were directed to teachers in the "Biology Curriculum and Instruction Evaluation Questionnaire". The data collected through these questions is displayed in Table 4.

Table 4. Physical Structure and Facilities of Schools

		Frequency	Percentage
Number of biology teachers in the school	1 teacher	94	13.6
	2-3 teachers	272	39.4
	4-5 teachers	186	26.9
	6 teachers and above	139	20.1
		N=691	
Average student number in 9th grade classes	25 and below	32	6.2
	26-30 students	75	14.6
	31-35 students	91	17.7
	36-40 students	104	20.2
	41-45 students	87	16.9
	46-50 students	64	12.5
	50 and above	61	11.9
		N=514	

Table 4 (continued).

Average student number in 10th grade classes	25 and below	76	15.5
	26-30 students	98	20.0
	31-35 students	81	16.5
	36-40 students	132	26.9
	41-45 students	57	11.6
	46 and above	46	9.4
		N=490	
Average student number in 11th grade classes	25 and below	89	18.7
	26-30 students	120	25.2
	31-35 students	66	13.9
	36-40 students	118	24.8
	41-45 students	50	10.5
	46 and above	33	6.9
		N=476	
Equipment and instructional materials	Available	191	28.1
	Moderately available	385	56.7
	Not available	103	15.2
		N=679	
Technical support	Available	242	35.7
	Moderately available	282	41.6
	Not available	154	22.7
		N=678	
Biology laboratory	Available	506	75.1
	Not independent	87	12.9
	Not available	81	12.0
		N=674	
Equipment in the laboratory	Available	171	25.6
	Moderately available	347	52.0
	Not available	149	22.3
		N=667	

N's for each item vary due to missing responses

To search specifically for the appropriateness of the physical structure and facilities of the schools for new high school biology curriculum to be implemented in the way it is intended, the number of biology teachers, average student number in each grade, technical support, equipment and instructional materials, and structure of biology laboratories were examined. Teachers were also asked if they face problems, originating from the inadequacies of physical structure and facilities of schools, during instruction.

As seen in Table 4, there are generally 2-3 biology teachers working at a school (39.4%), and average student number is between 36-40 in the 9^{th} and 10^{th} grades (respectively in 20.2% and 20.0% of the schools). In the 11^{th} grade the average number of students in classrooms decreases to 26-30 (in 25.2% of the schools). In 75.1% of the schools, there is an independent biology laboratory. Similar to instructional materials, and technical support in the schools, equipment in these laboratories is moderately available.

In relation to physical structure and facilities at schools, teachers mentioned inadequate physical conditions in laboratories, old and insufficient laboratory equipment and crowded classrooms as the major problems they face during instruction. Lack of an independent biology laboratory is another constraint during instruction in laboratory that is shared with other science courses. Following insufficient and old instructional materials, teachers also complain about a lack of support, staff and laboratory preparation rooms. It was also stated that the available biology laboratories were used for other purposes in some schools. Table 5 displays the problems teachers face due to inadequacies of physical structure and facilities of schools.

Table 5. Problems Faced due to Inadequacies of Physical Structure and Facilities of Schools

Inadequacy of laboratory's physical conditions/insufficient and old equipment	105
Crowded classrooms	75
Lack of separate biology laboratories, common usage with other science courses	66
Insufficient and old instructional materials	55
Lack of staff and laboratory preparation rooms	32
Usage of laboratories with other purposes (classroom, library, meeting rooms)	11

4.3. Perceptions of Biology Curriculum

Similar to the findings of previous research reviewed in the second chapter, teachers' beliefs and perceptions are identified as major factors influencing the process of curriculum implementation in this study.

Focusing on teachers' beliefs and perceptions of biology education and the new curriculum, this section examines the usage of curriculum and searches for the changes in teaching with the new curriculum and factors influencing it to be implemented in the way intended.

4.3.1. Goals, Content and Teaching in Biology Education

Before assessing their beliefs and perceptions of new curriculum, questions were directed to determine teachers' beliefs and perceptions of the goals, content and teaching methodologies of biology education that they think to be ideal.

4.3.1.1. Required Knowledge, Skills and Attitudes About Biology

When asked for the required knowledge, skills and attitudes any high school graduate should have (see Table 6), the majority of teachers listed structure and function of human body, and structure and properties of living things, their diversity and interactions with each other as the content to be learned. The most important skill students should gain in biology classes is to be able to relate the things learned in class to daily life, transform them into practice and solve various problems. Saving nature, gaining environmental consciousness and being aware of biological importance of living things was the most important attitude that many of the respondent teachers believed to be necessary for their students.

Ecology and ecosystems, and cell structure and systems are the third and fourth important subject matters that any high school graduate should know about biology. Following being able to relate the things learned in class to daily life, teachers emphasize the importance of being able to do experiments, using laboratory equipment, and having healthy eating habits and an understanding of how to maintain body health as the other important skills their students should gain in school. Teachers also mention living consciously, being healthy and model individuals in society, and developing healthy behaviors, being sensitive about environmental health and cleanliness as the other important attitudes that their students should develop.

Table 6 displays the other important knowledge, skills and attitudes about biology that teachers believe to be important and necessary for any high school graduate to have.

Table 6. Teacher Perceptions of Required Knowledge, Skills and Attitudes About Biology

Knowledge	
Structure and function of human body	283
Structure and properties of living things, their diversity and interactions with each other	228
Ecology and ecosystems	146
Cell structure and systems	100
Basic knowledge of biology	55
Genetics, evolution and classification	48
General knowledge of health, medical biology and first aid	35
Organic and inorganic molecules, energy production and cycles	22
Reproduction, growth and development	17
Information facilitating daily life and problem solving	14
Information helping to solve questions in university entrance examination	14
Botany	13
Knowledge of science and scientific methods	11
Microorganisms	9
Biodiversity in Turkey	2

Table 6 (continued).

Skills	
To be able to relate things learned in the class to daily life, transform them into practice and solve problems	199
To be able to do experiments, and to use laboratory equipment	138
Having healthy eating habits and maintaining body health	137
Preserving natural resources, and saving living things and nature	49
To be able to do research and observation	45
To be able to interpret the things learned in the class, relate them to each other and to daily life, and by sharing this knowledge help people to be aware of their environment and life	62
Ability of scientific thinking	42
To be able to identify living things and classify them	18
To be able to use first aid rules	17
Following developments in biology and being sensitive to these developments	12
Problem solving	10
To be able to take care of animals and grow plants	8
To be able to get benefit from natural resources	8
To be able to solve university entrance examination questions	5
Independent studying and decision making	5
Managing projects	3
To be able to work in groups	1
Attitudes	
Saving nature, gaining environmental consciousness and being aware of biologic importance of living things	236
Living consciously, being healthy and model individuals	64
Developing healthy behaviors, being sensitive for environmental health and cleanliness	57
Taking subject matter as a part of life, using them in daily life and sharing with others	35
Being aware of the importance of biology and following developments in it	23

4.3.1.2. How Biology Should be Taught?

Taking into consideration the teaching methods and techniques, and instructional materials used during instruction, the roles of teacher and students, and learning environment, teachers' beliefs about the ways of effective biology teaching are examined in this section. Table 7 displays the data collected using the "Biology Curriculum and Instruction Evaluation Questionnaire" with this purpose.

Table 7. Teachers' Suggestions for Effective Biology Teaching

Teaching methods and techniques	
Emphasis should be given to experiments, field trips and observations	254
Student-centered methods (questioning, lecture, discussions etc.) should be used	62
Subject matter should be connected to daily life and examples should be given	60
Subject matter should be supported with experiments	53
Subject matter should be taught from simple to complex and without going into details	21
Evaluation should be done during the instruction and tests should be used	18
Current events should be followed and transferred to students	17
Subject matter should be repeated often	3
Instructional materials	
Visual instructional materials (slides, models, CD's etc)	209
Scientific publications and journals	12
Educational software	8
Other written sources	4
Living-nonliving instructional materials	3
Teacher	
Should motivate students to do research	18
Should help students to be aware of the importance of biology	15
Should be competent and creative in teaching and facilitate learning	10
Should motivate students to ask questions	3
Should motivate students to work together	1
Should help students to improve their laboratory skills	1
Student	
Should actively participate in the lesson	38
Should learn by living, seeing and doing	34
Should not learn by memorization	27
Should be able do experiment by himself/herself	11
Should do projects about the subject matter	11
Should be enthusiastic to learn and be prepared for the class	9
Should be able to make interpretations about subject matter	5
Class/Learning environment	
Teaching should be done in the laboratory	88
Schools and laboratories should have enough technical support and equipment	55
Student number in classes should be reduced	30
There should be independent and technically supported biology classes in every school	8
Student level should be consistent in each classroom	5
There should be a library in each school	3
Seminars, workshops and conferences should be organized	3
Curriculum	
Should be simplified, Latin words should be removed	16

As Table 7 shows the majority of teachers believe in the importance of doing experiments, taking field trips and using observation as the most efficient methods for teaching biology. Similarly, they emphasize the importance of using visual instructional materials, such as slides, models and CD's, to facilitate students' learning. A considerable number of teachers responding to the questionnaire underlined the necessity for teaching to be done in a laboratory, this requires sufficient technical support and equipment. Some of the teachers also called for reduction in class sizes.

One-tenth of the teachers stress a need for student-centered teaching methods to be used during instruction. They highlighted the need to connect subject matter to daily life and gave various examples. A number of teachers in this group pointed to the importance of active student participation in the lesson. Students should learn by living, seeing and doing. Therefore teachers should be competent and creative in teaching and facilitating students' learning. They should be able to motivate students to do research and help them to be aware of the importance of biology.

In addition to the teaching methods and techniques, and instructional materials used during instruction, teacher and student roles and learning environment, a considerable number of teachers also pointed to a need for a curriculum that was for effective biology teaching. They stated that curriculum should be simplified and that Latin words should be removed to help them to teach biology effectively.

4.3.2. Perceptions of New Biology Curriculum

In addition to their beliefs regarding effective biology teaching, teachers' beliefs and perceptions of the new high school biology curriculum also needed to be examined to determine if the curriculum can draw a response from teachers, if they agree with curriculum developers regarding effective ways of teaching biology, and if curriculum helped them to teach biology. The information collected through "Biology Curriculum and Instruction Evaluation Questionnaire" on this topic is displayed in Table 8 (N's for each item vary due to missing responses).

Table 8. Teacher Perceptions of New High School Biology Curriculum

		Frequency	Percentage
Curriculum is efficiently introduced	Yes	160	25.4
	Moderately	251	39.9
	No	218	34.7
		N=629	
Language of the curriculum is clear and can be easily understood	Yes	286	49.1
	Moderately	246	42.3
	No	50	8.6
		N=582	
Curriculum is efficient enough for practical and easy usage	Yes	177	30.8
	Moderately	313	54.5
	No	84	14.6
		N=574	
Curriculum helps in making lessons more effective andefficient	Yes	194	34.2
	Moderately	306	54.0
	No	67	11.8
		N=567	
Curriculum connects lessons to daily life	Yes	193	33.2
	Moderately	310	53.3
	No	79	13.6
		N=582	
Curriculum helps to improve students' problem solving skills	Yes	115	20.2
	Moderately	353	61.9
	No	102	17.9
		N=570	
Curriculum helps students to improve their creativity	Yes	104	18.0
	Moderately	341	59.0
	No	133	23.0
		N=578	
Goals of the curriculum are appropriate for biology education	Yes	237	41.6
	Moderately	277	48.6
	No	56	9.8
		N=570	

Table 8 (continued).

Curriculum content is selected and organized appropriately	Yes	223	40.1
	Moderately	261	46.9
	No	72	12.9
		N=556	
Units of the curriculum have a good sequence	Yes	273	48.4
	Moderately	181	32.1
	No	110	19.5
		N=564	
Subject related examples and problems are efficient	Yes	106	18.9
	Moderately	224	39.9
	No	231	41.2
		N=561	
Suggested experiments, f. trips, obs., projects are appropriate	Yes	189	33.6
	Moderately	294	52.2
	No	80	14.2
		N=563	
Suggested instructional materials are efficient	Yes	156	27.9
	Moderately	237	42.3
	No	167	29.8
		N=560	
Teaching-learning activities help in planning and during ins.	Yes	197	35.1
	Moderately	314	56.0
	No	50	8.9
		N=561	
Curriculum is appropriate to student level	Yes	241	42.4
	Moderately	257	45.2
	No	71	12.5
		N=569	

As can be seen from Table 8 more than half of the teachers agreed or moderately agreed that curriculum has been efficiently introduced. However, one third of the teachers responding to the questionnaire disagreed with the idea that curriculum had been efficiently introduced. 91.4% of the teachers find the language of curriculum clear and said it could be easily understood. Although 85.3% of the teachers thought that curriculum helps them to make their lessons more effective and efficient, more than half of them (54.0%) stated that it is moderately helpful. Similarly the total amount of teachers thinking that curriculum connects lessons to daily life was close to 90% but the percentage stating that this effect was moderate was more than 50%. The same is true for the following items, more than 85% of the teachers found the curriculum helpful for improving creativity and problem solving skills of students, the goals of the curriculum were appropriate for biology education, the curriculum content was selected and organized appropriately, suggested experiments, field trips, observations and projects in the curriculum were appropriate, suggested instructional materials were efficient, teaching-learning activities outlined in the curriculum help in planning and during instruction, and curriculum was appropriate to student level. However, for all these items the percentage of teachers stating this was moderately so was more than the ones agreeing fully.

In the items about the sequence of units and subject related examples and problems in the curriculum, it is again seen that more than half of the teachers agree with units having a good sequence and efficiency of examples and problems. However, considerable percentage of teachers (41.2%) state that subject related examples and problems in the curriculum were not efficient. In contrast to the other items, it is also found that teachers agreeing fully with the statement on the good sequence of the units in the curriculum were more than the ones stating it was moderate.

Additionally some teachers called for simplification and reorganization of curriculum. They state that the curriculum should not be changed so often but new textbooks should be prepared and revised each year. They pointed to a need for an increase in class hours and instructional material support for schools where laboratory conditions should also be improved. They also pointed out to the need for teachers to attend in-service training programs for laboratory studies. These thoughts and suggestions for the new Turkish high school biology curriculum and its implementation are shown in Table 9.

Table 9. Teachers' Other Thoughts and Suggestions for Curriculum and Its Implementation

Curriculum	
It should be simplified, reorganized and not be changed so often	56
Class hours should be increased	43
Curriculum and university entrance examination should be related to each other	17
Laboratory guidebooks should be prepared, no. of experiments should be increased	14
Teacher guidebooks should be prepared	7
Subject matter of Health course should be integrated to biology courses	5
Teachers and specialists should work together for developing curriculum	4
Implementation courses should be integrated into biology courses	3
Instructional materials	
New textbooks should be prepared, and revised each year	34
Ministry of Education should prepare books and educational software about biology and suggest other sources	7
Physical conditions and facilities	
Schools should be supported with instructional materials, and conditions of laboratories should be improved	26
There should be independent biology classes in each school	8
Teachers	
Should participate in in-service training programs	22
About laboratory studies and using laboratory equipment	12
About introduction of curriculum and its implementation	4
Should be supported with new scientific publications	5
Teacher education should be improved	4
Organize science fairs and competitions in which students are awarded	2

4.3.2.1. How Do Teachers Use the New Curriculum?

Although teachers answering questions in this section were fewer than for teachers answering other questions, the responses of teachers answering the related question help to describe the usage of new biology curriculum by teachers. Grouped into two (see Table 10), these responses show that teachers use the curriculum mainly during instructional planning and for determining teaching/learning methods and techniques. The curriculum helps them to determine the content, goals, objectives, experiments and teaching/learning strategies to be used during instruction. It also facilitates the preparation and implementation of yearly and daily plans. Teachers state that suggested teaching learning strategies in the curriculum make the teaching process easier and relate subject matter to daily life. They also pointed to the emphasis put in the curriculum on using audiovisual instructional materials and practical studies during instruction.

In addition to teachers using the curriculum during instructional planning and for teaching learning activities, there was a small group of teachers who stated that curriculum did not help them specifically in preparing students for university entrance examination. The loaded curriculum content is detailed and contains lots of Latin words. Teachers' responses to the questions about the usage of curriculum are displayed in Table 10.

Table 10. Teachers' Perceptions of Ways of Curriculum Use

Instructional planning	
Determination of content, goals and objectives	78
Determination of teaching/learning strategies, choosing and doing experiments	48
Preparation and implementation of yearly and daily plans	46
Selection of measurement and evaluation techniques	9
Usage of instructional materials	4
Teaching/learning methods and techniques	
Making teaching process easier	17
Relating subject matter to daily life	11
Emphasis on using audiovisual instructional materials and practical studies	9
Increase in student participation	5
Preparing students to university entrance examination	4
Curriculum does not help	
In preparing students to university entrance examination	6
Loaded, detailed and contains lots of Latin words	5
Instead of curriculum textbook is used	2

4.3.2.2. Changes in Teaching with the New Curriculum

The changes that teachers experienced when teaching using the new curriculum were grouped into two categories as positive and negative changes. There was also a third group containing teachers who stated that there had been no changes in teaching practices brought by use of the new curriculum. Teachers' responses regarding the changes they experienced using the new curriculum are shown in Table 11.

Table 11. Changes Experienced in Teaching with New Biology Curriculum

Positive changes	
Subject matter	
Sequence of subject matter makes it more understandable	70
Contemporary, understandable and related to daily life	31
Simplified and not repeated	25
More appropriate for the university entrance examination (more test questions)	12
Instruction	
Role of students	
Increase in participation and interest in subject matter	46
Leaving rote learning	5
Teaching methods and techniques	
Increase in the usage of audiovisual instructional materials	13
Emphasis on laboratory studies, field trips and observations	12
More active teaching and learning processes	7
Doing experiments and giving more examples make teaching/learning process easier	5
Negative changes	
Subject matter	
Detailed, long and hard to understand, orient students to memorize	16
Sequence of subject matter makes understanding harder	12
Content is insufficient for university entrance examination	3
Time	
Time allocation for units is not appropriate	6
Due to decreased class hours, laboratory studies cannot be carried out	6
Textbook	
Inefficient and not appropriate for the curriculum	6
No change	**56**
Content, sequence of the units and experiments are same with the old curriculum	23
Due to insufficient conditions in the school, changes of the new curriculum cannot be implemented	11

In the first group, teachers listed positive changes in subject matter and instruction using the new curriculum. For the subject matter they indicate that it had been simplified and made contemporary and understandable. It is related to daily life and the sequence of learning set out facilitates understanding for students. Teachers saw the positive changes in instruction as being quoted on the role of students and teaching methods and techniques. Teachers stressed an increase in student participation during lessons and an increase in student interest in the subject matter. They also pointed to an increase in the use of audiovisual instructional materials and an emphasis on laboratory studies, field trips and observations during instruction.

The negative changes teachers had experienced with the new curriculum centered on subject matter, time and textbooks. Teachers complained about the subject matter being too detailed, long and oriented towards students memorizing the information. Additionally, the sequencing of the material made understanding harder. They also pointed to time, which was not allocated appropriately for units. Teachers also found the textbooks to be inefficient and not appropriate for the curriculum.

Teachers, who stated that no changes had occurred due to the new curriculum, said that content, sequence of the units and experiments in the new curriculum were same as the old curriculum. A percentage of teachers also complained about insufficient conditions in their schools so that changes in the curriculum could not be implemented. One of the teachers states, "Due to insufficient laboratory conditions and limited class hours, we cannot motivate students to do research and ask questions. Therefore they tend to memorize"

4.3.2.3. Factors Influencing Learning Environment and Curriculum Implementation

The factors positively or negatively influencing learning environment and curriculum implementation are shown in Table 12. As can be seen from table, teachers mainly identified student, curriculum, instruction, school and family-related factors as influencing the learning environment and the process of curriculum implementation. They stated that when students are interested in the subject matter and motivated to learn, the learning environment and the process of curriculum implementation are influenced positively. Connecting interesting and contemporary subject matter in the curriculum to daily life and the use of visual and other instructional materials are other factors that influence positively the learning environment and the process of curriculum implementation. Teachers also listed experiments, observation, field trips and use of lots of examples, appropriateness of school and laboratory facilities, and competent teachers who refresh their knowledge and skills to positively as factors that influence the learning environment and the process of curriculum implementation.

Table 12. Teachers' Perceptions of Factors Influencing Learning Environment and Curriculum Implementation

Positive Factors	
Students	
Being interested in subject matter and motivated to learn	21
Being high level students	8
Their participation	2
Curriculum	
Subject matter connected to daily life, interesting and contemporary	19
Sequence of subject matter from basics to complex, and their division in each grade	3
Sufficient time	2
Language of curriculum can be easily understood	1
Instructional materials	
Usage of visual and other instructional materials	14
Variety of sources	3
Teaching methods and techniques	
Doing experiments, observations and field trips, using lots of examples	10
Using student-centered teaching methods and techniques	7
Teaching in the laboratory	2
Connecting subject matter to university entrance examination	1
Doing projects about subject matter	1
Facilities and opportunities	
Appropriateness of school, laboratory and class facilities	9
Sufficient and easily found instructional materials	8
Not so many students in classrooms	8
Appropriate environmental conditions for observation and examination	1
Teacher	
Being competent and refreshing their knowledge and teaching skills	6
Communicating with students	2
Family's attitude	**2**
Negative Factors	
Physical Facilities and Opportunities	
Crowded classroom with students in different levels	274
Insufficient instructional materials	64
Insufficient technical supports and structure in schools	62
Insufficient laboratory conditions and equipment	59
Student	
Low level students having problem in learning the subject matter	105
No interest in subject matter due to their majors for university entrance examination	81
Facing problems in learning, inability to connect subject matter to daily life and tending to memorize	36
No interest ending with no participation and discipline problems	5
Curriculum	
Class hours are not enough	84
Loaded and detailed	59
Lots of Latin words	18

Table 12 (continued).

Textbook is not sufficient	4
No teacher laboratory guide book	1
University entrance examination and the number of biology questions	**37**
Teaching methods and techniques	
Just lecturing, no experiments, observation and field trips	26
Teacher	
Incompetence, being poor in adapting to developments	13
No interest of families	**7**
Administrative problems	**4**

Physical facilities and opportunities of schools were first on the list of factors negatively influencing the learning environment and process of curriculum implementation. Teachers most frequently stated crowded classrooms with students in different levels as a problem. This was followed by insufficient instructional materials, technical support and the structure in schools as the major negative factors influencing the learning environment and the process of curriculum implementation. Student related factors form the second group, low-level students have problems learning the curriculum material and some of the students were not interested in the subject matter due to their majors for the university entrance examination. The other factors negatively influencing the learning environment and process of curriculum implementation concerned the curriculum, university entrance examination, teaching methods and techniques, teachers, families and school administration.

Teachers mentioned that class hours were not enough for the loaded and detailed curriculum content. University entrance examination was a negative factor influencing learning environment and process of curriculum implementation. Teachers also stated that they just lecture and cannot do experiments, observation and field trip studies. Incompetent teachers who are poor in adapting to developments, families who are not interested in their children and administrative problems are the other factors that influence negatively the learning environment and the process of curriculum implementation.

4.4. Student Attitudes and Influences on Curriculum Implementation

As it was explained in the third chapter, a lack of students' viewpoints is one of the constraints of this study because students are the ones who actively participate in the implementation process together with teachers thus their beliefs and perceptions about curriculum are as important as teachers' beliefs and perceptions to describe the implementation process of the new biology curriculum in Turkey. However, using the "Biology Curriculum and Instruction Evaluation Questionnaire" rich descriptive data about classroom activities and students was collected from the teachers. These beliefs and perceptions of teachers about their students were specifically examined under the subtitles of "Beliefs and Perceptions of Students" "Why Students Like Biology Classes?" "Why Students Don't Like Biology Classes?" and "How Students' Level Influence the Process of Curriculum Implementation and Learning Environment?"

4.4.1. Beliefs on Students' Perceptions of Biology Lessons

Their responses show that nearly all of the teachers (more than 95%) believed their students were interested in biology, saw biology as an important course, actively participated in the lesson, and could connect lesson content to daily life. Teachers also thought that biology lessons increased students' interest in scientific thinking, learning and research, and answered students' questions about biology. However, for the items about interest in biology, scientific thinking, learning and research, active participation in lessons, and connecting lesson content to daily life, the percentage of teachers stating that this was moderate was more than that of those the ones agreeing fully. Table 13 shows teachers' beliefs and perceptions of their students.

Table 13. Teacher Beliefs on Students' Perceptions of Biology Lessons

		Frequency	Percentage
Students are interested in biology	Yes	279	41.5
	Moderately	375	55.7
	No	19	2.8
		N=673	
Students see biology as an important course	Yes	337	49.9
	Moderately	292	43.3
	No	46	6.8
		N=675	
Students actively participate in the lesson	Yes	211	31.5
	Moderately	429	64.0
	No	30	4.5
		N=670	
Biology lessons increase students' interest in scientific thinking, learning and research	Yes	290	43.0
	Moderately	328	48.7
	No	56	8.3
		N=674	
Lessons answer students' questions about biology	Yes	326	48.4
	Moderately	329	48.9
	No	18	2.7
		N=673	
Students can connect lesson content to daily life	Yes	250	37.3
	Moderately	386	57.6
	No	34	5.1
		N=670	

N's for each item vary due to missing responses

4.4.2. Why Students Like Biology Classes?

The majority of teachers stated that their students believed in the necessity of learning about the human body, other living things and nature that this was one of the main reasons they liked biology classes. According to their teachers the other reasons students liked biology classes were using new knowledge in daily life, belief in biology as a way to help in a future profession and it contains interesting subject matter. Nearly half of the teachers also mention that students enjoyed doing experiments and found biology teaching methods attractive. Since biology is a selective subject in the university entrance examination, some of the teachers indicated that this was another reason for students to like biology classes. The teacher's knowledge and attitude toward students was also mentioned as one of the reasons for students to like biology classes. Teachers' beliefs about why their students to like the biology classes are shown in Table 14.

Table 14. Teachers' Beliefs About Reasons of Students to Like Biology Lessons

	Frequency	Percentage
It is necessary to learn about human body, other living things and nature	583	86.9
Newly learned things can be used in daily life	364	54.2
Biology will help in a future profession	333	49.6
Subject matter is interesting	325	48.5
Doing experiments is enjoyable	308	45.9
Teaching methods are attractive	280	41.7
Others (university entrance examination, teachers, etc.)	78	11.6

4.4.3. Why Students Don't Like Biology Classes?

When teachers were asked to indicate what reasons students had for disliking biology (see Table 15), 53.7% of the teachers indicated that students found the subject matter hard; 51.4% teachers mentioned doing experiments with lots of students; 47.9% mentioned students' beliefs that they learnt unnecessary subject matter in biology classes; 41.3% of the responding teachers stated lack of practical studies and experiments, and 34.3% mentioned no use of visual instructional materials during instruction.

Table 15. Teachers' Beliefs About Reasons of Students to Dislike Biology Classes

	Frequency	Percentage
Subject matter is hard to learn	355	53.7
Experiments are done with lots of students	340	51.4
Unnecessary subject matters are taught	316	47.9
Practical studies and experiments about subject matters can not be done	273	41.3
Slides, models, tables, etc. about subject matter are not shown	226	34.3
Curriculum content does not include contemporary scientific knowledge	149	22.5
Subject matter does not include information about daily life	105	15.9
Figures and charts are not used during lessons	37	5.6
Others (subject matter, university entrance examnation, etc.)	150	22.7

A considerable percentage of teachers also indicated a lack of contemporary scientific knowledge and information about daily life in the curriculum content when they were asked to indicate what reasons students had for disliking biology.

As Table 15 shows 22.7% of teachers stated there were other reasons for students to dislike biology classes. The teachers indicated subject matter, university entrance examination and anxiety regarding success in the subject as the major reasons of students to dislike biology classes. As said by their teachers, students believe that subject matter is hard to learn, requires memorization and is therefore easily forgotten. They face problems in learning subject matter, which is not interesting, along with problems with the teaching methods. For the university entrance examination, teachers mentioned the number of biology questions, which is less compared to the questions of other science courses, and their structure that is long and requires higher levels of reasoning. Success anxiety and negative relationships with teachers are two other reasons identified by teachers for their students to disliking biology classes. Teachers' beliefs about the reasons for their students disliking biology classes are shown in Table 16.

Table 16. Other Reasons of Students to Dislike Biology Classes

Subject matter and Inability to learn easily	
Requires memorization, is hard to learn and forgotten easily	40
Facing problems in learning the subject matter and foreign words	38
Subject matter and teaching methods are not interesting	25
It's hard to relate subject matter to each other	4
Curriculum is loaded and subject matter is detailed	3
University Entrance Examination	
There are not so many biology questions	21
Questions are long, hard and require interpretation	10
No interest in biology classes due to major fields selected for the exam	9
Low success rate	5
Anxiety of success	
Pass/failure anxiety	5
Negative relationships between teachers and students	**3**

4.4.4. How Students' Level Influences the Process of Curriculum Implementation and Learning Environment?

The rich interpretive information collected about classroom activities and students (see Table 17) also helped to determine how students' level influences the process of curriculum implementation and learning environment. Grouped into three categories, this information showed that instruction becomes "more efficient and easygoing" in classes where the student level is high. In contrast, it becomes harder in classes where the student level is low. Interest in the subject matter increases, and more responsible behavior is observed in classes where the student level is high. Similarly, participation also increases; students comment on subject matter, ask questions and discuss their work. However, in classes where the student level is low, teachers report having to simplify the subject matter and to repeat it a number of times. Teachers complained that low-level students are not interested in learning or in the course. Therefore, success and participation in classroom activities decreases and problems are faced with classroom management. Similar problems were also mentioned for the classes where high and low level students are taught together. It is stated that students who are not interested in lessons negatively influence other students, and in so doing cause various teaching learning activities to become harder in these classes. Students' attention and participation in mixed level classrooms also decrease. Fifty of the respondent teachers also indicate that primary school graduates have too low level of biology education for the high school biology courses. The influence of student level on curriculum implementation and the learning environment are shown in Table 17.

Table 17. Influence of Student Level on Curriculum Implementation and Learning Environment

Classes where student level is high	
Instruction becomes more efficient and easygoing	123
Interest in the subject matter increases, more responsible behaviors are observed	46
Participation increases	44
More discussion and comment, increase in the amount of questions	37
Learning becomes easier and faster	20
Increase in the number of teaching learning activities, using student-centered teaching methods and teaching in detail	15
Increase in class success	11
Connecting subject matter to daily life	3
Increase in teacher motivation to teach and do research	2
Classes where the student level is low	
Doing various teaching-learning activities becomes harder	124
Subject matter is simplified and repeated for lots of time	84
No interest in learning and course	55
Decrease in class success	33
Problems in classroom management due to easily lost interest and attention	30
Decrease in participation in teaching learning activities	24
Inability to relate subject matter to each other, to daily life, tendency to rote learning	11
Classes where high and low level students are taught together	
Problems during instruction, inability to relate subject matters to each other	25
Students who are not interested in the subject matter are influencing others in a negative way	18
Doing teaching-learning activities become harder and they decrease in number	12
Decrease in attention and participation	10
Subject matter simplified for low-level students bores high level students	3
Decrease in class success	1

One of the teachers explained that unfamiliarity of students with critical thinking, problem solving and scientific research means that they tend to take notes and then memorize the notes. Therefore they think learning biology is hard. Another teacher said,

> When I compare my 10^{th} grade and 11^{th} grade students, I see my 10^{th} grade students are more interested in subject matter and doing experiments. In the 11^{th} grade those students become anxious because of university entrance examination. Instead of learning, increasing the graduation grade becomes more important. They start to plan for short periods of time. The university entrance examination makes each student, low or high level, similar to each other.

4.5. Instruction

This section describes how the new Turkish high school biology curriculum is being implemented in classrooms, what teaching methods and techniques, and instructional materials are used, and which problems are faced during instruction, how often laboratory studies are carried out and which strategies are followed during laboratory studies. The relationships between the teachers' characteristics, beliefs and perceptions, and teaching methods, techniques and instructional materials used during instruction, and laboratory studies carried out in biology classes are also explored in this section to address the second research question of the study.

4.5.1. Teaching Methods and Techniques Used During Instruction

The teachers' responses (see Table 18) showed that questioning was the most frequently used teaching method in biology classes. The other teaching methods and techniques commonly used during instruction were lecture and discussion. Teachers stated that they sometimes use the demonstration method. Field trips, observations and instructional technology were rarely used by teachers during instruction. The means and standard deviation scores for the teaching methods and techniques used by teachers in teaching biology are shown in Table 18.

Table 18. Teaching Methods and Techniques Used During Instruction

	Mean	Std. Dev.	%	N
Questioning	4.24	0.62	90.7	678
Lecture	3.71	0.96	61.7	658
Discussion	3.35	0.81	36.4	663
Demonstration	2.93	0.95	25.4	657
Field trips-observations	2.03	0.88	72.7	646
Instructional technology (Softwares, CDs etc.)	1.80	1.10	73.3	646

N 's for each item vary due to missing responses, and items in the table are listed in order of means

When use of the different teaching methods and techniques was examined, the differences in use were found to depend on school type, some of the teachers' characteristics such as age, sex, teaching experience and attendance at in-service training programs, workshops and/or seminars, and some of the teachers' beliefs and perceptions of the new curriculum and students were identified as factors influencing the teaching methods that were used.

Teachers working in Anatolian, private/foundation and public high schools used different teaching methods and techniques during instruction as shown in Table 19. While teachers in Anatolian high schools lectured more and used questioning often ($p<0.001$ and $p=0.01$ respectively), teachers in private/foundation schools used demonstration, field trips, observations and instructional technology more often than the teachers in Anatolian and public high schools ($p<0.001$, $p<0.001$ and $p<0.001$ respectively) for teaching biology.

Table 19. Use of Teaching Methods and Techniques by School Type

Lecture, X^2 (df=8, N=654)=23.10, p<0.001	Never N=9 %	Rarely N=62 %	Sometimes N=180 %	Often N=262 %	Always N=141 %
Anatolian High School	0.85	5.08	27.12	47.46	19.49
Private/Foundation School	1.61	24.19	19.35	40.32	14.52
Public High School	1.48	8.65	28.69	38.19	23.00

Table 19 (continued).

Questioning, X^2 (df=8, N=674)=20.58, p=0.01					
	Never N=1 %	Rarely N=1 %	Sometimes N=60 %	Often N=388 %	Always N=224 %
Anatolian High School	0	0.82	8.20	66.39	24.59
Private/Foundation School	1.59	0	7.94	60.32	30.16
Public High School	0	0	9.20	55.01	35.79
Demonstration, X^2 (df=8, N=653)=43.87, p<0.001					
	Never N=46 %	Rarely N=150 %	Sometimes N=292 %	Often N=135 %	Always N=30 %
Anatolian High School	0.82	21.31	44.26	27.05	6.56
Private/Foundation School	3.23	14.52	30.65	40.32	11.29
Public High School	9.17	24.52	46.70	16.42	3.20
Field Trips and Observations, X^2 (df=8, N=643)=64.28, p<0.001					
	Never N=195 %	Rarely N=274 %	Sometimes N=141 %	Often N=27 %	Always N=6 %
Anatolian High School	25.42	45.76	21.19	5.93	1.69
Private/Foundation School	5.08	27.12	54.24	11.86	1.69
Public High School	34.76	43.78	18.03	2.79	0.64
Instructional Technology, X^2 (df=8, N=643)=86.88, p<0.001					
	Never N=373 %	Rarely N=99 %	Sometimes N=109 %	Often N=49 %	Always N=13 %
Anatolian High School	48.25	28.95	11.40	9.65	1.75
Private/Foundation School	15.79	17.54	47.37	12.28	7.02
Public High School	65.47	11.86	14.62	6.57	1.48

Following school types, teacher characteristics were also identified as factors influencing the type of teaching methods and techniques used during instruction. For instance, there is a significant difference in some teaching methods and techniques used by teachers in different age groups (see Table 20). The teachers younger than 30 and the ones between 36-40 years of age lectured more often ($p<0.001$) and teachers younger than 30 and between the ages of 31-35 used the demonstration method ($p=0.01$) more often than the teachers in other age groups. The percentages of teachers in different age groups who mentioned how often they lectured and used the demonstration method to teaching biology are given in Table 20.

Table 20. Use of Teaching Methods and Techniques by Age

Lecture: X^2 (df=12, N=657)=29.87, p<0.001					
	Never % N=9	Rarely % N=63	Sometimes % N=179	Often % N=264	Always % N=142
<30 years	0.77	13.18	18.60	51.16	16.28
31-35	1.28	5.13	26.92	41.67	25.0
36-40	2.5	9.38	23.12	43.13	21.88
>41 years	0.94	10.85	35.85	30.19	22.17
Demonstration, X^2 (df=12, N=656)=26.42, p=0.01					
	Never % N=46	Rarely % N=151	Sometimes % N=292	Often % N=136	Always % N=31
<30	10.16	26.56	28.91	29.69	4.69
31-35	4.49	23.08	46.79	21.15	4.49
36-40	10.76	20.25	48.10	17.09	3.80
>41 years	4.21	22.90	49.53	17.76	5.61

When female and male teachers were compared for the teaching methods and techniques they used during instruction, it was found that female teachers used the questioning technique more often than male teachers during instruction (p<0.001). The frequency with which male and female teachers used the questioning technique in their classes to teach biology is shown in Table 21.

Table 21. Use of Teaching Methods and Techniques by Sex

Questioning, X^2 (df=4, N=656)=25.54, p<0.001					
	Never % N=1	Rarely % N=1	Sometimes % N=58	Often % N=381	Always % N=215
Female	0.25	0.25	4.50	59.75	35.25
Male	-	-	15.63	55.47	28.91

Similarly there is a significant difference in the teaching methods and techniques used by teachers with different years of teaching experience (see Table 22a). While teachers with more than 20 years of teaching experience stated that they always lectured (p=0.01), teachers with 1-5 years of teaching experience used the demonstration method more often during instruction (p=0.01). The percentages of the teachers with different years of teaching experience and that mentioned how often they lectured and used the demonstration method for teaching biology are given in Table 22a.

Table 22a. Use of Teaching Methods and Techniques by Teaching Experience

Lecture, X^2 (df=16, N=654)=31.36, p=0.01					
	Never N=9 %	Rarely N=63 %	Sometimes N=177 %	Often N=263 %	Always N=142 %
1-5 years	1.96	15.69	21.57	45.10	15.69
6-9 years	0.57	8.05	24.14	45.40	21.84
10-15 years	1.53	7.65	23.47	45.41	21.94
16-20 years	3.57	14.29	29.46	34.82	17.86
>20 years	0.00	8.26	37.19	27.27	27.27
Demonstration, X^2 (df=16, N=653)=31.93, p=0.01					
	Never N=46 %	Rarely N=149 %	Sometimes N=292 %	Often N=135 %	Always N=31 %
1-5 years	3.92	27.45	27.45	33.33	7.84
6-9 years	12.64	21.26	39.08	22.41	4.60
10-15 years	7.77	23.83	43.52	20.21	4.66
16-20 years	1.77	22.12	56.64	15.93	3.54
>20 years	4.10	22.13	50.82	18.03	4.92

As shown in Table 22b below, there was also a significant difference in the way field trips, observations and instructional technology were used by teachers with different years of teaching experience (p=0.04 and p<0.001 respectively). However, contrasting with the lecturing and demonstration methods, percentage of teachers who stated that they never or rarely used these methods was more than that for teachers who sometimes, often or always used field trips, observation and instructional technology. The percentage of teachers who did not use field trips and observations in the group of teachers with 10-15 and 16-20 years of teaching experience was greater than the percentage for the other groups. Similarly, teachers in the third and fifth teaching experience groups (10-15 and more than 20 years) stated that they use instructional technology less than teachers in the other groups.

Table 22b. Use of Teaching Methods and Techniques by Teaching Experience

Field trips-observations, X^2 (df=16, N=642)=27.03, p=0.04					
	Never N=193 %	Rarely N=273 %	Sometimes N=143 %	Often N=27 %	Always N=6 %
1-5 years	17.65	43.14	29.41	9.80	0.00
6-9 years	30.23	47.67	18.60	1.74	1.74
10-15 years	32.12	45.08	19.69	2.59	0.52
16-20 years	34.91	35.85	22.64	4.72	1.89
>20 years	27.5	36.67	28.33	7.5	0.00
Instructional technology, X^2 (df=16, N=642)=35.13, p<0.001					
	Never N=372 %	Rarely N=99 %	Sometimes N=109 %	Often N=49 %	Always N=13 %
1-5 years	34.62	23.08	26.92	7.69	7.69
6-9 years	58.33	15.48	13.69	10.71	1.79
10-15 years	62.30	18.32	13.61	4.19	1.57
16-20 years	56.76	11.71	23.42	6.31	1.80
>20 years	61.67	10.83	16.67	10.00	0.83

There was a significant difference between the teaching methods and techniques used by teachers who had never attended in-service training programs, seminars or workshops and the ones who attended at such programs once, twice, or more than two times. As shown in Table 23, teachers attending at these programs twice used demonstration technique more often than the other teachers ($p<0.001$). Similarly the percentage of teachers who mention that they sometimes used field trips, observation and instructional technology in the group of teachers who had attended these programs was more than twice is more than the percentage of teachers in the other groups ($p<0.001$ and $p<0.001$ respectively). Teachers who had never attended in-service training programs indicated that they lectured more often than the teachers in the other groups ($p<0.001$). However, the group of teachers that had attended such programs twice formed the largest group that always lectured during instruction.

Table 23. Use of Teaching Methods and Techniques by Attendance at In-service Training Programs

Lecture, X^2 (df=12, N=656)=36.82, p<0.001					
	Never N=9 %	Rarely N=63 %	Sometimes N=178 %	Often N=264 %	Always N=142 %
Never	1.83	8.56	24.77	43.43	21.41
Once	0.65	5.16	31.61	41.29	21.29
Twice	0	4.35	27.54	36.23	31.88
>2 times	1.90	22.86	27.62	31.43	16.19
Demonstration, X^2 (df=12, N=655)=43.55, p<0.001					
	Never N=46 %	Rarely N=151 %	Sometimes N=291 %	Often N=136 %	Always N=31 %
Never	11.25	26.25	41.88	17.19	3.44
Once	4.43	20.89	48.73	20.25	5.70
Twice	2.94	23.53	54.41	13.24	5.88
>2 times	0.92	16.51	39.45	36.7	6.42
Field trips-observations, X^2 (df=12, N=644)=68.44, p<0.001					
	Never N=194 %	Rarely N=274 %	Sometimes N=143 %	Often N=27 %	Always N=6 %
Never	38.02	42.17	16.93	2.88	0
Once	25.81	51.61	18.06	3.87	0.65
Twice	27.94	36.76	26.47	8.82	0
>2 times	14.81	34.26	40.74	5.56	4.63
Instructional technology, X^2 (df=12, N=644)=62.87, p<0.001					
	Never N=194 %	Rarely N=274 %	Sometimes N=143 %	Often N=27 %	Always N=6 %
Never	68.25	14.29	10.16	5.71	1.59
Once	56.77	14.84	15.48	11.61	1.29
Twice	48.57	20	18.57	8.57	4.29
>2 times	34.62	16.35	38.46	7.69	2.88

Table 24 displays a summary of significant relationships between teaching methods and techniques used in biology classes and some teacher characteristics, i.e. age, sex, teaching experience and attendance at in-service training programs, workshops and/or seminars. As seen in Table 24, the teachers younger than 30 and the ones between the ages of 36-40 years of age lectured more often and teachers younger than 30 and between the ages of 31-35 used the demonstration method more often than the teachers in other age groups. It was also found that female teachers used the questioning technique more often than male teachers during instruction. Similarly, teachers with more than 20 years of teaching experience lectured and teachers with 1-5 years of teaching experience used the demonstration method more often during instruction. Contrasting with the lecturing and demonstration methods, percentage of teachers in the third, fourth and fifth teaching experience groups (10-15, 16-20 and more than 20 years) who stated that they never or rarely used field trips, observation and instructional technology was more than that for teachers who sometimes, often or always used these methods. As shown in Table 24, teachers attending at in-service training programs, seminars and/or workshops twice used demonstration technique more often than the other teachers. Similarly teachers attending at such programs twice more often used field trips, observation and instructional technology. However, these teachers formed the largest group that always lectured during instruction. It was also seen that teachers who had never attended in-service training programs lectured more often than the teachers in the other groups.

Table 24. Use of Teaching Methods and Techniques by Teacher Characteristics (Summary)

	Lecture	Questioning	Demonstration	Field - trips-Observations	Instructional Technology
AGE					
<30	*		*		
31-35			*		
36-40	*				
SEX					
Female		*			
TEACHING EXPERIENCE					
1-5 years			*		
10-15 years				*** (less)**	*** (less)**
16-20 years				*** (less)**	
>20 years	*				*** (less)**
IN-SERVICE TRAINING					
Two times	**Largest group**		*	*	*
Never	*				

Following teachers' characteristics, teachers' beliefs and perceptions of the new curriculum were also identified as factors influencing which teaching methods and techniques were used and how often they were used during instruction. For instance teachers who agreed that the curriculum was efficient, easy and to use practical used demonstration (see Table 25a), which is one of the suggested teaching methodologies in the curriculum, more often than the teachers who moderately agree or disagree that the curriculum was efficient, easy and practical to use ($p=0.04$). However, the percentage of teachers who state that curriculum was moderately efficient or not efficient for easy and practical use and who never or rarely use field trips, observations and instructional technology when teaching biology was more than the percentage of teachers agreeing with the statement that curriculum was efficient and easy and practical to use ($p<0.001$ and $p=0.02$ respectively). Table 25a displays how often demonstration, field trip, observation and instructional technology are used in teaching biology by teachers who agreed, moderately agreed or disagreed with the statement that curriculum is efficient and easy, and practical to use.

Table 25a. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Curriculum is efficient enough for practical and easy usage					
Demonstration, X^2 (df=8, N=550)=16.11, p=0.04					
	Never N=39 %	Rarely N=129 %	Sometimes N=237 %	Often N=120 %	Always N=25 %
Yes	4.65	16.86	48.3	25.6	4.65
Moderately	6.64	26.91	40.9	21.3	4.32
No	14.29	24.68	40.3	15.6	5.19
Field trips-observations, X^2 (df=8, N=544)=27.01, p<0.001					
	Never N=163 %	Rarely N=224 %	Sometimes N=130 %	Often N=21 %	Always N=6 %
Yes	20.24	38.1	34.52	5.36	1.79
Moderately	31.77	43.81	20.07	3.34	1.00
No	44.16	37.66	15.58	2.6	0
Instructional technology, X^2 (df=8, N=541)=18.37, p=0.02					
	Never N=312 %	Rarely N=83 %	Sometimes N=98 %	Often N=37 %	Always N=11 %
Yes	47.06	18.24	23.53	9.41	1.76
Moderately	61.77	13.65	17.75	5.12	1.71
No	65.38	15.38	7.69	7.69	3.85

Demonstrations, field trips and observation are some of the teaching methods and techniques suggested in the curriculum to make biology lessons more effective and efficient. When teachers' beliefs are examined to see if they agree with the statement that the curriculum makes lessons more effective and efficient and to determine how often they use these teaching methods and techniques, it was found that teachers fully agreeing with the statement used field trips and observations more often ($p=0.03$). However, as shown in Table 25b teachers who disagreed with the statement that the new curriculum made lessons more effective and efficient used the demonstration method in teaching biology more often than did the teachers agreeing or moderately agreeing ($p<0.001$) with the statement.

Table 25b. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Curriculum helps in making biology lessons more effective and efficient					
Demonstration, X^2 (df=8, N=546)=25.99, p<0.001					
	Never N=37 %	Rarely N=127 %	Sometimes N=236 %	Often N=120 %	Always N=26 %
Yes	3.66	21.99	45.55	22.51	6.28
Moderately	7.14	23.13	46.94	19.39	3.40
No	14.75	27.87	18.03	32.79	10
Field trips-observations, X^2 (df=8, N=537)=17.26, p=0.03					
	Never N=157 %	Rarely N=224 %	Sometimes N=129 %	Often N=21 %	Always N=6 %
Yes	22.70	40.54	28.11	6.49	2.16
Moderately	31.14	43.6	21.45	3.11	0.69
No	39.68	36.51	23.81	0	2.16

One of the main purposes of the new biology curriculum is to connect lesson content to daily life. In order to facilitate this process various teaching methods and techniques are suggested in the curriculum. When teachers' beliefs and perceptions of the new curriculum are examined (see Table 25c), it is seen that teachers stating that the "curriculum connects lessons to daily life" lecture more often than the other teachers ($p=0.01$). Similarly, teachers who agreed or moderately agreed that curriculum was helpful in connecting lessons to daily life use demonstration method more often in teaching biology than the other teachers (p=0.04). However, the percentage of teachers who disagreed with the statement that the curriculum connected lessons to daily life and who used the discussion technique most often is more than the teachers in the other groups (p=0.01). Table 25c shows how often lecture, demonstration and discussion are used in teaching biology by teachers who agreed, moderately agreed or disagreed with the statement that the curriculum helped to connect lessons to daily life.

Table 25c. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Curriculum connects lessons to daily life					
Lecture, X^2 (df=8, N=560)=19.89, p=0.01					
	Never N=7 %	Rarely N=56 %	Sometimes N=155 %	Often N=219 %	Always N=123 %
Yes	1.09	8.70	22.83	38.04	29.35
Moderately	1.64	8.55	31.91	39.47	18.42
No	0	19.44	22.22	40.28	18.06
Discussion, X^2 (df=8, N=566)=19.01, p=0.01					
	Never N=4 %	Rarely N=55 %	Sometimes N=293 %	Often N=156 %	Always N=58 %
Yes	0.53	4.81	50.80	27.81	16.04
Moderately	0.66	11.92	50.66	29.14	7.62
No	1.30	12.99	58.44	20.78	16.04
Demonstration, X^2 (df=8, N=560)=16.17, p=0.04					
	Never N=38 %	Rarely N=134 %	Sometimes N=241 %	Often N=121 %	Always N=26 %
Yes	3.68	23.16	44.74	21.58	6.84
Moderately	7.07	23.57	45.45	20.54	3.37
No	13.7	27.4	28.77	26.03	4.11

It is stated in the goals of the new high school biology curriculum that it is important for students to learn more about biology and improve their problem solving skills. Therefore, the suggestions made in the curriculum to use demonstrations frequently as a teaching method during instruction. As shown in Table 25d below teachers, who believed that curriculum was helpful in improving students’ problem solving skills, use the demonstration method more often than the teachers who moderately agreed or disagreed with this statement (p=0.03).

Table 25d. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Curriculum helps students to improve their problem solving skills					
Demonstration, X^2 (df=8, N=549)=16.99, p=0.03					
	Never N=38 %	Rarely N=126 %	Sometimes N=241 %	Often N=118 %	Always N=26 %
Yes	4.42	21.24	48.67	19.47	6.19
Moderately	6.74	20.53	46.92	21.41	4.40
No	10.53	33.68	27.37	24.21	4.21

Similar to the demonstration method, the use of field trips and observation plays important roles in improving students' creativity. These teaching methods and techniques facilitate learning by seeing, hearing and doing. Teachers who agreed with the statement that the curriculum helped students to improve their creativity also use these teaching methods and techniques more often in teaching biology than the teachers who moderately agreed or disagreed (p=0.00). Use of instructional technology also facilitates understanding abstract biological concepts by seeing. Instructional technology also provides rich learning environments in which students have the chance to see and interpret various biological concepts and subject matter. Teachers who agreed with the statement that the curriculum helped students to improve their creativity use this teaching technique more often than the other teachers (p=0.01). Table 25e displays how often field trips, observation and instructional technology were used in teaching biology by teachers who agreed, moderately agreed or disagreed with the statement that the curriculum helped students to improve their creativity.

Table 25e. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Curriculum helps students to improve their creativity					
Field trips-observations, X^2 (df=8, N=548)=27.19, p<0.001					
	Never N=161 %	Rarely N=228 %	Sometimes N=132 %	Often N=21 %	Always N=6 %
Yes	26.26	36.36	27.27	8.08	2.02
Moderately	24.22	46.58	25.16	3.11	0.93
No	44.88	33.07	18.90	2.36	0.79

Table 25e. (continued)

Instructional technology, X^2 (df=8, N=547)=21.82, p=0.01					
	Never N=314 %	Rarely N=85 %	Sometimes N=99 %	Often N=37 %	Always N=12 %
Yes	46.94	19.39	20.41	11.22	2.04
Moderately	55.25	15.43	20.68	5.56	3.09
No	71.2	12.8	9.6	6.4	0

Biology education requires that various teaching methods and techniques are used to help students to learn by seeing, hearing and doing. Therefore, different teaching methods and techniques are suggested in the new biology curriculum to be used during instruction. When teachers' beliefs and perceptions of the curriculum goals and their appropriateness for biology education are examined, a significant difference is observed in the usage frequency of discussion and instructional technology methods between teachers who agreed, moderately agreed or disagreed that goals of the new biology curriculum are appropriate for teaching biology (see Table 25f). Teachers agreeing with this statement used discussion and instructional technology more often during instruction than the other teachers (p=0.02 and p=0.04 respectively). However, more than 60% of teachers in this group also mentioned that they never or rarely use instructional technology when teaching biology. Table 25f displays how often discussion and instructional technology were used in teaching biology by teachers who agreed, moderately agreed or disagreed with the statement that the goals of the curriculum are appropriate for biology education.

Table 25f. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Goals of the curriculum are appropriate for biology education					
Discussion, X^2 (df=8, N=555)=18.35, p=0.02					
	Never N=4 %	Rarely N=55 %	Sometimes N=285 %	Often N=154 %	Always N=57 %
Yes	0.87	6.99	58.52	22.27	11.35
Moderately	0.37	10.62	46.15	33.33	9.52
No	1.89	18.87	47.17	22.64	9.43

Table 25f. (continued)

Instructional technology, X^2 (df=8, N=539)=16.54, p=0.04					
	Never N=310 %	Rarely N=83 %	Sometimes N=97 %	Often N=37 %	Always N=12 %
Yes	49.78	16.88	20.78	8.66	3.90
Moderately	63.28	13.28	17.19	5.08	1.17
No	63.46	19.23	9.62	7.69	0

Considering their beliefs and perceptions of the subject related examples and problems, suggested experiments, field trips, observations, projects and instructional materials in the curriculum, differences in the teaching methods and techniques used by teachers were observed. As shown in Table 25g, teachers who disagreed with the statement that the subject related examples and problems in the curriculum were efficient lecture more often than the other teachers (p=0.01).

Table 25g. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Subject related examples and problems in the curriculum are efficient					
Lecture, X^2 (df=8, N=541)=20.74, p=0.01					
	Never N=8 %	Rarely N=55 %	Sometimes N=147 %	Often N=213 %	Always N=118 %
Yes	0	6.93	37.62	35.6	19.80
Moderately	3.24	8.33	26.85	42.6	18.98
No	0.45	13.39	22.77	37.9	25.45

Similarly teachers who disagreed with the appropriateness of the suggested experiments, field trips, observations and projects in the curriculum used demonstration method less than the teachers who agreed or moderately agreed with this statement. Table 25h displays how often the demonstration method was used to teach biology by teachers who agreed or moderately agreed with the statement that the suggested experiments, field trips, observations and projects in the curriculum are appropriate for biology education.

Table 25h. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Suggested experiments, field trips and observations and projects in the curriculum are appropriate					
Demonstration, X^2 (df=8, N=543)=20.21, p=0.01					
	Never N=37 %	Rarely N=127 %	Sometimes N=236 %	Often N=117 %	Always N=26 %
Yes	6.08	18.23	48.62	22.1	4.97
Moderately	4.86	27.43	43.06	20.5	4.17
No	16.2	20.27	32.43	24.3	6.76

Table 25i displays the percentages of teachers who agreed, moderately agreed or disagreed with the efficiency of suggested instructional materials in the new curriculum and how often they used the demonstration method and instructional technology in teaching biology. As it is seen in Table 25i, there is a significant difference in the usage frequency of these methods. Teachers moderately agreeing with the efficiency of the suggested instructional materials use the demonstration method more often than the other teachers (p=0.04). Although the percentage of teachers who agreed with the efficiency of suggested instructional materials and who use instructional technology often is more than the other teachers, 70% of teachers in this group also indicated that they rarely or never use this technique in teaching biology.

Table 25i. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Curriculum

Suggested instructional materials are efficient					
Demonstration, X^2 (df=8, N=538)=16.29, p=0.04					
	Never N=37 %	Rarely N=126 %	Sometimes N=233 %	Often N=116 %	Always N=26 %
Yes	6.58	23.68	46.05	18.42	5.26
Moderately	3.83	21.70	42.13	26.81	5.53
No	11.92	25.83	42.38	16.56	3.31
Instructional technology, X^2 (df=8, N=534)=17.16, p=0.03					
	Never N=305 %	Rarely N=83 %	Sometimes N=96 %	Often N=38 %	Always N=12 %
Yes	50.99	19.21	16.56	9.93	3.31
Moderately	53.45	15.52	20.69	8.19	2.16
No	68.87	11.92	15.23	2.65	1.32

Table 26 displays a summary of the significant relationships between teaching methods and techniques used in biology classes and teacher beliefs and perceptions of the new high school biology curriculum. As shown in Table 26, teachers who agreed that the curriculum was efficient, easy and practical to use used demonstration method more often than other teachers. However, the percentage of teachers who state that curriculum was moderately efficient or not efficient for easy and practical use and who never or rarely use field trips, observations and instructional technology when teaching biology was more than the percentage of teachers agreeing with this statement. It was also found that teachers fully agreeing with the statement that the curriculum makes lessons more effective and efficient used field trips and observations more often. However, teachers who disagreed with the statement that the new curriculum made lessons more effective and efficient used the demonstration method in teaching biology than did the other teachers. It was seen that teachers stating that the curriculum connects lessons to daıly lıfe lectured more often in teaching biology than the other teachers. Similarly teachers who agreed or moderately agreed that curriculum was helpful in connecting lessons to daily life used demonstration method more often in teaching biology than the other teachers. However, the percentage of teachers who disagreed with the statement that the curriculum connected lessons to daily life and who used the discussion technique most often is more than the teachers in the other groups. As seen in Table 26 teachers who believed that curriculum was helpful in improving students' problem solving skills used the demonstration method more often than the teachers who moderately agreed or disagreed with this statement. Teachers who agreed with the statement that the curriculum helped students to improve their creativity used demonstration, field trips and observations, and instructional technology more often in teaching biology than the teachers who moderately agreed or disagreed with this statement. Similarly teachers agreeing with the statement that goals of the new biology curriculum are appropriate for teaching biology used discussion and instructional technology more often during instruction than the other teachers. As shown in Table 26, teachers who disagreed with the statement that the subject related examples and problems in the curriculum were efficient lectured more often than the other teachers. Similarly teachers who disagreed with the appropriateness of the suggested experiments, field trips, observations and projects in the curriculum used demonstration method less than the teachers who agreed or moderately agreed with this statement. Teachers moderately agreeing with the efficiency of the suggested instructional materials used the demonstration method more often than the other teachers. The percentage of teachers who agreed with the efficiency of suggested instructional materials and use instructional technology often was also more than the other teachers.

Table 26. Use of Teaching Methods and Techniques by Teacher Beliefs and Perceptions of Curriculum (Summary)

	Lecture	Demonstration	Field-trips/ Observations	Instructional Technology	Discussion
Curriculum is efficient, easy and practical to use		*			
Curriculum is **moderately/is not** efficient, easy and …			**Never**	**Never**	
Curriculum makes lessons more effective and efficient			*		
Curriculum **does not** make lessons more effective…		*			
Curriculum connects lessons to daily life	*	*			
Curriculum **moderately** connects lessons to daily life		*			
Curriculum **does not** connect lessons to daily life					*
Curriculum helps in improving students' problem solving skills		*			
Curriculum helps students to improve their creativity		*	*	*	
Goals of the curriculum are appropriate for biology education				*	*
Subject related examples and problems in the curriculum **are not** efficient	*				
Suggested experiments, field trips, observations and projects in the curriculum **are not** appropriate		**less**			
Suggested instructional materials in the new curriculum are **moderately** efficient		*			
Suggested instructional materials in the new curriculum are efficient				*	

Similar to their beliefs and perceptions of the new biology curriculum, teachers' beliefs and perceptions of students were also identified as factors influencing the use of various teaching methods and techniques during instruction. Teachers' beliefs regarding their student interest in biology, scientific thinking, learning and research, their active participation in lesson and ability to connect lesson content to daily life by asking questions determined how often teachers used the various methods of lecturing, demonstrations, field trips, observation, questioning, discussion and instructional technology when teaching biology. For instance, teachers who mentioned that their students were interested in biology used demonstrations, field trips and observation more often than other teachers ($p<0.001$ and $p<0.001$ respectively). Teachers that moderately agreed that students were interested in biology lectured more often ($p=0.04$). Table 27a shows how often the lecture, demonstration, field trips and observation methods are used to teach biology by teachers who agreed or moderately agreed with the statement that their students are interested in biology.

Table 27a. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Students

Students are interested in biology					
Lecture, X^2 (df=8, N=647)=16.28, p=0.04					
	Never N=9 %	Rarely N=61 %	Sometimes N=179 %	Often N=258 %	Always N=140 %
Yes	1.5	13.48	26.22	35.58	23.22
Moderately	1.1	6.077	28.73	43.09	20.99
No	5.56	16.67	27.78	38.89	11.11
Demonstration, X^2 (df=8, N=645)=26.75, p<0.001					
	Never N=45 %	Rarely N=148 %	Sometimes N=287 %	Often N=134 %	Always N=31 %
Yes	5.24	16.85	44.19	28.84	4.87
Moderately	7.78	27.78	44.44	15.28	4.72
No	16.67	16.67	50	11.11	5.56
Field trips-observations, X^2 (df=8, N=634)=52.82, p<0.001					
	Never N=192 %	Rarely N=269 %	Sometimes N=140 %	Often N=27 %	Always N=6 %
Yes	18.08	43.46	31.92	4.61	1.92
Moderately	37.54	42.86	15.13	4.20	0.28
No	64.71	17.65	17.65	0	0

As shown in Table 27b, teachers who stated that their students actively participated in lesson use the methods and techniques of lecture, questioning, discussion, demonstration, field trips and observation, and instructional technology more often than the other teachers who moderately agreed or disagreed that students actively participated in lessons (p=0.02, p<0.001, p<0.001, p<0.001, p<0.001, and p<0.001 respectively).

Table27b. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Students

Students actively participate in lessons					
Lecture, X^2 (df=8, N=643)=17.69, p=0.02					
	Never N=8 %	Rarely N=62 %	Sometimes N=178 %	Often N=255 %	Always N=140 %
Yes	1.98	13.86	28.22	31.68	24.26
Moderately	0.97	8.03	27.98	43.55	19.46
No	0	3.33	20	40	36.67
Questioning, X^2 (df=8, N=663)=36.64, p<0.001					
	Never N=1 %	Rarely N=1 %	Sometimes N=59 %	Often N=379 %	Always N=223 %
Yes	0	0.47	5.69	58.77	35.07
Moderately	0.24	0	8.53	56.64	34.6
No	0	0	36.7	53.33	10
Discussion, X^2 (df=8, N=649)=29.84, p<0.001					
	Never N=4 %	Rarely N=62 %	Sometimes N=343 %	Often N=176 %	Always N=64 %
Yes	0.48	6.22	46.41	30.62	16.27
Moderately	0.48	10.41	56.17	25.67	7.26
No	3.7	22.22	51.85	22.22	0
Demonstration, X^2 (df=8, N=642)=35.17, p<0.001					
	Never N=46 %	Rarely N=147 %	Sometimes N=284 %	Often N=134 %	Always N=31 %
Yes	4.81	16.35	40.87	30.29	7.69
Moderately	7.65	25.19	46.42	17.04	3.70
No	17.24	37.93	37.93	6.89	0
Field trips-observations, X^2 (df=8, N=632)=48.17, p<0.001					
	Never N=191 %	Rarely N=268 %	Sometimes N=140 %	Often N=27 %	Always N=6 %
Yes	14.21	50.76	27.41	6.6	1.01
Moderately	35.47	39.9	20.2	3.45	0.98
No	65.52	20.69	13.79	0	0

Table 27b. (continued)

Instructional technology, X^2 (df=8, N=635)=23.72, p<0.001					
	Never N=369 %	Rarely N=95 %	Sometimes N=108 %	Often N=50 %	Always N=13 %
Yes	44.72	20.6	22.61	9.04	3.02
Moderately	63.97	12.75	14.46	7.11	1.72
No	67.86	7.14	14.29	10.71	0

Similarly, teachers who believed that biology lessons increased their students' interest in scientific thinking, learning and research used the teaching methods and techniques of questioning, discussion, demonstration, field trips and observations more often than other teachers during instruction (p=0.02, p<0.001, p<0.001, and p<0.001 respectively). However, 63.74% of these teachers stated that they rarely or never use field trips and observations when teaching biology. As shown in Table 27c teachers who lectured more are the ones who disagreed with the statement that biology lessons increased students' interest in scientific thinking, learning and research (p=0.03).

Table27c. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Students

Lessons increase students' interest in scientific thinking, learning and research					
Lecture, X^2 (df=8, N=647)=16.76, p=0.03					
	Never N=9 %	Rarely N=61 %	Sometimes N=179 %	Often N=256 %	Always N=142 %
Yes	1.81	10.51	34.42	32.97	20.29
Moderately	0.95	8.889	22.54	45.39	22.22
No	1.79	7.143	23.21	39.28	28.57
Questioning, X^2 (df=8, N=667)=18.16, p=0.02					
	Never N=1 %	Rarely N=1 %	Sometimes N=59 %	Often N=381 %	Always N=225 %
Yes	0	0	4.483	58.96	36.55
Moderately	0.31	0.31	11.73	54.32	33.33
No	0	0	15.09	64.15	20.75
Discussion, X^2 (df=8, N=652)=29.17, p<0.001					
	Never N=4 %	Rarely N=64 %	Sometimes N=346 %	Often N=174 %	Always N=64 %
Yes	0.35	7.37	50.53	27.37	14.39
Moderately	0.32	10.48	55.56	26.67	6.98
No	3.85	19.23	51.92	23.08	1.92

Table 27c. (continued)

Demonstration, X^2 (df=8, N=646)=24.07, p<0.001	Never N=46 %	Rarely N=148 %	Sometimes N=286 %	Often N=135 %	Always N=31 %
Yes	5.3	19.08	44.17	24.03	7.42
Moderately	7.72	23.79	46.30	19.29	2.89
No	13.46	38.46	32.69	13.46	1.92
Field trips-observations, X^2 (df=8, N=635)=33.25, p<0.001					
	Never N=192 %	Rarely N=270 %	Sometimes N=140 %	Often N=27 %	Always N=6 %
Yes	22.71	41.03	28.94	6.23	1.1
Moderately	33.44	43.73	18.65	3.21	0.96
No	50.98	43.14	5.88	0	0

Examined together with the usage frequencies for discussion, field trips and observation methods, teachers' beliefs on their lessons answering students' questions about biology show that the teachers who agreed with this statement use these methods and techniques more often (p=0.01 and p=0.01 respectively). Table 27d shows how often discussion, field trips and observation methods are used to teach biology by teachers who agreed, moderately agreed or disagreed with the statement that biology lessons answer students' questions about biology.

Table27d. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Students

Lessons answer students' questions about biology					
Discussion, X^2 (df=8, N=651)=20.44, p=0.01					
	Never N=4 %	Rarely N=64 %	Sometimes N=345 %	Often N=174 %	Always N=64 %
Yes	0.63	8.57	50.16	29.52	11.11
Moderately	0.31	10.03	56.11	24.76	8.78
No	5.88	29.41	47.06	11.76	5.88
Field trips-observations, X^2 (df=8, N=635)=19.22, p=0.01					
	Never N=193 %	Rarely N=269 %	Sometimes N=141 %	Often N=27 %	Always N=5 %
Yes	26.38	42.34	24.76	5.54	0.98
Moderately	33.01	42.95	20.51	3.20	0.32
No	56.25	31.25	6.25	0	6.25

When teachers beliefs regarding students who are able to connect lesson content to daily life are examined together with the use frequency for questioning, discussion, demonstration, field trips and observation methods and techniques (see Table 27e), it can be seen that teachers who agreed that students can connect lesson content to daily life used these methods and techniques more often than other teachers who moderately agreed or disagreed ($p<0.001$, $p<0.001$, $p<0.001$, and $p=0.03$ respectively). Table 27e displays how often questioning, discussion, demonstration, field trips and observation methods were used in teaching biology by teachers who agreed, moderately agreed or disagreed that students can connect lesson content to daily life.

Table27e. Use of Teaching Methods and Techniques by Beliefs and Perceptions of Students

Students can connect lesson content to daily life					
Questioning, X^2 (df=8, N=663)=21.46, p=0.00					
	Never N=1 %	Rarely N=1 %	Sometimes N=59 %	Often N=377 %	Always N=225 %
Yes	0.4	0	5.64	58.47	35.48
Moderately	0	0.26	9.45	55.64	34.65
No	0	0	26.47	58.82	14.71
Discussion, X^2 (df=8, N=648)=28.73, p<0.001					
	Never N=4 %	Rarely N=64 %	Sometimes N=343 %	Often N=173 %	Always N=64 %
Yes	0	6.28	52.3	26.78	14.64
Moderately	0.8	10.7	54.13	26.67	7.733
No	2.94	26.5	44.12	26.47	0
Demonstration, X^2 (df=8, N=643)=22.03, p<0.001					
	Never N=46 %	Rarely N=147 %	Sometimes N=286 %	Often N=133 %	Always N=31 %
Yes	4.53	17.28	51.03	19.75	7.407
Moderately	8.19	25.96	40.44	21.86	3.552
No	14.71	29.41	41.18	14.71	0
Field trips-observations, X^2 (df=8, N=633)=17.41, p=0.03					
	Never N=193 %	Rarely N=267 %	Sometimes N=140 %	Often N=27 %	Always N=6 %
Yes	23.11	47.89	22.69	5.46	0.84
Moderately	33.43	38.95	22.65	3.87	1.1
No	51.52	36.36	12.12	0	0

Table 28 displays a summary of the significant relationships between teaching methods and techniques used in biology classes and teacher beliefs and perceptions of their students. As seen in Table 28, teachers who mentioned that their students were interested in biology used demonstrations, field trips and observation in teaching biology more often than other teachers. However, teachers who moderately agreed that students were interested in biology lectured more often. Teachers who stated that their students actively participated in lesson used the methods and techniques of lecture, questioning, discussion, demonstration, field trips and observation, and instructional technology more often than the other teachers who moderately agreed or disagreed that students actively participated in lessons. Similarly, teachers who believed that biology lessons increased their students' interest in scientific thinking, learning and research used the teaching methods and techniques of questioning, discussion, demonstration, field trips and observations more often than other teachers during instruction. However, teachers who lectured more are the ones who disagreed with the statement that biology lessons increased students' interest in scientific thinking, learning and research. Teachers who agreed that lessons answer students' questions about biology used the discussion, field trips and observation methods more often. Similarly teachers who agreed that students can connect lesson content to daily life used questioning, discussion, demonstration, field trips and observation methods and techniques more often than other teachers who moderately agreed or disagreed with this statement.

Table 28. Use of Teaching Methods and Techniques by Teacher Beliefs and Perceptions of Students (summary)

	Lecture	Demonstration	Field-trips/ Observations	Instructional Technology	Discussions	Questioning
Students are interested in biology		*	*			
Students are **moderately** interested in biology	*					
Students actively participate in lesson	*	*	*	*	*	*
Lessons increase students'interest in scientific thinking, learning and research		*	*		*	*

Table 28. (continued)

Lessons **do not** increse students' interest in scientific …	*					
Lessons answer students' questions about biology			*		*	
Students can connect lesson content to daily life		*	*		*	*

4.5.2. Instructional Materials Used During Instruction

An intention of the new high school biology curriculum is that various instructional materials should be used during instruction to facilitate learning by seeing, living and doing for students. To this end various instructional materials are suggested in the curriculum. When their usage frequencies are examined (see Table 29), it is seen that written materials (words, texts, formulas, and signs), examples and models (DNA model etc.), and diagrams, graphs etc. are the most frequently used instructional materials in biology classes. Teachers mentioned that they sometimes used living things (animals and plants), dia, overhead projector and slides, and rarely use films during instruction. Table 29 displays which instructional materials are how often used in biology classes.

Table 29. Instructional Materials Used in Teaching Biology

	Mean	Std. Dev.	%	N
Written materials (words, texts, formulas, signs)	4.09	1.05	45.4	654
Examples and models (DNA model, etc.)	4.01	0.92	33.1	664
Diagrams, graphs, etc.	3.64	1.14	26.1	652
Living things (animals and plants)	3.00	1.01	8.4	653
Dia, overhead projector, slides	2.66	1.38	12.3	626
Films	2.15	1.24	4.7	633

N 's for each item vary due to missing responses, and items in the table are listed in order of means

Similar to their general use, there are also differences in the usage frequencies of instructional materials during instruction depending on school type, some teacher characteristics such as age, sex, and attendance at in-service training programs, workshops and/or seminars, and some teacher beliefs and perceptions of the new curriculum and their students. For instance, while films; dia, overhead projector and slides are more often used in private/foundation schools, diagrams, graphs etc. are mostly used in public high schools ($p<0.001$, $p<0.001$, and $p<0.001$ respectively). Table 30 displays how often films; dia, overhead projector, slides; diagrams, graphs etc. are used in biology classes at Anatolian, private/foundation and public high schools.

Table 30. Use of Instructional Materials by School Type

Films, X^2 (df=8, N=629)=122.94, p<0.001					
	Never N=285 %	Rarely N=95 %	Sometimes N=148 %	Often N=72 %	Always N=29 %
Anatolian H.S.	26.67	25.83	31.67	6.67	9.17
Private/Found. H.S.	7.02	19.3	21.05	43.86	8.77
Public High School	55.09	11.73	21.68	8.63	2.88
Dia, overhead projector, slides, X^2 (df=8, N=624)=65.22, p<0.001					
	Never N=185 %	Rarely N=101 %	Sometimes N=152 %	Often N=109 %	Always N=77 %
Anatolian H.S.	15.83	15	27.5	22.5	19.17
Private/Found. H.S.	6.90	10.34	22.41	27.59	32.76
Public High School	36.32	17.26	23.77	14.8	7.85
Diagrams, graphs, etc., X^2 (df=8, N=648)=37.13, p<0.001					
	Never N=36 %	Rarely N=67 %	Sometimes N=156 %	Often N=219 %	Always N=170 %
Anatolian H.S	0	11.67	21.67	35	31.67
Private/Found.H.S	1.69	10.17	10.17	27.12	50.85
Public High School	7.46	10.02	26.44	34.33	21.75

There are also differences in the usage frequencies of examples and models, and dia, overhead projectors, and slides between teachers in different age groups (see Table 31). While teachers between the ages of 31 and 35 used examples and models more often than the teachers in other age groups (p=0.04), teachers younger than 30 years of age more frequently used dia, overhead projector, slides during instruction (p=0.04). Table 31 shows how often teachers in different age groups used examples and models, and dia, overhead projectors, and slides during instruction.

Table 31. Use of Instructional Materials by Age

Examples and models (DNA model, etc.), X^2 (df=12, N=663)=21.56, p=0.04	Never N=14 %	Rarely N=19 %	Sometimes N=135 %	Often N=275 %	Always N=220 %
<30 years	4.51	3.76	19.55	44.36	27.82
31-35	1.92	1.28	17.95	51.28	27.56
36-40	1.86	4.35	24.22	34.16	35.40
>41 years	0.94	2.35	19.72	38.03	38.97
Dia, overhead projector, slides, X^2 (df=12, N=626)=21.72, p=0.04					
	Never N=186 %	Rarely N=101 %	Sometimes N=153 %	Often N=109 %	Always N=77 %
<30 years	33.33	12.70	15.87	22.22	15.87
31-35	25.68	17.57	25.68	22.29	8.78
36-40	30.46	17.88	31.13	9.93	10.60
>41 years	29.85	15.92	23.88	16.42	13.93

There is also a significant difference between the instructional materials used by female and male teachers (see Table 32). For instance female teachers use living things (animals and plants); dia, overhead projectors, slides; diagrams, graphs etc.; and written materials (words, texts, formulas, signs) more often than male teachers during instruction ($p<0.001$, $p=0.03$, $p<0.001$, and $p<0.001$ respectively). Table 32 shows use frequencies for these instructional materials by female and male teachers.

Table 32. Use of Instructional Materials by Sex

Living things (animals and plants) X^2 (df=4, N=633)=23.55, p<0.001	Never N=51 %	Rarely N=121 %	Sometimes N=295 %	Often N=111 %	Always N=55 %
Female	6.58	13.95	50.79	20.26	8.42
Male	10.28	26.88	40.32	13.44	9.09
Dia, overhead projector, slides, X^2 (df=4, N=605)=10.46, p=0.03					
	Never N=183 %	Rarely N=97 %	Sometimes N=146 %	Often N=105 %	Always N=74 %
Female	31.87	14.56	20.60	18.96	14.01
Male	27.80	18.26	29.46	14.94	9.54
Diagrams, graphs, etc., X^2 (df=4, N=633)=25.20, p<0.001					
	Never N=37 %	Rarely N=64 %	Sometimes N=153 %	Often N=213 %	Always N=166 %
Female	5.97	7.79	19.22	36.10	30.91
Male	5.65	13.71	31.85	29.84	18.95

Table 32. (continued)

Written materials (words, texts, formulas, signs), X^2 (df=4, N=634)=57.03, p<0.001					
	Never N=20 %	Rarely N=33 %	Sometimes N=103 %	Often N=192 %	Always N=286 %
Female	2.09	2.61	10.97	28.72	55.61
Male	4.78	9.16	24.30	32.67	29.08

Although there is no difference in their use by teachers with different years of teaching experience, there are differences in the use frequency of instructional materials by teachers who never, once, twice or more than twice attended in-service training programs, workshops and/or seminars. As shown in Table 33 teachers that had attended at such programs more than twice used films; dia, overhead projectors, slides; and diagrams, graphs etc. more often than other teachers ($p<0.001$, $p<0.001$, $p<0.001$, and $p<0.001$ respectively).

Table 33. Use of Instructional Materials by Attendance at In-Service Training

Films, X^2 (df=12, N=632)=29.57, p<0.001					
	Never N=286 %	Rarely N=95 %	Sometimes N=149 %	Often N=72 %	Always N=30 %
Never	51.14	14.33	21.50	8.14	4.89
Once	49.68	12.74	22.29	10.83	4.46
Twice	35.38	21.54	27.69	12.31	3.08
>2 times	27.18	16.5	29.13	21.36	5.83
Dia, overhead projector, slides, X^2 (df=12, N=625)=45.81, p<0.001					
	Never N=186 %	Rarely N=101 %	Sometimes N=153 %	Often N=108 %	Always N=77 %
Never	36.81	14.98	22.48	16.61	9.12
Once	30.2	18.79	22.82	18.79	9.396
Twice	18.46	13.85	30.77	26.15	10.77
>2 times	15.38	17.31	28.85	11.54	26.92
Diagrams, graphs, etc., X^2 (df=12, N=650)=45.96, p<0.001					
	Never N=37 %	Rarely N=67 %	Sometimes N=156 %	Often N=220 %	Always N=170 %
Never	8.49	8.49	26.73	34.28	22.01
Once	3.16	16.46	23.42	34.18	22.78
Twice	2.90	8.70	26.09	42.03	20.29
>2 times	2.86	7.62	15.24	26.67	47.62

Table 34 displays a summary of the significant relationships between instructional materials used in biology classes and some teacher characteristics, i.e. age, sex and attendance at in-service training programs, workshops and/or seminars. As seen in Table 34, teachers between the ages of 31 and 35 used examples and models more often than the teachers in other age groups and teachers younger than 30 years of age more frequently used dia, overhead projector and slides during instruction. Similarly female teachers used living things (animals and plants); dia, overhead projectors, slides; diagrams, graphs etc.; and written materials (words, texts, formulas, signs) more often than male teachers during instruction. As shown in Table 34, teachers who attended at in-service training programs, workshops and/or seminars more than twice used films; dia, overhead projectors, slides; and diagrams, graphs etc. more often than other teachers.

Table 34. Use of Instructional Materials by Teacher Characteristics (summary)

	Examples and Models	Dia, overhead projector, slides	Living things	Diagrams and graphs	Written materials	Films
AGE						
<30	*					
31-35		*				
SEX						
Female		*	*	*	*	
ATTENDANCE AT IN-SERVICE TRAINING PROGRAMS						
>2 times		*		*		*

The teachers' beliefs and perceptions of the new high school biology curriculum also influenced how often they used which instructional materials during instruction. For instance, as shown in Table 35a, teachers who stated that the curriculum had been efficiently introduced use diagrams, graphs, etc. more often during instruction than the other teachers who moderately agreed or disagreed with this statement ($p=0.04$)

Table 35a. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Curriculum is efficiently introduced					
Diagrams, graphs, etc., X^2 (df=2, N=597)=16.29, p=0.04					
	Never N=34 %	Rarely N=61 %	Sometimes N=144 %	Often N=202 %	Always N=156 %
Yes	5.26	5.92	23.03	35.53	30.26
Moderately	6.30	9.66	27.73	36.55	19.75
No	5.31	14.01	20.77	29.47	30.43

Similarly teachers who mentioned that the language of the curriculum was clear and easily understandable used written materials (words, texts, formulas, signs) more often than the other teachers (p=0.02). Table 35b displays how often written materials were used by teachers, who agreed, moderately agreed or disagreed with the statement that the language of the curriculum was clear and easily understandable.

Table 35b. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Curriculum's language is clear and can be easily understood					
Written materials (words, texts, formulas, signs), X^2 (df=8, N=553)=18.05, p=0.02					
	Never N=18 %	Rarely N=31 %	Sometimes N=95 %	Often N=154 %	Always N=255 %
Yes	4.43	2.95	16.61	24.72	51.29
Moderately	2.14	8.55	17.52	28.63	43.16
No	2.08	6.25	18.75	41.67	31.25

In contrast to diagrams, graphs and written materials, it is seen that films and dia, overhead projectors and slides are more often used by teachers who disagreed that curriculum helped to make biology lessons more effective and efficient (p=0.01 and p=0.02 respectively). Table 35c shows how often teachers who agreed, moderately agreed or disagreed with the new curriculum making biology lessons more effective and efficient use these instructional materials.

Table 35c. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Curriculum helps in making biology lessons more effective and efficient					
Films, X^2 (df=8, N=527)=19.05, p=0.01					
	Never N=235 %	Rarely N=83 %	Sometimes N=121 %	Often N=65 %	Always N=23 %
Yes	39.25	15.05	28.49	11.29	5.91
Moderately	46.93	15.88	23.1	11.19	2.89
No	50	17.19	6.25	20.31	6.25
Dia, overhead projector, slides, X^2 (df=8, N=523)=17.76, p=0.02					
	Never N=151 %	Rarely N=78 %	Sometimes N=129 %	Often N=96 %	Always N=60 %
Yes	24.02	15.64	27.93	16.76	15.64
Moderately	29.86	15.47	24.82	20.5	9.35
No	37.88	10.61	15.15	13.64	22.73

There are also significant differences in the use frequency of examples and models, films, diagrams and graphs, etc, and written materials between teachers who agreed, moderately agreed or disagreed that the new biology curriculum helped to connect lessons to daily life (see Table 35d). Teachers who agreed with that the curriculum connected lessons to daily life used examples and models, films, diagrams and graphs, etc, more often than other teachers ($p<0.001$, $p<0.001$, and $p=0.02$ respectively), whereas teachers who disagreed with the statement that the curriculum connected lessons to daily life used written materials more often ($p=0.01$). Table 35d shows how often teachers used these instructional materials.

Table 35d. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Curriculum connects lessons to daily life					
Examples and models (DNA model, etc.), X^2 (df=8, N=564)=23.02, p<0.001					
	Never N=12 %	Rarely N=17 %	Sometimes N=114 %	Often N=235 %	Always N=186 %
Yes	0.54	3.26	17.93	36.96	41.3
Moderately	1.65	2.97	21.12	43.89	30.36
No	7.79	2.6	22.08	44.16	23.38

Table 35d. (continued)

Films, X^2 (df=8, N=539)=22.27, p<0.001	Never N=243 %	Rarely N=84 %	Sometimes N=122 %	Often N=65 %	Always N=25 %
Yes	37.36	13.74	30.22	12.64	6.04
Moderately	47.87	15.6	21.63	10.28	4.61
No	53.33	20	8	17.33	1.33
Diagrams, graphs, etc., X^2 (df=8, N=553)=18.04, p=0.02					
	Never N=29 %	Rarely N=36 %	Sometimes N=138 %	Often N=184 %	Always N=146 %
Yes	6.67	7.78	20	30	35.56
Moderately	4.04	12.12	25.93	36.03	21.89
No	6.58	7.89	32.89	30.26	22.37
Written materials (words, texts, formulas, signs), X^2 (df=8, N=555)=21.55, p=0.01					
	Never N=17 %	Rarely N=31 %	Sometimes N=96 %	Often N=157 %	Always N=254 %
Yes	4.92	6.01	14.75	20.77	53.55
Moderately	1.36	6.78	18.64	31.19	42.03
No	5.19	0	18.18	35.06	41.56

As shown in Table 35e teachers who agreed that the goals of the curriculum are appropriate for biology education used living things (animals and plants), examples and models (DNA model etc.), films, dia, overhead projector, slides, and diagrams, graphs, etc. more often than the other teachers during instruction (p<0.001, p<0.001, p<0.001, p=0.04, and p=0.01 respectively).

Table 35e. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Goals of the curriculum are appropriate for biology education					
Living things (animals and plants), X^2 (df=8, N=544)=23.85, p<0.001					
	Never N=44 %	Rarely N=100 %	Sometimes N=251 %	Often N=99 %	Always N=50 %
Yes	6.11	16.59	52.84	13.1	11.35
Moderately	8.05	19.16	42.53	23.75	6.51
No	16.67	22.22	35.18	12.96	12.96
Examples and models (DNA model, etc.), X^2 (df=8, N=552)=22.86, p<0.001					
	Never N=12 %	Rarely N=17 %	Sometimes N=113 %	Often N=229 %	Always N=181 %
Yes	1.3	1.74	20	35.22	41.74
Moderately	2.25	4.12	19.48	48.31	25.84
No	5.45	3.64	27.27	34.55	29.09

Table 35e. (continued)

Films, X^2 (df=8, N=530)=27.48, p<0.001					
	Never N=240 %	Rarely N=82 %	Sometimes N=119 %	Often N=64 %	Always N=25 %
Yes	36.24	12.66	29.69	15.72	5.68
Moderately	49.8	18.47	17.67	9.64	4.42
No	63.46	13.46	13.46	7.692	1.92
Dia, overhead projector, slides, X^2 (df=8, N=529)=16.30, p=0.04					
	Never N=153 %	Rarely N=78 %	Sometimes N=131 %	Often N=97 %	Always N=70 %
Yes	24.09	12.27	25	19.55	19.1
Moderately	31.91	15.95	24.12	18.29	9.73
No	34.62	19.23	26.92	13.46	5.77
Diagrams, graphs, etc., X^2 (df=8, N=544)=19.78, p=0.01					
	Never N=29 %	Rarely N=54 %	Sometimes N=137 %	Often N=180 %	Always N=144 %
Yes	4.87	8.41	26.55	25.66	34.51
Moderately	5.32	11.03	22.81	38.78	22.05
No	7.27	10.91	30.91	36.36	14.55

When teachers' beliefs about the efficiency of suggested instructional materials in the curriculum are examined, it is found that the teachers who moderately agreed with their efficiency use living things, films and dia, overhead projector and slides more often than the other teachers during instruction (p=0.03, p<0.001, and p<0.001 respectively). Table 35f displays how often teachers who agreed, moderately agreed or disagreed with the efficiency of the instructional materials used these materials.

Table 35f. Use of Instructional Materials by Beliefs and Perceptions of Curriculum

Suggested instructional materials are efficient					
Living things (animals and plants), X^2 (df=8, N=535)=17.53, p=0.03					
	Never N=42 %	Rarely N=99 %	Sometimes N=245 %	Often N=98 %	Always N=51 %
Yes	7.38	21.48	48.32	12.75	10.07
Moderately	5.28	17.62	42.29	25.11	9.69
No	11.95	16.98	48.43	13.84	8.80

Table 35f. (continued)

Films, X^2 (df=8, N=553)=27.33, p<0.001					
	Never N=235 %	Rarely N=81 %	Sometimes N=116 %	Often N=64 %	Always N=25 %
Yes	38.78	19.05	21.77	14.97	5.44
Moderately	39.91	13.45	28.7	14.35	3.59
No	58.94	15.23	13.25	6.62	5.96
Dia, overhead projector, slides, X^2 (df=8, N=518)=23.99, p<0.001					
	Never N=147 %	Rarely N=78 %	Sometimes N=128 %	Often N=94 %	Always N=71 %
Yes	28.87	16.9	24.65	17.61	11.97
Moderately	20.89	14.67	23.56	22.22	18.67
No	39.07	13.91	26.49	12.58	7.947

Table 36 displays a summary of the significant relationships between instructional materials used in biology classes and teacher beliefs and perceptions of the new high school biology curriculum. As shown in Table 36, teachers who stated that the curriculum had been efficiently introduced used diagrams, graphs etc. more often during instruction than the other teachers who moderately agreed or disagreed with this statement. Similarly teachers who mentioned that the language of the curriculum was clear and easily understandable used written materials (words, texts, formulas, signs) more often than the other teachers. It was seen that films and dia, overhead projectors and slides are more often used by teachers who disagreed that curriculum helped to make biology lessons more effective and efficient. Teachers who agreed that the curriculum connected lessons to daily life used examples and models, films, diagrams and graphs, etc. more often than other teachers, whereas teachers who disagreed with the statement that the curriculum connected lessons to daily life used written materials more often. As seen in Table 36, teachers who agreed that the goals of the curriculum are appropriate for biology education used living things (animals and plants), examples and models, films, dia, overhead projector, slides and diagrams, graphs etc. more often than the other teachers during instruction. It was also found that the teachers who moderately agreed with the efficiency of suggested instructional materials in the curriculum used living things, films and dia, overhead projector and slides more often than the other teachers during instruction.

Table 36. Use of Instructional Materials by Teacher Beliefs and Perceptions of Curriculum (Summary)

	Diagrams and graphs	Written materials	Films	Dia, overhead projector, slides	Examples and models	Living things
Curriculum has been efficiently introduced	*					
Language of the curriculum is clear and easily understandable		*				
Curriculum **does not** make lessons more effective and efficient			*	*		
Curriculum connects lessons to daily life	*		*		*	
Curriculum **does not** connect lesson to daily life		*				
Goals of the curriculum are appropriate for biology education	*		*	*	*	*
Suggested instructional materials in the curriculum are **moderately** efficient			*	*		*

Similar to their beliefs and perceptions of the new curriculum, teachers' beliefs and perceptions of their students also influenced the use frequency of some of the instructional materials. For instance, teachers who believed that students are interested in biology used films and diagrams, graphs, etc. more often than the rest of the teachers during instruction ($p<0.001$ and $p=0.03$ respectively). Table 37a shows how often teachers use these instructional materials.

Table 37a. Use of Instructional Materials by Beliefs and Perceptions of Students

Students are interested in biology					
Films, X^2 (df=8, N=623)=25.83, p<0.001					
	Never N=285 %	Rarely N=94 %	Sometimes N=144 %	Often N=71 %	Always N=29 %
Yes	34.75	18.92	28.19	11.58	6.56
Moderately	53.03	12.39	19.6	11.53	3.46
No	64.71	11.76	17.65	5.88	0

Table 37a. (continued)

Diagrams, graphs, etc., X^2 (df=8, N=641)=17.28, p=0.03					
	Never N=36 %	Rarely N=67 %	Sometimes N=153 %	Often N=216 %	Always N=169 %
Yes	6.77	10.9	18.05	33.46	30.83
Moderately	4.77	9.55	28.37	33.15	24.16
No	5.26	21.05	21.05	47.37	5.26

It was also found that teachers who stated that biology lessons increased their students' interest in scientific thinking, learning and research used living things (animals and plants), examples and models (DNA model, etc.), films, dia, overhead projector, slides, diagrams and graphs, and written materials (words, texts, formulas, signs) more often than other teachers (p=0.01, p=0.02, p<0.001, p=0.01, p<0.001, and p<0.001 respectively). Table 37b shows how often teachers use these instructional materials.

Table 37b. Use of Instructional Materials by Beliefs and Perceptions of Students

Biology lessons increase students' interest in scientific thinking, learning and research					
Living things (animals and plants), X^2 (df=8, N=642)=19.63, p=0.01					
	Never N=52 %	Rarely N=121 %	Sometimes N=297 %	Often N=118 %	Always N=54 %
Yes	5.71	16.43	49.64	21.43	6.78
Moderately	9.03	19.03	44.52	17.74	9.67
No	15.38	30.77	38.46	5.77	9.62
Examples and models (DNA model, etc.), X^2 (df=8, N=653)=17.54, p=0.02					
	Never N=14 %	Rarely N=19 %	Sometimes N=133 %	Often N=271 %	Always N=216 %
Yes	2.11	2.11	17.19	40.35	38.25
Moderately	2.54	2.54	22.22	42.86	29.84
No	0	9.43	26.42	39.62	24.53
Films, X^2 (df=8, N=624)=28.96, p<0.001					
	Never N=286 %	Rarely N=94 %	Sometimes N=144 %	Often N=71 %	Always N=29 %
Yes	37.04	13.7	27.78	14.44	7.04
Moderately	50.33	17.22	20.86	8.61	2.98
No	65.38	9.615	11.54	11.54	1.92

Table 37b. (continued)

Dia, overhead projector, slides, X^2 (df=8, N=617)=21.95, p=0.01					
	Never N=186 %	Rarely N=98 %	Sometimes N=149 %	Often N=107 %	Always N=77 %
Yes	23.16	16.18	25.37	19.49	15.81
Moderately	35.25	13.56	24.07	16.61	10.51
No	38	28	18	10	6
Diagrams, graphs, etc., X^2 (df=8, N=642)=26.69, p<0.001					
	Never N=37 %	Rarely N=67 %	Sometimes N=155 %	Often N=214 %	Always N=169 %
Yes	7.53	7.88	22.22	29.75	32.62
Moderately	4.53	10.68	24.27	37.22	23.3
No	3.70	22.22	33.33	29.63	11.11
Written materials (words, texts, formulas, signs), X^2 (df=8, N=643)=29.57, p<0.001					
	Never N=20 %	Rarely N=35 %	Sometimes N=106 %	Often N=192 %	Always N=290 %
Yes	3.23	6.45	12.19	23.66	54.48
Moderately	2.57	4.82	18.97	33.12	40.51
No	5.66	3.77	24.53	43.4	22.64

As shown in Table 37c, living things; dia, overhead projector, slides, diagrams, graphs, etc.; and written materials are also used more often by teachers who agreed that students can connect lesson content to daily life than by other teachers who moderately agreed or disagreed with this statement (p=0.01, p<0.001, p=0.02 and p<0.001 respectively).

Table 37c. Use of Instructional Materials by Beliefs and Perceptions of Students

Students can connect lesson content to daily life					
Living things (animals and plants), X^2 (df=8, N=639)=20.06, p=0.01					
	Never N=52 %	Rarely N=119 %	Sometimes N=296 %	Often N=117 %	Always N=55 %
Yes	5.88	17.65	46.64	19.75	10.08
Moderately	7.90	19.62	46.05	18.26	8.17
No	26.47	14.71	47.06	8.824	2.94
Dia, overhead projector, slides, X^2 (df=8, N=613)=45.91, p<0.001					
	Never N=185 %	Rarely N=99 %	Sometimes N=149 %	Often N=105 %	Always N=75 %
Yes	24.02	18.34	23.58	18.34	15.72
Moderately	33.99	11.61	26.06	17.28	11.05
No	32.26	51.61	9.677	6.45	0

Table 37c. (continued)

Diagrams, graphs, etc., X^2 (df=8, N=638)=18.82, p=0.02					
	Never N=37 %	Rarely N=67 %	Sometimes N=153 %	Often N=214 %	Always N=167 %
Yes	7.85	7.85	19.42	33.88	31
Moderately	4.12	11.54	26.1	33.79	24.5
No	9.37	18.75	34.38	28.13	9.38
Written materials (words, texts, formulas, signs), X^2 (df=8, N=639)=21.75, p<0.001					
	Never N=20 %	Rarely N=35 %	Sometimes N=106 %	Often N=191 %	Always N=287 %
Yes	3.72	4.54	12.81	24.38	54.54
Moderately	3.01	6.57	18.08	32.88	39.45
No	0	0	28.13	37.5	34.37

Table 38 displays a summary of the significant relationships between instructional materials used in biology classes and teacher beliefs and perceptions of students. As shown in Table 38, teachers who believed that students are interested in biology used films and diagrams, graphs etc. more often than the rest of the teachers during instruction. It was also found that teachers who stated that biology lessons increased students' interest in scientific thinking, learning and research used living things (animals and plants), examples and models (DNA model, etc.), films, dia, overhead projector, slides, diagrams and graphs, and written materials (words, texts, formulas, signs) more often than other teachers. Living things; dia, overhead projector, slides, diagrams, graphs, etc.; and written materials are also used more often by teachers who agreed that students can connect lesson content to daily life than by other teachers who moderately agreed or disagreed with this statement.

Table 38. Use of Instructional Materials by Teacher Beliefs and Perceptions of Students

	Films	Diagrams and graphs	Living things	Examples and models	Dia, slides, overhead projector	Written materials
Students are interested in biology	*	*				
Biology lessons increase students' interest in scientific thinking, learning and research	*	*	*	*	*	*
Students can connect lesson content to daily life		*	*		*	*

4.5.3. Laboratory Studies

Due to their importance in biology education laboratory studies are strongly emphasized in the new Turkish high school biology curriculum. Under the subtitles of how often laboratory studies are carried out and which strategies are followed during these studies, the differences depending on teacher characteristics, beliefs and perceptions are examined in this section.

4.5.3.1. How Often Laboratory Studies are Carried Out?

As shown in Table 39, 81.3% of the teachers responding to the "Biology Curriculum and Instruction Evaluation Questionnaire" mention that laboratory studies were carried out once a month or once a week in their biology classes. Close to one-tenth of the teachers also stated that they used a biology laboratory session once a semester. Although only 5.4% of the responding teachers mentioned that they carry out laboratory studies in all biology classes, 6.9% of them declared that they never use laboratory instruction during classes.

Table 39. Usage Frequency of Laboratory

	Frequency	Percentage
Once a month	278	46.7
Once a week	206	34.6
Never	41	6.9
Once a semester	38	6.4
In all biology classes	32	5.4
	N=595	

Items in the table are listed in order of percentages.

The responses of teachers working in Anatolian, private/foundation and public high schools to the related question show that laboratory studies are carried out once a week in private/foundation schools and once a month in Anatolian and public high schools. Table 40 shows how often laboratory studies are carried out in Anatolian, private/foundation and public high schools.

Table 40. Usage Frequency of Laboratory by School Type

X^2 (df=8, N=593)=31.90, p<0.001	In all biology classes N=32 %	Once a week N=206 %	Once a month N=277 %	Once a semester N=38 %	Never N=40 %
Anatolian High School	5.77	40.38	43.27	5.77	4.81
Private/Foundation School	14.52	53.23	27.42	3.23	1.61
Public High School	3.98	30.68	50.35	7.03	7.96

Although there is no difference in the usage frequency for laboratory sessions between teachers in different age groups, between teachers who had never, once, twice or more than twice attended in-service training programs, workshops and seminars, and between female and male teachers, there was a significant difference between teachers with different years of teaching experience in using laboratory sessions during instruction (see Table 41). Teachers with 1-5 years of teaching experience used the laboratory once a week, teachers in other experience groups (6-9 years, 10-15 years, 16-20 years, and more than 20 years) used the laboratory once a month in their biology classes (p=0.03). Table 41 shows how often teachers with different years of teaching experience used the laboratory during instruction.

Table 41. Usage Frequency of Laboratory by Teaching Experience

X^2 (df=8, N=592)=28.27, p=0.03	In all biology classes N=32 %	Once a week N=204 %	Once a month N=277 %	Once a semester N=38 %	Never N=41 %
1-5 years	10.0	44.0	32.3	6.4	8.3
6-9 years	5.81	39.35	41.29	5.81	7.74
10-15 years	2.37	28.99	53.25	7.69	7.69
16-20 years	4.76	24.76	52.38	9.52	8.57
>20 years	7.96	40.71	46.02	2.65	2.65

In addition to their teaching experiences, teachers' beliefs and their perceptions of their students were also identified as factors influencing how often they used the laboratory when teaching biology. As shown in Table 42 the majority of teachers who agreed that students actively participate in lessons used the laboratory once a week in their biology classes, whereas the teachers who moderately agreed or disagreed that students actively participate in lessons used laboratory once a month ($p<0.001$). Similarly, the majority of teachers who believe that biology lessons increased students' interest in scientific thinking, learning and research use laboratory once a week and teachers who moderately agreed or disagreed with them use laboratory once a month ($p<0.001$).

Table 42. Usage Frequency of Laboratory by Beliefs and Perceptions of Students

Students actively participate in the lessons X^2 (df=8, N=584)=24.36, p<0.001					
	In all biology classes N=32 %	Once a week N=202 %	Once a month N=41 %	Once a semester N=271 %	Never N=38 %
Yes	8.02	42.78	41.18	4.28	3.74
Moderately	4.59	31.89	48.11	7.57	7.84
No	0	14.81	59.26	7.41	18.52
Biology lessons increase students' interest in scientific thinking, learning and research, X^2 (df=8, N=589)=24.32, p<0.001					
	In all biology classes N=32 %	Once a week N=205 %	Once a month N=273 %	Once a semester N=38 %	Never N=41 %
Yes	5.84	43.19	42.02	4.28	4.67
Moderately	6.05	29.89	48.04	7.83	8.18
No	0	19.61	58.82	9.80	11.76

4.5.3.2. Strategies Followed During Laboratory Studies

When teachers are asked for the strategies they followed during laboratory studies (see Table 43), 57.7% of the teachers responding to the "Biology Curriculum and Instruction Evaluation Questionnaire" mentioned demonstration experiments in which the teachers did the experiments by themselves and students watched their teachers. As shown in Table 43, 40.4% of the teachers stated that they start doing an experiment and their students followed them, whereas 27.5% of teachers mentioned experiments in which students followed the experiment using written texts. Experiments in which students determined the steps of the experiment with the help of available equipment, and students tested hypotheses in the laboratory by themselves were mentioned by 25.1 and 12.9% of the teachers.

Table 43. Strategies Followed During Laboratory Studies

	Frequency	Percentage
Demonstration-experiments	340	57.7
Teacher leads, students follow	238	40.4
Students follow the steps of the written experiment	162	27.5
Students determine the steps of the experiment with the help of available equipment	148	25.1
Others (group studies, using slides, models etc.)	121	20.5
Students test hypotheses by themselves	76	12.9

Items in the table are listed in order of percentages.

The other strategies followed during laboratory studies were group studies, using slides, models and transparencies, independent studies in which students designed experiments by themselves, and questioning during the experiment and discussion of the results at the end of the lesson. Table 44 displays the other strategies followed by teachers during laboratory studies.

Table 44. Other Strategies Followed During Laboratory Studies

Group studies in the laboratory	17
Usage of slides, models and transparencies	10
Independent studies for designing experiments	8
Raising questions during the experiment and discussing results at the end	3

When teachers in Anatolian, private/foundation and public high schools were asked which of these strategies they follow during laboratory studies, the majority of teachers in public high schools and close to half of the teachers in Anatolian high schools stated demonstration experiments ($p<0.001$), whereas teachers in private/foundation schools mentioned experiments in which students followed the experiment from written texts and tested hypotheses in the laboratory by themselves ($p<0.001$ and $p<0.001$ respectively). Table 45 shows which strategies were followed during laboratory studies in Anatolian, private/foundation and public high schools.

Table 45. Laboratory Strategies by School Type

Demonstration experiments, X^2 (df=2, N=586)=15.3, p<0.001		
	No N=247 %	Yes N=339 %
Anatolian High School	50.93	49.07
Private/Foundation School	59.68	40.32
Public High School	37.26	62.74
Students follow steps of written experiment, X^2 (df=2, N=586)=27.42, p<0.001		
	No N=425 %	Yes N=161 %
Anatolian High School	67.59	32.41
Private/Foundation School	46.77	53.23
Public High School	77.64	22.36
Students test hypotheses by themselves, X^2 (df=2, N=586)=18.26, p<0.001		
	No N=511 %	Yes N=75 %
Anatolian High School	85.19	14.81
Private/Foundation School	70.97	29.03
Public High School	90.14	9.86

Although there is no significant difference in the laboratory strategies followed by teachers in different age groups, between teachers with different years of teaching experience, and between female and male teachers, a significant difference was observed between teachers who had never, once, twice or more than twice attended at in-service training programs, workshops or seminars. As shown in Table 46, teachers attending such programs more than twice carry out laboratory studies in which students followed experiments from written texts more often than the other teachers (p=0.01).

Table 46. Laboratory Strategies by Attendance at In-service Training

Students follow steps of written experiment, X^2 (df=3, N=587)=11.07, p=0.01		
	No N=426 %	Yes N=161 %
Never	76.41	23.59
Once	75.86	24.14
Twice	65.52	34.48
>2 times	61.0	39.0

As Table 47 shows that the teachers' beliefs and perceptions of the new biology curriculum also influenced which strategies were followed during laboratory studies. For instance teachers who believed that the curriculum help to make biology lessons more effective and efficient carry out laboratory studies in which students determine the steps of the experiment with the help of available equipment more often than the other teachers (p=0.01). In contrast teachers disagreeing with these teachers let their students test hypotheses by themselves more often in the laboratory (p=0.04).

Table 47. Strategies Followed in Laboratory Studies by Beliefs and Perceptions of Curriculum

Curriculum helps in making biology lessons more effective and efficient		
Students determine the steps of the experiment with the help of available equipment, X^2 (df=2, N=491)=9.82, p=0.01		
	No N=353 %	Yes N=138 %
Yes	64.20	35.80
Moderately	77.61	22.39
No	68.09	31.91
Students test hypotheses by themselves, X^2 (df=2, N=491)=6.57, p=0.04		
	No N=431 %	Yes N=60 %
Yes	90.34	9.66
Moderately	88.06	11.94
No	76.60	23.40

Similar to their beliefs and perceptions of the new high school biology curriculum, teachers' beliefs and perceptions of their students also influenced which strategies were followed during laboratory studies. For instance, teachers who stated that their students actively participated in lessons more often allow their students to test hypotheses by themselves in the laboratory (p=0.01). Similarly, teachers who believed that biology lessons increased students interest in scientific thinking, learning and research more often let their students determine the steps of experiments with the help of available equipment and to test hypotheses by themselves in the laboratory (p=0.04 and p<0.001

respectively). Table 48 displays teachers' beliefs and perceptions of their students and the strategies they follow during laboratory studies.

Table 48. Strategies Followed in Laboratory Studies by Beliefs and Perceptions of Students

Students actively participate in the lessons/ Students test hypotheses by themselves, X^2 (df=2, N=579)=7.91, p=0.01		
	No N=506 %	Yes N=73 %
Yes	81.58	18.42
Moderately	89.75	10.25
No	95.65	4.35
Biology lessons increase students' interest in scientific thinking, learning and research/ Students determine the steps of experiment with the help of available equipment, X^2 (df=2, N=579)=6.24, p=0.04		
	No N=432 %	Yes N=147 %
Yes	69.62	30.38
Moderately	78.55	21.45
No	79.55	20.45
Biology lessons increase students' interest in scientific thinking, learning and research/ Students test hypotheses by themselves, X^2 (df=2, N=579)=16.07, p<0.001		
	No N=505 %	Yes N=74 %
Yes	81.15	18.85
Moderately	91.64	8.36
No	95.45	4.54

4.5.4. Problems Faced During Instruction

Problems faced during instruction in biology classes are examined in this section. The differences in the problems between the five schooling level strata, and Anatolian, private/foundation and public high schools are also examined in this section.

The results of the "Biology Curriculum and Instruction Evaluation Questionnaire" (see Table 49) showed that limited time for laboratory studies caused by a loaded curriculum content was the most frequently faced problem in biology classes. More than 50% of the teachers also pointed to crowded classrooms and doing experiments with lots of students as the other problems they face during instruction. Lack of laboratory and teacher guidebooks was also mentioned as a problem by 50.7% of the teachers responding to the "Biology Curriculum and Instruction Evaluation Questionnaire." Similarly, limited use of instructional materials, such as films, slides, models and tables, was also identified as another major problem in biology classes, which close to 50% of teachers stated. As shown in Table 49, teachers also mentioned lack of laboratory studies, a need for various written sources, limited opportunities to reach these sources, an inability to actively involve students during instruction and to connect subject matter to daily life, a lack of knowledge and difficult to use laboratory equipment, as the other problems teachers faced during instruction.

Table 49. Problems Faced During Instruction

	Frequency	Percentage
Limited time for laboratory studies due to loaded curriculum content	501	75.0
Crowded classrooms	396	59.4
Doing experiments with lots of students	396	59.4
Lack of laboratory and teacher guidebooks	339	50.7
Limited usage of visual materials (films, slides, models)	320	47.9
Theoretical instruction	255	38.2
Necessity of other written sources rather than textbook	229	34.3
Limited opportunities to reach other written sources	201	30.1
Inability to activate students during instruction	198	29.6
Usage hardiness of some laboratory equipment	151	22.6
Lack of knowledge to use laboratory equipment	122	18.3
Inability to connect subject matter to daily life	113	16.9
Others (class hours, university entrance examination, etc.)	105	15.7

Items in the table are listed in order of frequencies

In addition to the above-mentioned problems, teachers also pointed to problems originating from physical conditions and opportunities in schools, class hours, university entrance examination, teachers and students. Table 50 shows the problems teachers face in their biology classes.

Table 50 Other Problems Faced During Instruction

Physical conditions and opportunities in schools	
Lack of laboratory equipment and insufficient laboratory conditions	39
Insufficient and old instructional materials	9
Class hours	
Due to limited class hours, laboratory studies are not done	20
Students	
No interest in subject matter and no preparation for the class	18
Inadequacy of their level	17
Students in different levels are in the same classes	1
University Entrance Examination	
Preparation to university entrance examination	12
Teacher	
Lack of knowledge for doing some experiments, inability to evaluate results of experiments	3
Loaded class hours per week	1

When these problems are examined if they show differences in schools at different schooling level strata, it can be seen that problem of theoretical instruction; lack of laboratory studies is faced mostly in the fourth stratum in which schooling level is 50-59% (p=0.02). Similarly, as shown in Table 51, the problems of doing experiments a lot of students in one class and the lack of laboratory and teacher guidebooks were also faced in schools belonging to this stratum (p=0.01 and p=0.02 respectively).

Table 51. Problems Faced During Instruction by Schooling Level

	SCHOOLING LEVEL				
PROBLEMS FACED DURING INSTRUCTION	20-29% (N=47)	30-39% (N=128)	40-49% (N=140)	50-59% (N=98)	60-69% (N=255)
Theoretical instruction X^2 (df=4, N=668)=11.58, p=0.02	27.66%	35.16%	34.29%	52.04%	38.43%
Doing experiments with lots of students X^2 (df=4, N=667)=13.47, p=0.01	41.3%	53.91%	62.86%	70.41%	59.22%
Lack of Laboratory and Teacher Guidebooks X^2 (df=4, N=668)=12.11, p=0,02	46.81%	43.75%	55%	64.29%	47.45%

N ‘s vary due to missing responses.

Comparison of these problems in public, Anatolian and private/foundation schools showed that majority of them were experienced in public high schools (see Table 52). Followed by Anatolian high schools, public high schools faced the problems of crowded classrooms, theoretical instruction; lack of laboratory studies, limited use of visual instructional materials, and limited opportunities to get hold of written sources ($p<0.001$, $p=0.02$, $p<0.001$, and $p<0.001$ respectively). Teachers in public high schools also faced the problems of an inability to engage students during instruction; the difficulty is faced when trying to use some laboratory equipment and a lack of knowledge regarding laboratory equipment ($p=0.04$, $p<0.001$, and $p=0.02$ respectively). Although teachers in public high schools also mentioned doing experiments with large classes to be another major problem, teachers in Anatolian high schools stated this problem more often ($p<0.001$). Table 52 shows the problems faced by teachers during instruction at public, private/foundation and Anatolian high schools.

Table 52. Problems Faced During Instruction by School Type

PROBLEMS FACED DURING INSTRUCTION	Public High Schools (N=484)	Anatolian High Schools (N=120)	Private/ Foundation Schools (N=60)
Crowded classrooms X^2 (df=2, N=663)=102.46, p<0.001	69.83%	43.33%	6.78%
Theoretical instruction X^2 (df=2, N=664)=8.18, p=0.02	41.12%	34.17%	23.33%
Limited usage of visual materials (films, slides) X^2 (df=2, N=664)=43.8, p<0.001	54.55%	39.17%	11.67%
Doing experiments with lots of students X^2 (df=2, N=663)=19.11, p<0.001	61.7%	64.17%	33.335
Inability to activate students during instruction X^2 (df=2, N=664)=6.67, p=0.04	32.02%	26.67%	16.67%
Limited opportunities to reach other written resources X^2 (df=2, N=663)=16.25, p<0.001	34.5%	21.85%	13.33%
Usage hardiness of some laboratory equipment X^2 (df=2, N=664)=16.0, p<0.001	25.83%	20.0%	3.33%
Lack of knowledge to use laboratory equipment X^2 (df=2, N=662)=7.7, p=0.02	19.88%	19.17%	5.08%

N ‘s vary due to missing responses.

4.6. Summary of the Results

Responses of a representative sample by teacher characteristics, i.e. age, sex, years of teaching experience, and attendance at in-service training programs, workshops and/or seminars, and schools, i.e. public, private/foundation and Anatolian high schools in different schooling level strata, pointed to inadequate facilities in and the physical structure of schools that prevent the new Turkish biology curriculum being implemented in the ways intended. Crowded classrooms, insufficient and old laboratories, equipment and instructional materials are the major problems faced during instruction by many of the teachers responding to the “Biology Curriculum and Instruction Evaluation Questionnaire.”

Following external constraints, teachers’ beliefs and perceptions of the new curriculum, students and biology education in general influence the process of curriculum implementation. Although their beliefs of the goals, content and teaching, i.e. teaching methods, techniques and instructional materials used during instruction, teacher and student roles, and learning environment, in biology education are consistent with the philosophy of curriculum, teachers’ instructional activities show differences due to their demographic characteristics, i.e. age, sex, years of teaching experience, and attendance at in-service training programs, workshops and/or seminars, and beliefs and perceptions of the new curriculum and students.

Used for instructional planning and for the selection of teaching methods and techniques by some teachers, the new curriculum brought about positive and negative changes to biology teaching. The major positive changes center on the sequence of subject matter, role of students, and teaching methods and techniques. Although many teachers favor its sequence, there were some teachers who complained about the content of the curriculum as a negative change they experience together with problems with time and textbook. There was also another group of teachers who stated that there was no change in teaching with the new curriculum.

Instruction and family related factors were also identified as influencing the process of curriculum implementation and the learning environment. For instance, whether students were interested in the subject matter and motivated to learn, the connection of subject matter to daily life and the use of instructional materials positively influenced both the curriculum implementation process and the learning environment. Physical facilities and opportunities within schools; insufficient instructional materials and technical support, and crowded classrooms, were the main factors negatively influencing the process of curriculum implementation and the learning environment. Similarly low-level students, university entrance examination, the curriculum itself, teaching methods and techniques, families and school administration negatively influence curriculum implementation. Teachers also complained about insufficient class hours for the loaded curriculum content, and their own incompetence in adapting to developments in the field.

Although the students' role in the curriculum implementation process was interpreted through the eyes of their teachers, the valuable information collected using "Biology Curriculum and Instruction Questionnaire" helped to understand students' attitudes and influences on the curriculum implementation and learning environment. As said by their teachers, students are interested in biology and actively participate in the lessons. Biology lessons increase their interest in scientific thinking, learning and research and answer their questions about biology. They liked biology classes because they believe in the necessity of learning about the human body and nature. They liked to use what they learn in class in their daily lives. They also believe that biology will help them in their future professions. However, their teachers pointed to the difficult nature of the subject matter, that it was hard to learn and there were too many students doing experiments as major reasons for students to dislike biology lessons. Similarly, students also believed that they were learning unnecessary things in biology classes without doing experiments and practical studies.

Considering students' level, teachers reported changes in the implementation process of the new curriculum. For instance, instruction becomes efficient and easygoing in classes of high-level students, whereas it becomes harder in classes where the student level is low. Likewise more responsible behavior, increased interest in subject matter and participation in lessons, increase in variety of instructional activities and increase in success is observed in the classes of high-level students. In contrast, teachers simplify subject matter and repeat several times in classes where the student level is low. Success and participation in lesson decrease and problems in classroom management are faced in these classes. Similarly, in mixed-ability classes student interest in subject matter decrease and instruction becomes harder.

Examining instruction using teaching methods and techniques, and instructional materials used during instruction and laboratory studies provided a close look to the curriculum implementation process. For instance it was found that questioning is the most frequently used teaching method in biology classes this is followed by lecture and discussion methods. However, there are differences between the teaching methods and techniques used in different schools by different teachers. For example, in Anatolian high schools lecturing and questioning methods are used more often than in private/foundation and public high schools. Similarly, demonstrations, field trips, observations and instructional technology are the methods and techniques that more often used in private/foundation schools.

The results of the "Biology Curriculum and Instruction Evaluation Questionnaire" also demonstrated a relationship between some teacher characteristics and the teaching methods and techniques they used during instruction. For instance, teachers younger than 36 use demonstration methods more often than other teachers. Like, teachers younger than 30 and between the ages of 36-40 lectured more frequently than other teachers. Similarly, female teachers use questioning methods more often than male teachers, and teachers with more than 20 years of teaching experience mostly lectured whereas the ones with 1-5 years of teaching experience use demonstration methods more often than the other teachers. A common characteristic of teachers with different years of teaching experience was that field trips, observation and instructional technology were rarely used teaching methods and techniques in their classes. Attendance at in-service training programs, workshops and/or seminars is another factor related to teachers that caused differences in the teaching methods and techniques they use. For example, teachers attending these programs more than twice use demonstration method more often than other teachers who had never, once or twice attended. Similarly, they used more often field trips, observation and instructional technology in their classes. It is seen that teachers who had never attended in-service training programs, workshops and/or seminars lectured frequently. However, teachers attending these programs more than two times lectured more often than these teachers.

A relationship between teachers' beliefs and perceptions of the new curriculum and their students, and the teaching methods and techniques they use during instruction was also observed. For instance, teachers agreeing that "curriculum is efficient, easy and practical to use," "curriculum makes lessons more effective and efficient," "curriculum is helpful in improving students' problem solving skills and creativity," "goals of the curriculum are appropriate to biology education," and "suggested instructional materials in the curriculum are efficient" used suggested teaching methods and techniques in the curriculum, i.e. demonstration, field trips, observations, discussion, etc., more often than other teachers. However, it was also observed that teachers stating that "curriculum connects lessons to daily life" and teachers finding suggested experiments, field trips, observations and projects in the curriculum inefficient lectured more often than other teachers, and teachers who disagreed that curriculum makes lessons more effective and efficient used demonstration method more frequently. Like, teachers who disagreed that "curriculum connects lessons to daily life" used discussion technique more than other teachers. In general, it was observed that teachers either agreed, moderately agreed or disagreed with curriculum characteristics, used field trips, observations or instructional technology less than the other teaching methods and techniques during instruction.

Responses of teachers showed that their beliefs of students' interest in biology, scientific thinking, learning and research, their active participation in lesson and ability to connect lesson content to daily life by asking questions determined how often teachers use various teaching methods and techniques during instruction. For instance, teachers who believed that their students were interested in biology used demonstration, field trip and observation methods more often than other teachers. Similarly teachers who stated that "students actively participate in lessons," "biology lessons increased students' interest in scientific thinking, learning and research," "lessons answered students' questions about biology," "students can connect lesson content to daily life" used suggested teaching methods and techniques in the curriculum more often than other teachers. However, they used field trips, observations and instructional technology less than the other teaching methods and techniques in general.

Instructional materials used during instruction also helped us to understand the process of curriculum implementation in different settings. Although written materials (words, texts, formulas, and signs), examples and models (DNA model etc.) and diagrams, graphs etc. were seen to be the most frequently used instructional materials during instruction in general, some differences depending on school type, some teacher characteristics, beliefs and perceptions were also observed. For instance, audiovisual instructional materials were more often used in private/foundation schools, whereas diagrams, graphs, etc. were mostly used in public high schools. Teachers in different age groups used different instructional materials in their classes. Teachers younger than 30, and teachers between the age range of 31-35 use dia, overhead projectors and slides, and examples and models more often than other teachers. Similarly female teachers used living things (animals and plants); dia, overhead projector, slides; diagrams, graphs etc.; and written materials (words, texts, formulas, signs) more often than male teachers during instruction. Although there is no difference in the use of instructional materials between teachers with different years of teaching experience, attendance at in-service training programs was a factor influencing use frequency of instructional materials between teachers. For instance teachers attending such programs more than twice used films; dia, overhead projector, slides; and diagrams, graphs etc. more often than the other teachers.

Their beliefs and perceptions of the new curriculum also influenced how often teachers use certain instructional materials during instruction. Teachers who stated that “curriculum is efficiently introduced,” “language of the curriculum is clear and easily understandable,” “curriculum connects lessons to daily life,” “goals of the curriculum are appropriate for biology education,” “suggested instructional materials in the curriculum are efficient” used suggested instructional materials in the curriculum more often than the other teachers. However, a group of teachers who disagreed that curriculum helps in making biology lessons more effective and efficient used films, dia, overhead projector, and slides more frequently than the ones who agreed or moderately agreed with this statement. Teachers’ beliefs and perceptions of students also influenced the instructional materials were used during instruction. Teachers who stated that “students are interested in biology,” “biology lessons increase students’ interest in scientific thinking, learning and research,” and “students can connect lesson content to daily life” used suggested instructional materials in the curriculum more often than the other teachers.

A close look at the laboratory studies also provided rich information about the implementation process of the new high school biology curriculum. Teacher responses showed that laboratory studies were carried out once a month or once a week during instruction in general. However, how often laboratory studies are carried out and which strategies are followed during these studies showed variations depending on school types, teacher characteristics, beliefs and perceptions. For instance, laboratory studies were carried out once a week in private/foundation schools, and once a month in Anatolian and public high schools. Though there was no difference between teachers in different age groups, between teachers who never, once, twice or more than twice attended in-service training programs, workshops and/or seminars, and between female and male teachers in using laboratory during instruction, a significant difference between teachers with different years of teaching experience was observed. Teachers with 1-5 years of teaching experience used the laboratory once a week and teachers in other experience groups used laboratory once a month in their biology classes. Similar to their teaching experiences, teachers' beliefs and perceptions also influenced how often they used laboratory in teaching biology. For instance, teachers who stated that "students actively participate in lessons" and "biology lessons increase students' interest in scientific thinking, learning and research" used the laboratory more often than the other teachers.

Demonstrating experiments was the most frequently followed strategy during laboratory studies. Generally teachers started experimenting and students followed their teachers. Laboratory studies in which students did independent studies were rarely carried out. The strategies followed during laboratory studies also showed differences depending on school types, teacher characteristics, beliefs and perceptions. For instance, teachers in Anatolian and public high schools did demonstration experiments, while teachers in private/foundation schools let their students follow experiments from written texts and test hypotheses in laboratory by themselves. Though there was no difference in laboratory studies followed by teachers in different age groups, between teachers having different years of teaching experience, and between female and male teachers, there was a significant difference between teachers who had never, once, twice or more than two times attended at in-service training programs, workshops and/or seminars. Teachers who had attended at such programs more than twice carry out laboratory studies in which students followed experiments from written texts more often than other teachers.

Teachers’ beliefs and perceptions of new curriculum and students also influenced the strategies they followed during laboratory studies. Teachers who stated “curriculum helps in making biology lessons more effective and efficient” carried out laboratory studies in which students determine the steps of the experiment with the help of available equipment more often than the other teachers. In contrast, teachers who disagreed with these teachers more often let their students test hypotheses by themselves in the laboratory. Similar to their beliefs and perceptions of the curriculum, teachers’ beliefs and perceptions of students also influenced the strategies they follow during laboratory studies. For instance, teachers who stated “students actively participate in lessons” and teachers who believed that biology lessons increase students’ interest in scientific thinking, learning and research more often allowed their students to test hypotheses by themselves in the laboratory and determine the steps of the experiments with the help of available equipment.

When the problems faced in biology classes were investigated after examining the major aspects of instruction; teaching methods, techniques, and instructional materials used during instruction and laboratory studies, limited time for laboratory studies due to a loaded curriculum content emerged as the most frequently faced problem. It was followed by crowded classrooms and doing experiments with lots of students. Lack of laboratory and teacher guidebooks was another major problem teachers faced during instruction. These problems also varied depending on school types and five schooling level strata. For example, schools in the fourth stratum, where schooling level is 50-59%, faced the problems of theoretical instruction, doing experiments with lots of students and lack of laboratory and teacher guidebooks more often than the schools in the other four strata. Similarly, public high schools faced the problems of crowded classrooms, theoretical instruction; lack of laboratory studies, limited use of visual instructional materials and limited opportunities to reach written sources. Anatolian high schools also experienced the same problems. Yet, teachers working in these schools also pointed to doing experiments with lots of students as one of the main problems they faced during instruction in biology classes. Teachers working in public high schools also mentioned an inability to activate students during instruction, difficult to use laboratory equipment and lack of knowledge as to how to use some laboratory equipment as the other problems they faced during instruction.

The findings of the study were presented in this chapter addressing each research question. In the next chapter, conclusions drawn from "Biology Curriculum and Instruction Evaluation Questionnaire" and implications for practice and future research are presented.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

This chapter includes an interpretation and synthesis of the findings and conclusions drawn from “Biology Curriculum and Instruction Evaluation Questionnaire” and implications and suggestions for practice and future research.

5.1. Conclusions

Findings concerning curriculum implementation in biology classes, and local, school and classroom level factors influencing the process of curriculum implementation are presented in this section.

5.1.1. Implementation of Curriculum Intentions in Biology Classes

Following physical structure and facilities of schools, teaching methods and techniques, and instructional materials used during instruction and laboratory studies carried out in biology classes are examined to see how curriculum intentions are implemented in biology classes.

As it is reported in the studies of Karagözoğlu (1987), Ekici (1996), Yaman (1998), Turan (1996), Erten (1993), Özbaş and Soran (1993), and Dindar (2001), the physical structure and facilities of Turkish schools constrain biology teachers from carrying out the desirable teaching tasks in their classrooms. The results of this study showed that the process of the new high school biology curriculum is somewhat limited due to insufficient physical structure and facilities at schools. Classrooms are crowded and conditions are insufficient for using the intended teaching methods, techniques and instructional materials during instruction. Although there is an independent biology laboratory in two-thirds of the schools, teachers report lack of sufficient technical support, old and insufficient laboratory equipment and instructional materials in most of these schools. In schools where the laboratory is shared with other science courses or used with other purposes, teachers also complain about inadequate physical conditions and facilities.

Similar to what Öztürk (1999), Ekici (1996), Yaman (1998), Akaydın and Soran (1993) found in their studies, teaching methods and techniques used during instruction showed that teacher is still the main authority in the class who most often lecture, directs questions to students and guide teacher centered discussions. In contrast to the student-centered preference in the curriculum, student participation in the lesson is still limited to following the teacher, and asking and answering questions. As yet, teachers use instructional technology, demonstrations, field trip and observation studies rarely in their biology classes.

Instructional materials used during instruction were mostly in written forms as Akaydın and Soran (1993) report in their study. In addition to words, texts, formulas and signs, it was found that examples and models, diagrams and graphs were also used to visualize the subject matter. However, the biology curriculum intends more visual and interactive instructional materials to be used during instruction to enrich the learning environment and relate subject matter to daily life situations.

Laboratory studies, which help students to see, to learn, to understand and to criticize the subject matter, were generally carried out once a month. Yaman (1998), Turan (1996) and Erten (1993) also report that laboratory studies are rarely carried out in biology classes. However, this study shows that in some schools laboratory studies are carried out once a week. When the strategies followed during these studies were examined, it was seen that teachers prefer demonstration experiments as it is reported in Özbaş and Soran's (1993) study. Similar to demonstration experiments, a considerable number of teachers described laboratory studies in which they start doing the experiment and students follow them. For both of the most commonly followed laboratory strategies, students have little opportunity to comprehend and interpret the subject matter, and develop their scientific thinking abilities. In just a limited number of schools, students did experiments using trial and error in the laboratory with the guidance of their teachers.

5.1.2. Local, School and Classroom Level Factors Influencing the Process of Curriculum Implementation

In general, loaded curriculum content and crowded classrooms were identified as major constraints during the process of curriculum implementation. Similar to what Tobin (1987) and Scott (1994) report in their studies, teachers felt obliged to cover large amounts of curriculum content and therefore could not carry out laboratory studies so often. As Strage and Bol (1996), Gwimbi and Monk (2003) stress in their studies, too many students in classrooms also make it harder to do experiments in the laboratory. Since there are no laboratory and teacher guidebooks, teachers face problems in implementing the curriculum. As Kimpston (1985) and Scott (1994) point out in their studies, many teachers need support in improving their teaching and laboratory skills to implement the curriculum in intended ways. In addition to teachers' own lack of capabilities, physical conditions and facilities of schools limit the process of curriculum implementation as Fullan and Pomfret (1977), Scott (1994), Shymansky and Kyle (1992), Strage and Bol (1996) mention before. Lack of time is another constraint teachers feel in carrying out desirable curriculum implementation tasks as Kimpston (1985), Scott (1994), Anderson and Helms (2001) conclude in their studies.

This section examines various factors influencing the process of new high school biology curriculum implementation. Grouped into three, factors identified in this study are explored at local, school and classroom level. The first group includes factors causing differences in the process of curriculum implementation at local level strata. The second group consists of factors differentiating the process of curriculum implementation at school level. The third group is formed by classroom level factors that are mainly about teachers and their classroom behavior.

5.1.2.1. Local Level Factors

In spite of the fact that schooling level strata were created to facilitate the sampling process, results of the study showed significant differences in the process of curriculum implementation in five schooling level strata. Though there are relatively few studies examining local level differences during the process of curriculum implementation, findings of this study support what House (1974) and Downey et al. (1975) report in their studies (cited in Fullan and Pomfret, 1977). As they point to the teachers' needs, access to information and resources, and preparedness of staff to implement the curriculum, findings of this study show that teacher' needs and access to the resources in schools influence the implementation process at local level.

In contrast to schools in the other four strata, schools in the fourth stratum, where schooling level is between 50-59%, are constrained to carry out curriculum tasks in intended ways. Since the criterion in creating the five strata was schooling level, it inevitably becomes evident that big cities are in high schooling level strata. Take for instance Kocaeli and Bursa in the fourth stratum, big cities also have big populations. Therefore classrooms can be more crowded and access to resources like laboratory and teacher guidebooks may be limited, and this will prevent teachers carrying out intended curriculum tasks as was found in this study.

5.1.2.2. School Level Factors

The examination of new high school biology curriculum implementation in public, Anatolian and private/foundation schools also point to differences in the process of implementation at school level. Similar to what Özbaş and Soran (1993) and Ekici (1996) reported in their studies, findings drawn from "Biology Curriculum and Instruction Evaluation Questionnaire" show significant differences in the teaching methods and techniques, and instructional materials used during instruction, frequency of laboratory studies carried out and strategies followed during these studies in public, Anatolian and private/foundation schools.

A comparison of teaching methods and techniques used in public, Anatolian and private/foundation schools highlighted teacher - centered orientation in Anatolian high schools where teachers more frequently lectured and directed questions to students. However, in private/foundation schools instructional technology is used more often, teaching is facilitated with demonstrations, and students are provided with more opportunities to gain knowledge by doing, seeing and interpreting in field trip and observation studies. Özbaş and Soran (1993) also report that private/foundation schools have better facilities to carry out laboratory studies more often than Anatolian and public high schools.

Similar to teaching methods and techniques used during instruction, instructional materials used in biology classes of public, Anatolian and private/foundation schools also show differences. Although in private/foundation schools learning is facilitated with the help of more visual instructional materials like films, dia, overhead projectors and slides, teachers in Anatolian high schools reported using diagrams and graphs to visualize the subject matter.

Frequency of laboratory studies carried out in biology classes, and strategies followed during these studies in public, Anatolian and private/foundation schools were also different. Although teachers in private/foundation schools carry out laboratory studies once a week and let their students follow experiments from written texts and test given hypotheses in the laboratory by themselves during these studies, teachers in Anatolian and public high schools carry out laboratory studies once a month and generally do demonstration experiments. Özbaş and Soran (1993) explain this difference between private/foundation schools and Anatolian, public high schools with limited budgets separated to biology laboratories and more students in classrooms of public and Anatolian high schools.

The results of the study also showed that the problems faced during instruction differ in public, Anatolian and private/foundation schools. Connected to the learning environments created in biology classes at each school and the teachers' capabilities in teaching biology, the process of curriculum implementation is somewhat more limited in public high schools. Due to the crowded classrooms and limited opportunities for carrying out the intended curriculum implementation tasks, teachers feel constrained in these schools. Teachers working in public high schools also have concerns about their own incapability to teach and carrying out laboratory studies.

5.1.2.3. Classroom Level Factors

Parallel to the literature, the results of this study show that teachers play a key role during the process of curriculum implementation. They interpret and practice curriculum intentions in their classrooms. In addition to their own capabilities in teaching, their beliefs and perceptions of curriculum, students and effective biology education determine how curriculum is implemented in classrooms. The results of the study also show that teacher characteristics such as their age, sex, teaching experience and attendance at professional teacher development activities, in-service training programs, seminars and/or workshops, influence the process of new high school biology curriculum implementation. However, it was also found that students' level, their classroom behaviors and interest in subject matter influence teachers' decisions and classroom behaviors.

5.1.2.3.1. Teacher Related Factors

As reported by Solomon et al. (1977), Ashley and Butts (1970), Cole (1971, cited in Fullan and Pomfret (1977)), Crocker and Banfield (1986), Tobin and Gallagher (1987), Tobin (1987), Mitchener and Anderson (1989), Cronin-Jones (1991), Hawthorne (1992), Evans (1986), Gess-Newsome and Lederman (1995), Lederman (1999), Lumpe, Haney and Czerniak (2000), Cho (2001), Gwimbi and Monk (2003), teacher characteristics, i.e. age, sex, teaching experience and attendance at professional teacher development programs, beliefs and perceptions of new curriculum and students are identified as some of the major factors influencing the process of new high school biology curriculum implementation in this study.

5.1.2.3.1.1. Teacher Characteristics

It was found that female and male teachers, teachers in different age groups, teachers with different years of teaching experience, and teachers who had never, once, twice or more than twice attended in-service training programs, workshops and/or seminars used different teaching methods, techniques and instructional materials during instruction, and carried out laboratory studies in different periods of time and follow different strategies during these laboratory studies.

Sex: Although teachers' sex is only reported by Evans (1986) as one of the potentially important determinants of the implementation process, the results of this study also show significant differences in the teaching methods, techniques and instructional materials used by female and male teachers during instruction. Female teachers used the questioning technique more often than male teachers during instruction. Similarly they use instructional materials such as living things (animals and plants), dia, overhead projector and slides, diagrams, graphs, and written materials, more often than male teachers in the classroom. However, there is no difference between female and male teachers in their frequency for carrying out laboratory studies, and the strategies they follow during these studies.

Age: As it is identified by Evans (1986) and Ekici (1996), teachers' age is another determinant of implementation process. Similar to the findings of Ekici's study (1996), the results of this study show that teachers younger than 30 and teachers between the ages of 36 and 40 used the lecturing method more often than teachers in other age groups. Similarly, teachers younger than 30 and teachers between the ages of 31 and 35 used the demonstration method more frequently than teachers in other age groups during instruction. There was also a significant difference in the instructional materials used by teachers in different age groups. Teachers younger than 30 years of age use dia, overhead projector and slides, and teachers between the ages of 31 and 35 use examples and models more often than teachers in other age groups. There was no difference in the frequency of carrying out the laboratory studies, and the strategies followed during these studies between teachers in different age groups.

Teaching Experience: Teaching experience is identified as another factor influencing the process of curriculum implementation in this study as reported by Evans (1986), Ekici (1996), Lederman (1999) and Cho (2001). There are significant differences in the teaching methods and techniques used during instruction and the frequency of carrying out laboratory studies between teachers with different years of teaching experience. In contrast to what Ekici (1996) reported, it was found in this study that experienced teachers (more than 20 years) used the lecture method more often than other teachers. However, Cho (2001) notes that novice teachers use curriculum faithfully confronting to the curriculum developers' intentions, we found that teachers with 1 to 5 years of teaching experience used demonstration method more often than other teachers. It was also found that teachers with 10 to 15 and 16 to 20 years of teaching experience formed the largest group of teachers who never or rarely carried out field trips and observation studies. Similarly, teachers with 10 to 15 and more than 20 years of teaching experience formed the largest group who never or rarely used instructional technology in their classes.

There was no significant difference in the instructional materials used during instruction and the strategies followed during laboratory studies by teachers in different teaching experience groups. However, it was found that teachers with 1 to 5 years of teaching experience carried out laboratory studies once a week whereas teachers with 6 to 9, 10 to 15, 16 to 20 and more than 20 years of teaching experience carried out laboratory studies once a month.

Attendance at Professional Teacher Development Programs: Cole (1971, cited in Fullan and Pomfret, 1977) identifies intensive in-service training as an important strategy for curriculum implementation. Solomon et al. (1977), Ashley and Butts (1970, cited in Fullan and Pomfret, 1977) also report that teachers that received in-service training shifted toward behaviors consistent with implementation of the curriculum. When the teachers' classroom practices were examined in the light of these findings, significant differences in the teaching methods, techniques and instructional materials used during instruction and the strategies followed during laboratory studies between teachers who had never, once, twice or more than twice attended in-service training programs, workshops and/or seminars were also observed in this study. Although teachers who had never attended such programs mostly use lecture method, teachers who attended such programs twice or more than twice used the demonstration method, field trips, observations and instructional technology more often than other teachers. Ekici (1996) also report more desired classroom practices in teachers attending in-service training programs. However, it was also found that teachers who attended at such professional teacher development programs more than twice formed the largest group of teachers who most often used the lecture method in their biology classes.

Although they lectured most of the time in their classes, teachers attending in-service training programs, workshops and/or seminars more than twice use visual instructional materials such as films, dia, overhead projectors, and slides, diagrams and graphs more often than the other teachers. There was no difference in the frequency of carrying out laboratory studies between teachers who had never, once, twice or more than twice attended at professional teacher development programs. However, a significant difference was observed between the strategies they follow during these studies. Teachers who attend these programs more than twice carry out laboratory studies more often in which their students followed experiments from written texts.

5.1.2.3.1.2. Teacher Beliefs and Perceptions

As Crocker and Banfield (1986), Mitchener and Anderson (1989), Cronin-Jones (1991), Lumpe, Haney, and Czerniak (2000) report in their studies, the results of this study also show that teacher' beliefs and perceptions of new curriculum, of students and of effective biology education influenced the implementation process of the new high school biology curriculum.

Effective Biology Education: As Cronin-Jones (1991) identified in her study, teachers' beliefs about the most important student outcomes exert a powerful influence on the curriculum implementation process. Similarly, Tobin (1987) states that teachers' beliefs about how students learn and what they ought to learn have the greatest impact on the curriculum implementation process. Whether in the same line of the curriculum intentions or not, teachers beliefs determine what and how they teach in the classroom. The findings of this study show that teachers' beliefs about effective biology education; about the required knowledge, skills and attitudes about biology, and teaching learning strategies that should be used in biology classes, are in the same line as the curriculum philosophy. Teachers believe that students should gain knowledge about their own body structure, and other living things, their diversity and interactions in the nature. Students should be able to apply what they learn at school in their daily lives. They should gain an understanding of a wholesome life and environmental consciousness in biology classes. Therefore a curriculum depending on understanding, comprehension and interpretation should be implemented. Students should be kept active during the lessons and teachers should help them to learn by living and doing. Subject matter should be visualized and related to real life situations.

New High School Biology Curriculum: Similar to the teachers in Crowther's (1972, cited in Fullan and Pomfret, 1977) study, teachers participating in this study were generally in favor of the new curriculum. They think that the new curriculum has a clear and understandable language and it helps them in making lessons more effective and efficient with the suggested teaching learning strategies, experiments and instructional materials. Teachers thought that curriculum also connected lessons to daily life and helped students to improve their creativity and problem solving skills.

The teachers' beliefs regarding the structure and organization of the new high school biology curriculum show that they find the goals of the curriculum appropriate for biology education. The teachers thought that the curriculum content was selected and organized appropriately to the student level; they agreed that the suggested experiments, field trips, observations, projects and instructional materials in the curriculum were efficient and appropriate. The teachers believed that the suggested teaching and learning activities in the curriculum helped them in planning and during instruction.

Although the teachers moderately or fully approved many characteristics of the new high school biology curriculum, they pointed to some changes necessary for the curriculum itself and for biology classes. They thought that curriculum should be simplified and reorganized, and should not be changed so often. Textbooks prepared in line with the curriculum should be revised each year to help teachers carry out intended curriculum tasks, teachers should attend in-service training programs, class hours for biology should be increased and schools should be supported technically.

Using the new curriculum mainly for instructional planning and for determining the teaching learning strategies to be followed during instruction, teachers identified the emphasis on visualization of subject matter with various instructional materials and practical studies in the new curriculum. The teachers believed that students' active participation and interest in the subject matter has increased with the new curriculum. The teachers think that the curriculum content has a good sequence and that the subject matter is related to real life issues. However, the teachers find subject matter too detailed that orient students to rote learning. They also think that the time allocated for the loaded curriculum content is not enough to carry out intended curriculum tasks.

Although the teachers seemed to approve the major aspects of the new curriculum in general, there were some differences in the ways they practiced the curriculum's intentions in their classrooms. As Hawthorne (1992) puts in his study, teaching methods and techniques, instructional materials, frequency of laboratory studies and the strategies followed during these studies show differences between teachers who agree, moderately agree or disagree with curriculum characteristics.

It was found that teachers who generally agreed with the efficiency of curriculum for teaching biology used the demonstration method more often. Although these teachers also seemed to use instructional technology, field trips and observations more often than other teachers, it was observed that these teaching methods and techniques were rarely or never used during instruction in general.

Teachers who generally agreed with the efficiency for curriculum in teaching biology also used instructional materials more often in their classrooms than the other teachers. Although the instructional materials used by these teachers show variety (written materials, examples and models, films, diagrams and graphs, living things, dia, overhead projector and slides), the findings of this study show that written materials, diagrams and graphs were the most commonly used instructional materials in biology classes.

Similar to the teaching methods, techniques and instructional materials used during instruction, there is a significant difference in the laboratory strategies followed by teachers who agreed, moderately agreed or disagreed with the efficiency of the curriculum. It was found that teachers who agreed or moderately agreed with the efficiency of curriculum let their students determine the steps of experiments with the help of available equipment in the laboratory whereas teachers who disagreed this let their students test hypotheses in the laboratory.

Students: In addition to teacher characteristics, and beliefs and perceptions of new high school biology curriculum, teachers' beliefs and perceptions of students emerged as an important factor influencing the process of curriculum implementation in this study. It was found that the teaching methods, techniques and instructional materials used during instruction, and frequency of laboratory studies and strategies followed during these studies were also related to teachers' beliefs and perceptions of their students.

Findings drawn from "Biology Curriculum and Instruction Evaluation Questionnaire" showed that teachers generally think that their students are interested in biology. Since they wonder about their own body structure and nature and find the subject matter interesting they actively participate in the lessons and ask questions to their teachers. Teachers also believed that biology lessons increase students' interest in scientific thinking, learning and research. As said by their teachers, students can relate subject matter to real life issues and enjoy doing experiments in the laboratory. However, students find the subject matter hard to learn. As stressed by half of the teachers participating in the study students think that unnecessary subject matter is taught in biology classes. Teachers believed that there is a tendency among students to rote learn long and detailed subject matter.

As Mitchener and Anderson (1989), Gess-Newsome and Lederman (1995) reported, teachers' classroom practices also point to a significant relationship between their beliefs and perceptions of students and the teaching methods and techniques they use during instruction. Similar to what Smerdon and Burkam (1999) found out in their study, students' interest, liking of the subject and performance in the classroom were also identified as exerting an influence on the curriculum implementation process in this study. The results of the study showed that teachers who believed that their students were interested in biology and actively participated in lessons use a wide variety of teaching methods and techniques. Although these methods and techniques were mostly teacher centered (lecture, questioning and discussion), teachers tried to enrich the instruction by using instructional technology, and field trip and observation studies. However, when compared to traditional methods these newer teaching methods and techniques were rarely used in biology classes.

Similar to the relationship between teachers' beliefs and perceptions of students and the teaching methods and techniques they use during instruction, a significant relationship was also observed between teachers' beliefs and the perceptions of students and the instructional materials they use during instruction. It was found that teachers who believed their students were interested in biology and could relate subject matter to daily life issues used a wide variety of instructional materials such as films, diagrams, and graphs, living things (animals and plants), examples and models, slides and written materials during instruction. These teachers also carried out laboratory studies more often than the other teachers (once a week) and generally let their students to do the experiments by themselves in the laboratory using trial and error.

5.1.2.3.2. Student Related Factors

Although they were not involved in this study, information collected from teachers showed that students form one of the major factors influencing the implementation process of the new high school biology curriculum. As said by their teachers teaching becomes more efficient and easygoing when the student level is high in the classroom. There is more interaction in the classroom and students ask more questions, participate in subject related discussions and comment on daily life issues. However, teachers need to simplify and repeat the subject matter several times when the student level is low. Tobin and Gallagher (1987), and Smerdon and Burkam (1999) also report teachers' preference for didactic instruction in low-level classrooms where they think drill and practice is more efficient. Since poor achievement students are often not interested in the lesson and learning, the teachers also face management problems in low-level classrooms. As stated by Tobin (1987) these management problems in turn negatively influence the quality of instruction. The results of the study show that teachers also experience similar problems in the mixed level classrooms. Students who are not interested in lesson disrupt other students and it becomes harder for teachers to carry out desired curriculum implementation tasks in these classrooms. As Mitchener and Anderson (1989) and Lederman (1999) report teachers' concerns about loosing class control orient them to continue with a traditional lecturer-expert role and student attention and participation in the lesson decrease.

5.1.3. Implications for Practice

Suggestions for practice are offered in this section regarding school and classroom contexts, teacher development and curriculum design based on the major findings of the study.

Since the physical structure and facilities of the schools emerged as one of the major factors constraining the implementation process of the new high school biology curriculum, the first focus is on school and classroom contexts.

Schools should have all the means necessary for a curriculum to be implemented the way it is originally intended. In order to use inquiry-based practices, teachers should be supported with rich and satisfactory conditions in classrooms and schools. However, the results of this study show that teachers working in different schools do not have access to the same satisfactory conditions to use the desired implementation tasks in their classrooms. In general class sizes are not small, rich materials and educational aids for instruction are usually not available, and facilities are old and generally not well maintained. Situation is far from ideal in many schools trying to implement the new high school biology curriculum in the way it is intended.

In order to ensure that intended constructivist ideas are practiced in classrooms, it is necessary to support schools with all possible means to implement the new high school biology curriculum. Instead of using curriculum laboratory schools (CLS) as a reference to evaluate the efficiency of new curricula and to follow their implementation, various schools should be visited and classroom observations should be conducted. Resources and materials in each school should be examined to see if they allow the curricula to be implemented in the ways intended. When it is necessary, schools should be supported with new facilities, resources and materials and existing and emerging technologies.

Another major finding of the study deals with the vital role of teachers in translating curriculum intentions into classroom experiences. Following school and classroom contexts, differences in the implementation process of new high school biology curriculum rely on different teacher characteristics, beliefs and perceptions. As a common feature of instruction the teaching behavior of teachers shows similarities. In contrast to the curriculum philosophy and their own beliefs, teachers continue to be the central authority in teacher-centered classrooms where they emphasize teaching basic facts and definitions. Although content dependency and time constraints are identified as major reasons that determine teachers' instructional decisions and classroom behavior, a crucial change is needed to move from being teacher-centered towards being learner-centered in education. Therefore teachers should enrich their knowledge, learn new behaviors and be supported professionally.

In order to help teachers change their classroom behavior and restructure their beliefs, teachers should be provided with opportunities to reflect on their own classroom experiences. It is not enough to inform teachers about changes and give directions on how to enact curriculum in the classroom. Teachers should experience their expected roles in the classrooms, and they should have hands-on experience with the materials they are going to use while teaching.

Since teaching is an isolated profession, talking with other teachers and sharing ideas with them provide rich opportunities to teachers for increasing the efficiency of instruction. Peer-support makes it easier to find solutions to the problems teachers are experiencing in classrooms. Working together and sharing ideas and experiences help teachers implement the curriculum more successfully. Therefore, rather than holding committee meetings, teams should work together and be built up in each school and to promote shared understanding of curriculum content and to form a peer support group for the biology teaching process. Experts should sometimes guide these team meetings at the local level and facilitate discussions on teaching, new curriculum and classroom practices. Since it is not possible for all teachers to participate in in-service training programs, workshops and/or seminars, teachers attending professional teacher development activities should share their experiences and new knowledge with their colleagues at the team meetings.

Teachers should also be encouraged to read and to continue to learn about diverse approaches in their profession and to develop effective classroom strategies. Research should be used to support teachers' professional development and should have practical application in facilitating curriculum implementation. The findings of this study and similar studies should be brought into teachers' attention to help them improve curricular experiences.

It is also important to train teacher candidates in line with the intended curriculum characteristics. In methodology courses teacher candidates should be supported with practical advice from professionals for successful lessons, be given theoretical and practical knowledge and have their ability for biology teaching enhanced. Teachers and teacher candidates should also engage in research on biology teaching and learning and use the results of these studies to improve their practices.

It also appeared that teachers need more guidance and advice to follow curriculum recommendations and the suggestions made in the curriculum in the classroom. However, the guide published in the Journal of Announcements of Ministry of Education (no. 2485) is still used as the only way to communicate the instructional strategy and rationale behind the curriculum. As teachers participating in the study demanded, separate, clearly defined, specific curriculum handbooks for teachers and for laboratory studies should be prepared.

Content dependency and the time expectancies of teachers were among the major findings of the study that need attention from the curriculum developers. It is found that the loaded curriculum content and suggestion for timing negatively influenced the curriculum implementation process. Since teachers have to cover large amounts of content in a relatively short time, they tend to teach basic facts and definitions using traditional teaching methods. They relatively emphasize applications of knowledge and development of higher order thinking skills less during instruction and laboratory studies. In contrast to the curriculum intentions, rote learning of factual information is still common among students.

Despite the fact that the curriculum is built on constructivist views of learning, the suggested timing, and structure and organization of its content orient teachers to practicing traditional teaching behaviors in the classroom. The curriculum developers need to revise the curriculum; its content and suggested timing, taking into account its underlying philosophy and the assumptions made about its implementation. It is not enough to change the curriculum. Similar to the planning done during curriculum development, careful and deliberate planning should also be done for the curriculum implementation process. Teachers should also be supported with all possible means to implement the curriculum in the intended way.

5.1.4. Implications for Future Research

Suggestions for future research are offered in this section regarding development of new science curricula and improvement of science education in our country. .

It is seen that the findings of this study can be used to help curriculum developers in planning strategies for improving the present high school biology curriculum. Similar studies can also be carried out to guide the development of new science curricula. Describing the implementation process of present day science, physics or chemistry curricula would help us to improve science education in our country.

In order to collect rich data with the purpose of improving science education in Turkey, ıt is better to combine a survey questionnaire with teacher and student interviews and classroom observations in the future research. Since students also actively participate in the implementation process together with teachers their thoughts and perceptions should also be examined in the future research. The findings of the research investigating implementation of science curricula through questionnaires, teacher and student interviews, and classroom observations can form a basis for further progress to be made in curriculum design and improvement of instructional practices.

It should always be kept in mind that if one does not know how a new curriculum is implemented in the classroom, it is not possible to evaluate how it is contributing to the achievement of the intended learning outcomes, and thus to determine the success and/or failure of the new curriculum.

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APPENDICES

APPENDIX A

BİYOLOJİ PROGRAMI ve ÖĞRETİMİ DEĞERLENDİRME ANKETİ

Sayın Öğretmen,

Bu anket yeni biyoloji dersi öğretim programının uygulanmasını etkileyen faktörlerin belirlenmesi amacıyla gerçekleştirilen akademik bir çalışmada kullanılmak üzere hazırlanmıştır. Sizden beklenen bu ankette yer alan soruları içtenlikle cevaplayarak öğretim sürecinde etkili olan faktörlerin tespitinde yardımcı olmanızdır.

Beş bölümden oluşan anketin ilk bölümünde sizinle ve çalıştığınız okulla ilgili bazı genel bilgileri toplamak amacıyla hazırlanan sorular yer almaktadır. İkinci bölümde biyoloji dersi öğretim programının uygulanışı konusunda okulunuzdaki gerekli alt yapı desteğinin tespiti ve sizin programla ilgili algılarınızı belirlemek amacıyla hazırlanan sorular yer almaktadır. Anketin üçüncü ve dördüncü bölümlerinde yer alan sorular derslerinizde kullandığınız öğretim yöntem, teknik ve araç gereçlerini, ve biyoloji dersinin öğrencileriniz üzerindeki etkileri hakkındaki görüş ve düşüncelerinizi anlamak amacıyla sorulmuştur. Anketin son bölümünde ise biyoloji öğretimini ve programın uygulanışı konusunda hazırlanan genel sorular yer almaktadır.

Yanıtlarınızın akademik amaçlarla kullanılacağı bu ankete isimlerinizi yazmanız gerekmemektedir. Katkılarınızdan ötürü teşekkür eder, çalışmalarınızda başarılar dilerim.

Araş. Gör. Ebru Öztürk
O.D.T. Ü. Eğitim Fakültesi
Eğitim Bilimleri Bölümü

A) Aşağıda sizinle ve çalıştığınız okulla ilgili bazı genel bilgileri toplamak amacıyla hazırlanan sorular yer almaktadır. Lütfen size uygun olan seçenekleri işaretleyiniz.

1) Yaşınız
☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41 ve üstü

2) Cinsiyetiniz ☐ Kadın ☐ Erkek

3) Mezun olduğunuz yüksekokul/üniversite ve bölüm ____________________________

4) Şu anda görev yaptığınız il _________________ veya ilçe ______________________

5) Çalıştığınız okul türü ☐ Anadolu Lisesi ☐ Özel/Vakıf Lisesi ☐Genel Lise

6) Okulunuzdaki toplam biyoloji öğretmeni sayısı _____

7) Okulunuzdaki 9, 10 ve 11. sınıfların ortalama mevcutları
9. sınıf ____ 10. sınıf ____ 11. sınıf _____

8) Kaç yıldır öğretmenlik yapıyorsunuz?
☐ 1-5 ☐ 6-9 ☐ 10-15 ☐ 16-20 ☐ 21 veya daha fazla

9) Son üç yıl içerisinde Biyoloji 1,2,3 derslerinden hangilerini okuttunuz?
☐ Tümünü ☐ Sadece Biyoloji 1 ☐ Sadece Biyoloji 1 ve 2
☐ Sadece Biyoloji 2 ☐ Sadece Biyoloji 1 ve 3
☐ Sadece Biyoloji 3 ☐ Sadece Biyoloji 2 ve 3

10) Bu dönem haftada toplam kaç saat derse giriyorsunuz? ______

11) Sizin de içinde bulunduğunuz biyoloji zümresi ayda kaç kere toplantı yapıyor?
☐ Hiç ☐ 1-2 ☐ 3-4 ☐ 5 ve daha fazla

12) Görsel ve yazılı yayın organlarından (Radyo, televizyon, gazete, dergi, internet vs.) biyoloji ile ilgili yeni yayınları takip ediyor musunuz?
☐ Evet ☐ Sınırlı düzeyde ☐ Hayır

13) a) Şimdiye kadar kaç kez biyoloji eğitimiyle ilgili bir hizmet içi eğitim kursuna, çalışma ya da toplantıya katıldınız?
☐ Hiç katılmadım ☐ Bir kez ☐ İki kez ☐ İkiden fazla

b) Katıldıysanız bu hizmet içi eğitim kursu, çalışma ya da toplantı sizce ne derece yararlı oldu?
☐ Çok yararlı oldu ☐ Kısmen yararlı oldu ☐ Hiç yararlı olmadı

c) Bu kurs, çalışma ya da toplantının neden yararlı olduğunu ya da yararlı olmadığını düşünüyorsunuz? Lütfen açıklayınız.__________________________

____

____

____

____

B) Aşağıda yeni biyoloji programının uygulanışı konusunda okulunuzdaki gerekli alt yapı desteğinin tespiti ve sizin programla ilgili algılarınızı belirlemek amacıyla hazırlanan sorular yer almaktadır. Lütfen her ifade için uygun olduğunu düşündüğünüz seçeneği işaretleyerek görüş ve düşüncelerinizi belirtiniz.

1) Program İçin Gerekli Altyapı Desteği	Evet	Kısmen	Hayır
a) Gerektiğinde okulunuzda kolayca araç-gereç ve materyal bulabiliyor musunuz?			
b) Okulunuz teknik donanım olarak (TV, video, tepegöz,bilgisayar vb.) yeterli koşullara sahip mi?			
c) Okulunuzda biyoloji laboratuvarı var mı?			
d) Okulunuz biyoloji laboratuvarında yeterli araç gerece sahip misiniz?			

Biyoloji öğretimi kapsamında okulunuzun fiziki koşulları konusunda yaşadığınız başka güçlükler var mıdır? Varsa lütfen yazınız. ____

____

2) Programla İlgili Görüş ve Düşünceler	Evet	Kısmen	Hayır
a) Program yeterince tanıtıldı mı?			
b) Programın dili sizce yeterince açık ve anlaşılır mıdır?			
c) Program kolay uygulanabilirlik ve pratiklik bakımından yeterli midir?			
d) Yeni program biyoloji dersini daha etkili ve verimli hale getirmede size yardımcı oluyor mu?			
e) Program biyoloji öğretimini günlük yaşama yaklaştırabiliyor mu?			
f) Program öğrencinin problem çözme becerisini geliştirmeye katkıda bulunuyor mu?			
g) Program öğrencinin yaratıcılığını geliştirmeye katkıda bulunuyor mu?			
h) Program hedefleri biyoloji öğretimi için uygun olarak hazırlanmış mıdır?			
ı) Programın içeriği uygun olarak seçilmiş ve düzenlenmiş midir?			
j) Programda ünitelerin sırası uygun mudur?			
k) Programda konular ile ilgili örnek ve problemleri yeterli buluyor musunuz?			
l) Programda önerilen uygulama, deney, gezi, gözlem ve projeleri uygun buluyor musunuz?			
m) Programda önerilen film, saydam, video kaset gibi öğretim materyallerini yeterli buluyor musunuz?			
n) Programdaki öğrenme-öğretme etkinlikleri dersi planlamada ve öğretimde yararlı olmakta mıdır?			
o) Programın öğrenci düzeyine uygun olduğunu düşünüyor musunuz?			

3) Sizce haftalık biyoloji ders saatleri ne kadar olmalıdır?
Biyoloji 1____ Biyoloji 2____ Biyoloji 3____

Neden? Lütfen açıklayınız.____

4) Yeni programla birlikte biyoloji öğretiminde ne tür değişiklikler yaşadınız?

5) Program bir bütün olarak size ne derece yardımcı olmaktadır? Programı nasıl kullanıyorsunuz?

C) Aşağıda biyoloji derslerinde kullandığınız öğretim yöntem, teknik ve araç-gereçlerini belirlemek amacıyla hazırlanan sorular yer almaktadır. Lütfen her ifade için uygun olduğunu düşündüğünüz seçeneği işaretleyerek görüş ve düşüncelerinizi belirtiniz.

1) Derslerinizi işlerken aşağıdaki öğretim yöntem ve tekniklerinden hangilerini, hangi sıklıkla kullanıyorsunuz?	Her Zaman	Sık sık	Bazen	Nadiren	Hiçbir zaman
a) Düz anlatım					
b) Soru-cevap					
c) Tartışma					
d) Gösteri (demonstrasyon)					
e) Gezi-gözlem çalışmaları					
f) Bilgisayar uygulamaları (Eğitim yazılımları, CD vs. kullanmak)					

2) a) Okulunuzda biyoloji laboratuvarı var mı?
☐ Evet ☐ Hayır

b) Varsa hangi sıklıkla kullanıyorsunuz?
☐ Tüm biyoloji derslerinde ☐ Ayda bir kez
☐ Haftada en az bir kez ☐ Sömester boyunca bir kez
☐ Hiç kullanmıyorum

Yanıtınız “Hiç kullanmıyorum” ise lütfen 4. soruya geçiniz.

3) Laboratuvar çalışmalarında deney yaparken aşağıdakilerden hangi yolu izliyorsunuz? *(Birden fazla seçeneği işaretleyebilirsiniz.)*

ﻕ Deneyi bir düzenek halinde kendim yaparak öğrencilerin hepsine bu düzenek üzerinde anlatıyorum

ﻕ Deneyi yazılı olarak veriyorum, öğrenciler işlem basamaklarını adım adım izleyerek yapıyorlar.

ﻕ Deneyi önce kendim yapıyorum, daha sonra öğrencilerin kendi kendilerine yapmalarını sağlıyorum.

ﻕ Sadece araç gereçleri öğrencilere veriyorum, deneyi öğrenciler işlem basamaklarını kendileri belirleyerek yapıyorlar.

ﻕ Öğrencilere konuyu (hipotezi) veriyorum, sınama yoluyla doğru olup olmadıklarını kendileri buluyorlar.

ﻕ Diğer (Lütfen yazınız) ____

____

____

4) Aşağıda belirtilen eğitim araçlarını derslerinizde hangi sıklıkla kullanıyorsunuz?	Her Zaman	Sık sık	Bazen	Nadiren	Hiç bir zaman
a) Gerçek canlılar (hayvan, bitki vb.)					
b) Örnekler, modeller (DNA modeli vb.)					
c) Sesli filmler					
d) Hareketsiz görüntüler (dia, tepegöz, film şeritleri)					
e) Görsel semboller (diyagram, şema, plan, grafik)					
f) Sözel semboller (söz, yazı, formül, işaretler)					

5) Okulunuzda biyoloji derslerinde hangi kitabı/kitapları kullanıyorsunuz? Lütfen adını/adlarını ve yazarlarını yazınız.

____

____

6) Biyoloji kitaplarının kullanımıyla ilgili aşağıdakilerden sizce uygun olanını işaretleyiniz *(Birden fazla seçeneği işaretleyebilirsiniz.)*.

ﻕ Dersleri işlerken yalnız ders kitabını izliyorum.

ﻕ Dersleri ders kitabından işliyorum, fakat öğrencilere yararlanmaları için kaynak kitap veriyorum.

ﻕ Bazı konuları başka kitaplardan anlatıyorum.

ﻕ Şekil, çizelge, tablo gibi kısımları gerek oldukça başka kitaplardan alıyorum.

ﻕ Diğer (Lütfen yazınız)____

____

____

7) Derslerinizi yabancı dille işliyor musunuz? (YALNIZ ANADOLU LİSESİ ve ÖZEL/VAKIF LİSESİNDE ÇALIŞAN ÖĞRETMENLER TARAFINDAN CEVAPLANACAKTIR.)

ق Evet ق Kısmen ق Hayır

Eğer yanıtınız evet ya da kısmen ise derslerinizi yabancı dille işlemek sorun yaratıyor mu? Lütfen açıklayınız____

____

____

8) Biyoloji dersinin işlenişinde aşağıdaki aksaklıkların hangileriyle karşılaşıyorsunuz? *(Birden fazla seçeneği işaretleyebilirsiniz.)*

ق Sınıftaki öğrenci sayısının fazla oluşu
ق Programın yoğun olması nedeniyle laboratuvar çalışmalarına zaman ayrılamaması
ق Konuların teorik olarak anlatılması
ق Konularla ilgili film, slayt, maket, tablo vb gösterilememesi
ق Ders konularının günlük yaşamla bağlantılarının kurulamaması
ق Çok sayıda öğrenci ile deney yapılması
ق Derste öğrencinin aktif olmasının sağlanamaması
ق Ders kitabı dışında kaynaklara ihtiyaç duyulması
ق Yararlanılacak kaynaklara ulaşabilme olanağının kısıtlı olması
ق Program öğretmen ve laboratuvar kılavuz kitabının bulunmaması
ق Bazı laboratuvar araç ve gereçlerini kullanma zorluğu
ق Laboratuvar araç ve gereçlerini kullanmadaki bilgi yetersizliği
ق Diğer (Lütfen yazınız.) ____

____

____

D) Aşağıda biyoloji dersinin öğrencileriniz üzerindeki etkilerini belirlemek amacıyla hazırlanan sorular yer almaktadır. Lütfen her ifade için uygun olduğunu düşündüğünüz seçeneği işaretleyerek görüş ve düşüncelerinizi belirtiniz.

1) Öğrencilerle İlgili Görüş ve Düşünceler	Evet	Kısmen	Hayır
a) Öğrencileriniz biyoloji bilimine ilgi duyuyorlar mı?			
b) Öğrencileriniz biyoloji dersini önemli bir ders olarak görüyorlar mı?			
c) Öğrencileriniz derse aktif olarak katılıyor mu?			
d) Biyoloji dersi öğrencilerinizin bilimsel düşünme, öğrenme ve araştırmaya ilgilerini arttırıyor mu?			
e) Biyoloji dersi öğrencilerinizin biyoloji ile ilgili merak ettiği sorulara cevap verebiliyor mu?			
f) Öğrencileriniz biyoloji dersi içeriğini günlük yaşamla ilişkilendirebiliyorlar mı?			

2) Öğrencilerinizin biyoloji dersini sevme nedenleri aşağıdakilerden hangisi ya da hangileridir? *(Birden fazla seçeneği işaretleyebilirsiniz.)*
☐ Vücutlarını, canlıları ve doğayı tanımanın gerekliliğine inanmaları
☐ Konuların ilgi çekici olması
☐ Öğrendiklerini günlük yaşamda kullanabilmeleri
☐ Deney yapmayı sevmeleri
☐ Biyolojinin ileride seçecekleri meslek alanına katkısı olacağına inanmaları
☐ Ders işleyiş yöntemlerinin ilgilerini çekmesi
☐ Diğer *(Lütfen yazınız.)* ____

3) Öğrencilerin biyoloji dersini sevmeme nedenleri aşağıdakilerden hangisi ya da hangileridir? *(Birden fazla seçeneği işaretleyebilirsiniz.)*
☐ Derste öğrenmekte zorluk çektikleri konuların işlenmesi
☐ Derste gereksiz olduğunu düşündükleri konuların işlenmesi
☐ Konuların günlük yaşamla ilgili bilgileri kapsamaması
☐ Programın biyoloji alanındaki yeni gelişmeleri kapsamaması
☐ Konularla ilgili deney ve uygulama çalışmalarının yapılmaması
☐ Çok sayıda öğrenci ile deney yapılması
☐ Konuların şekil-şema çizilerek anlatılmaması
☐ Konularla ilgili slayt, maket, tablo vb. gösterilmemesi
☐ Diğer *(Lütfen yazınız.)*____
____
____

4) Öğrencilerinizin düzeyi öğretimin gerçekleştirilmesini, sınıf ortamını ve etkinliklerini nasıl etkiliyor?
____
____
____
____
____

E) Biyoloji Öğretimiyle İlgili Genel Sorular

1) Sizce liseyi bitiren bir öğrencide bulunması gereken biyolojiyle ilgili temel bilgi, beceri ve tutumlar nelerdir?
Bilgi: ____
____
____
Beceri: ____
____
____
Tutum: ____
____
____

2) Sizce biyoloji öğretimi nasıl gerçekleştirilmelidir?

3) Sizce sınıf ortamını ve programın uygulanmasını olumlu ya da olumsuz olarak etkileyen başlıca faktörler nelerdir?

4) Yeni biyoloji dersi programı ve uygulanması konusunda başka düşünce ve önerileriniz varsa lütfen yazınız.

APPENDIX B
TURKISH SUMMARY

Fen eğitimi alanında uzun yıllar boyunca öğretimin etkililiğini arttırmak amacıyla pek çok yenilikçi yaklaşım takip edilmiştir. Öğrenmenin yapılandırmacı yaklaşımlar temel alınarak gerçekleştirilmesi amacıyla önce öğretim programları, daha sonra öğretim yöntem ve teknikleri değiştirilmiş, sınıflardaki öğrenci sayısı azaltılmış, ders saatleri ve öğrencilerin okulla ilgili yükümlülükleri arttırılmıştır (De Jong, 2000; Hurd, 2000). Bununla birlikte öğretim programları ve materyalleri için yapılan büyük yatırımların öğretimde beklenen değişiklikleri getirmediği ve sınıflarda geleneksel fen eğitimine devam edildiği gözlemlenmiştir (Scott, 1994).

Davis (2002) öğretimin öğretmen merkezli yürütüldüğü fen sınıflarında düz anlatımın en sık kullanılan öğretim yöntemi olduğunu rapor etmektedir. Zohar, Degani ve Vaaknin (2001) ise fen sınıflarını öğretmenlerin, öğrencilerin öğrenmelerini kolaylaştırmak ve onlara düşünmeyi öğretmek yerine programı yetiştirmek amacıyla bilgi aktarımında bulundukları ortamlar olarak tanımlamaktadır. Penick'in (1995) fen eğitimi alanında yapılan çalışmalar üzerinde yaptığı incelemesinde de yenilikçi yaklaşımların öğretmenlerin öğrenmeyi kolaylaştıran, öğrencilerin birlikte çalışarak, yaratıcı düşünme becerilerini geliştirerek ve öğrendiklerini ihtiyaçlarına uygun olarak kullanabilmelerini sağlayacak zengin öğrenme ortamları yaratmasını hedeflediği, ancak öğretmenlerin bunun aksine geleneksel yöntemlerle öğretime devam ettikleri görülmüştür.

Yager'in de (2000) belirttiği gibi fen eğitimi, öğrencilerin yaparak ve yaşayarak öğrenmelerini gerektirir. Bilimsel kavramları okumak ya da öğretmenlerin bu konuda yaptığı açıklamaları dinlemek yeterli değildir. Bununla birlikte yapılan pek çok çalışma fen sınıflarında gerçekleşen öğretimin öğrencileri ezbere öğrenmeye yönelttiğini göstermiştir. Pek çok öğretmen arasında öğrencilerin konuları anlayabilmeleri için çok sayıda kavramı bilmeleri gerektiği kanısı yaygındır Bu kavramların öğretilmesi ise çok zaman almakta ve bu nedenle fen sınıflarında uygulama çalışmaları yapılamamaktadır. (Gallagher, 2000). Öte yandan oluşturmacı yeni yaklaşımlar öğrencilerin sorun çözebilme ve yaratıcı olma becerilerini geliştirerek, öğrendiklerini günlük hayatlarında uygulayabilmelerini hedeflemektedir (Strage ve Bol, 1996).

Tüm dünyada hızla yaygınlaşan fen alanındaki bu yeni oluşturmacı yaklaşımların Türk eğitim sisteminde de etkileri görülmektedir. Örneğin yeni lise biyoloji dersi öğretim programı içeriği özellikle sağlık konuları ve günlük hayatla ilişkilendirilmiş, öğrencilerin ezbere öğrenmeden uzaklaşarak öğrendiklerini kavramaları ve günlük hayatlarında tecrübe etmeleri hedeflenmiştir. Programda yer alan detaylı açıklama ve önerilerle sınıfların öğrenmenin sadece duyarak değil, öğretmen rehberliğinde görerek ve yaparak gerçekleştiği ortamlar olması beklenmektedir. Bununla birlikte Öztürk (1999) tarafından programın ülke genelinde uygulanışının ilk yılında yapılan durum çalışması hedeflenenin aksine öğretimin hem öğretmen hem de öğrenciler açısından sorgulama temelli olmadığını göstermiştir. Öğretimin öğretmen merkezli düz anlatım yöntemiyle gerçekleştirildiğini rapor eden Öztürk öğrencilerin sınıftaki rollerinin dinlemek ve not tutmakla sınırlı olduğunu belirtmektedir. Ders sırasında yapılan sık tekrarların öğrencileri ezbere öğrenmeye yönlendirdiği bu çalışmada olduğu gibi Tobin (1987) tarafından da rapor edilmiştir. Öztürk ayrıca programda hedeflenenin aksine öğretim araç ve gereçlerinin ders sırasında nadiren kullanıldığını aktarmaktadır.

Öztürk'ün bulguları hedeflenen ve uygulanan öğretim programları arasındaki farklılıklara işaret etmektedir. Munby (1984) tarafından program geliştirme uzmanlarının ve uygulayıcıların farklı bakış açıları nedeniyle ortaya çıktığı belirlenen bu farklılıklar Waxman (2001) tarafından program uygulama çalışmalarının temel sorunu olarak tanımlanmaktadır. Waxman'a göre pek çok yenilikçi öğretim programının başarısız olmaları nedeniyle uygulamadan kaldırılmalarının nedeni öğretmenlerin temel ihtiyaçları ve sorunlarına program geliştirme uzmanları tarafından gereken önemin verilmemesidir.

Öğretim programlarının geliştirilmesi ve uygulamaların etkililiğinin arttırılabilmesi için uygulama sürecini inceleyen araştırmaların gerekliligi her geçen gün artmaktadır. Bu gereklilik eğitim hedeflerinin nasıl gerçekleştirildiklerinin anlaşılmasında esas etkendir. Davis (2002) öğretim programlarının uygulama süreçlerinin incelenmesinde ve hedeflenen uzun vadeli değişikliklerin gerçekleştirilmesinde öğretmenlerin bilgi ve deneyimlerinin de incelenmesi gerektiğini vurgulamaktadır.

Fullan'a (1997) göre yeni bir öğretim programının uygulanışının incelenmesindeki gereklilik değişikliklerin gerçekleşip gerçekleşmediğinin anlaşılması ve başarısızlıkla sonuçlanan girişimlerin esas sorunlarının tespitine dayanmaktadır. Scott (1994) son yirmi yıl içinde başarısızlıkla sonuçlanan öğretim programı projelerinin temelinde okul idarelerinin, öğretmen geliştirme programlarının eksikliğinin ve öğretmenlerin diğer öğretmenlerden kopuk öğretime devam etmelerinin yattığını belirtmektedir. Scott'a göre programlardaki değişikliklerle birlikte öğretmenlerin sınıf içi ihtiyaçlarının giderilmesi ve öğretmenlerin bilgi ve becerilerini geliştirme konusunda destek almaları gerekmektedir. Davis'te (2002) öğretmenlerden yeni programlarla birlikte öğretimde değişiklikler yapmaları istenirken, öğretmenlerin bilgi ve becerilerini geliştirmelerini sağlayacak fırsatlarında yaratılması gerektiğini vurgulamaktadır.

Öğretim programlarıyla ilgili yenilikçi bir yaklaşımın başlangıç noktası öğretmenler, onların bilgi ve deneyimleri olmalıdır. Strage ve Bol da (1996) öğretmenlerin sınıf içi davranışlarının gözlemlenmesinin uygulamaların etkililiğini ve başarısını arttırmak konusunda en önemli yöntemlerden biri olduğunu belirtmektedir. Böylece öğretmenlerin sınıflarında yeni kararları nasıl uyguladıkları belirlenebilecek, uygulama sırasında karşılaşılan sorunlar daha etkili bir biçimde tespit edilebilecektir. Öte yandan sınıf gözlemlerinin yapılmaması öğretmenlerin geçmiş deneyimlerinin rehberliğinde yeni kararları eski ve etkili olduğunu düşündükleri yöntemlerle uygulamalarına neden olabilir. Böylece hedeflenen ve uygulanan öğretim programları arasında büyük farklılıklar ortaya çıkabilir. Öğretmenler ve program geliştirme uzmanlarının fen ve etkili fen öğretimi konusundaki farklı görüşlerinin de benzer farklılıklara neden olabileceğini belirten Fetters, Czerniak ve Shawberry (2002) kimi zaman öğretmenlerin bu nedenlerle değişikliklere karşı direndiklerini vurgulamaktadır.

Hashweh'e (2003) göre öğretmenlerin öğretim davranışlarını değiştirmeleri öncelikle değişikliğe hazır ve istekli olmalarına dayanmaktadır. Daha sonra öğretmenlerin kendi düşünce ve deneyimlerini inceleyerek çözümleyebilmeleri ve böylece eski ve yeni kararlar arasındaki farklılıkları tespit ederek yeni kararları uygulayabilmeleri gerekmektedir. Benzer şekilde Lumpey, Haney ve Czerniak (2000) öğretmenlerin düşünce ve inançlarının değişim süreci içinde en önemli belirleyici olduğunu vurgulamaktadır. Öte yandan yapılan çalışmalarda öğretmenlerin değişim sürecindeki etkili rollerinin bir takım dış faktörlerden etkilendiği belirlenmiştir. Çeşitli ve çok sayıdaki bu tür faktörleri Fullan (1992) 1965'ten bu yana yapılan çalışmaların ışığında dört grupta incelemektedir: öğretim programıyla hedeflenen değişikliklerin kendine özgü özellikleri, okul düzeyinde etkili olan faktörler, bölge düzeyinde etkili olan faktörler ve programın uygulanışını etkileyen diğer dış faktörler. Anderson ve Helms (2001) Fullan'ın dört grupta incelediği bu faktörleri zaman, hedeflenen ve gerçekleşen, değişen roller ve iş, hazırlık ve eşitlik başlıkları altında incelemektedir.

Genel olarak öğretim programlarının hedeflendiği biçimde uygulanışını etkileyen faktörler öğretmenlerle ilgili olanlar ve diğer faktörler başlıkları altında incelenmektedir (Fullan ve Pomfret, 1977). Yenilikçi yaklaşımların uygulanışındaki başarı öğretmenlerin bu yenilikler konusunda yeterli bilgi sahibi olmalarına, bu değişiklikleri uygulamak konusunda yetkin olmalarına, okullarında uygulama için gerekli kaynağa sahip olmalarına ve en önemlisi bu değişiklikleri uygulama konusunda istekli olmalarına dayanmaktadır.

Diğer dünya ülkelerinde olduğu gibi ülkemizde de cumhuriyetin ilk yıllarından itibaren fen eğitimini iyileştirmek amacıyla pek çok yenilikçi yaklaşım takip edilmiştir. Bununla birlikte 1960'lara kadar ülkemizde fen eğitiminin ders kitabı destekli ve teorik olarak gerçekleştirildiği görülmüştür. Daha sonraki dönemde kullanılan yabancı öğretim programlarının (PSSC, CHEM Study, BSCS) ise uygulamalarında sosyal ve ekonomik farklılıklar nedeniyle sorunlar yaşanmıştır. Milli Eğitim Bakanlığı bünyesinde kurulan komisyon tarafından geliştirilen öğretim programlarında ise kullanılan öğretim yöntemleri, araç - gereç yetersizliği, kalabalık sınıflar ve öğretmenlerden kaynaklanan sorunlar nedeniyle uygulama sırasında zorluklar yaşanmıştır. 1993 yılında Türk milli eğitim sisteminin ihtiyaçları göz önünde bulundurularak Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı (EARGED) tarafından geliştirilen program geliştirme modelinin her düzeyde ve konu alanı ayırdedilmeksizin kullanılmasına karar verilmiştir.

Lise biyoloji dersi öğretim programı EARGED tarafından geliştirilen program modeli temel alınarak iki yıllık kapsamlı bir çalışma sonunda geliştirilen ilk öğretim programıdır. Programın geliştirilmesinde esas unsur biyoloji derslerinin içeriklerinin daha kapsamlı, çağdaş ve öğrenciler için ilgi çekici olmasıdır. Öğrencilerin kendi vücut yapıları ve çevreleriyle ilgili bilgilenmeleri, bilimsel düşünme becerilerini günlük hayatta kullabilmeleri, öğrendiklerini toplumun diğer bireyleriyle paylaşabilmeleri, biyoloji bilimine karşı olumlu bir tutum geliştirmeleri, meraklı ve sağlıklı bir hayat görüşü kazanmaları programın temel hedeflerindendir. Bu nedenle programın uygulanışında öğrencilerin ezbere öğrenmeden uzaklaşmaları, bilgiyi kavrama ve yorumlayabilmelerinin sağlanması hedeflenmektedir. Programın hedefleri, öğrenme-öğretme etkinlikleri, deneyler, gezi–gözlem çalışmaları, proje ve değerlendirme calışmaları program kitapçığında ayrıntılı olarak yer almaktadır. Benzer şekilde ünite planlarının ilgili bölümlerinde de kullanılması hedeflenen öğretim araç ve gereçlerine de yer verilmektedir. Programda verilen detaylı açıklama ve önerilerle biyoloji sınıflarının öğrencilerin sadece duyarak değil, görerek, yaparak ve yaşayarak öğrendikleri yerler olması hedeflenmektedir.

Programda biyoloji dersleri sırasında kullanılması önerilen öğretim yöntem ve tekniklerinin öğrenci merkezli olduğu görülmektedir. Öğretmenlerin sınıftaki rolleri ise bilgi aktarımı yapmak yerine, öğrencilerin öğrenmesini kolaylaştırmak ve rehberlik etmek olarak tanımlanmaktadır. Bu nedenle öğretmenlerin sınıflarında öğrencilerinin tüm duyu organları yardımıyla öğrenmelerini sağlayacak öğretim yöntem, teknik ve araç - gereçleri kullanmaları gerekmektedir. Benzer şekilde öğretmenlerin öğrencilerin yaratıcı düşünme ve problem çözme becerilerini geliştirmek amacıyla konularla ilgili proje çalışmaları vermesi, laboratuvar çalışmaları konusunda öğrencilerini desteklemeleri gerekmektedir. Gezi-gözlem çalışmaları ile öğrencilerin sınıfta öğrendiklerini yerinde görmesi, incelemesi ve yorumlaması sağlanmalıdır. Bu yolla öğretmenlerin öğrencilerin sınıfta öğrendiklerini günlük yaşamla ilişkilendirebilmelerini kolaylaştırmaları hedeflenmektedir. Yeni programla birlikte öğretmenlerden ayrıca öğrencilerinin çevre bilinci kazanmaları ve doğanın korunması konusunda etkin rol almalarını sağlaması da beklenmektedir.

Yeni biyoloji dersi öğretim programında yer alan detaylı açıklamalar ve önerilere karşın programın uygulanısının dördüncü yılında Öztürk'ün (1999) durum çalışması dışında programın biyoloji sınıflarında nasıl uygulandığı konusunda yeterli bilgi bulunmamaktadır. Programın ülke genelinde nasıl uygulandığının ve uygulama sürecinde etkili olan faktörlerin belirlenmesi amacıyla kapsamlı bir çalışmanın yapılması gereği belirmiştir. Bu çalışma bu ihtiyacı gidermek amacıyla gerçekleştirilmiştir.

İlgili literatürde yapılan araştırmalar "1970'lerde Öğretim Programı Uygulamaları," "Uygulamanın Belirleyici Unsurları," "1970 Sonrası Öğretim Programı Uygulamaları," ve "Türkiye'de Biyoloji Eğitimi ve Öğretim Programı Uygulamaları" başlıkları altında dört grupta incelenmiş, öğretmenler, sınıf içi öğrenme ortamları ve öğretim programı uygulamaları arasındaki ilişkiler özel olarak araştırılmıştır.

1970'li yıllarda yapılan çalışmalarda iki ana grup Fullan ve Pomfret (1977) tarafından uygulamanın hedeflerle gösterdiği tutarlılık ve uygulama sürecinde gerçekleşen değişikliklerin incelenmesi olarak tanımlanmıştır. Bu iki ana başlık altında çok sayıda araştırmayı örnek olarak kullanan Fullan ve Pomfret genel olarak öğretim programı uygulamalarının incelenmesindeki gerekliliğin değişikliklerin gerçekleştirilmesini engelleyen temel sorunların tanımlanmasına dayandığını belirtmektedir.

1970'lerde gerçekleştirilen çok sayıda çalışmanın sonuçları ışığında öğretim programı uygulamalarının belirleyici unsurlarını dört grupta inceleyen Fullan ve Pomfret (1977) programlarla beraber gelen yeni uygulamaların özelliklerine, programın uygulanmasıyla ilgili hizmet içi eğitim programları, kaynak desteği, dönüt mekanizmaları ve benzeri uygulamalarla ilgili strateji ve taktiklere, programların uygulanacağı koşullara, ve okul dışında kalan diğer dış faktörlere dikkat çekmektedir. Genel olarak tüm bu belirleyici unsurların programla beraber okul ve sınıf düzeyinde etkili olduğu ve öğretmenlerin karar verme süreçlerinde anahtar rolü oynadıkları görülmektedir.

1970'ler sonrasında öğretim programlarıyla ilgili yapılan çalışmalarda da öğretmenler ve onların sınıf içi davranışlarının incelendiği ve benzer sonuçların rapor edildiği görülmektir. Örneğin Kimpston (1985) öğretim programlarının uygulanışında alınan öğretmen görüşlerinin programın nasıl uygulandığının anlaşılmasını kolaylaştıracağını aktarmaktadır. Benzer şekilde Dreyfus, Jungwith ve Tamir (1985) öğretmen görüş ve düşüncelerinin ve bilgisinin öğretimin nasıl gerçekleştirildiğini belirlediğini vurgulamaktadır. Mitchener ve Anderson da (1989) öğretmenlerin öğretim programlarının uygulanış sürecindeki rollerinin programın başarısını belirlediğini aktarmaktadırlar. Cronin-Jones da (1991) çalışmasında öğretmen görüş ve düşüncelerinin öğretim programlarının uygulanışında önemli rol oynadığını vurgulamaktadır. Cronin-Jones'un çalışmasının bir başka sonucu öğretmenlerin öğretim programlarına karşı olan tutumlarının da uygulamayı etkileyen önemli unsurlardan biri olduğunu göstermektedir.

Öğretim programlarının uygulanışında bir başka unsur öğretmenlerin öğrencilerinin seviyeleri hakkındaki görüşleridir. Örneğin Duschl ve Wright (1989) öğretmenlerin sınıf içi davranışlarının yüksek seviyeli ve düşük seviyeli öğrencilerin olduğu sınıflarda farklılıklar gösterdiğini rapor etmektedir. Benzer şekilde Smerdon ve Burkam (1999) öğretmenlerin düşük seviyeli öğrencilerin olduğu sınıflarda sık tekrarları tercih ettiklerini ve bu sınıflarda öğretimin öğrencileri ezbere öğrenmeye yönlendirdiğini aktarmaktadır.

Tobin ve Gallagher'in (1987) çalışmasında ise öğretmenlerin fen konusundaki bilgi birikimlerinin, öğrenme ve öğretme konusundaki görüş ve düşüncelerinin öğretim programı uygulamasında etkili olan unsurlar olduğu rapor edilmektedir. Öğretmenlerin öğrencileriyle ilgili beklentilerininde yüksek ve düşük seviyeli öğrencilerin olduğu sınıflarda öğretim programı uygulamasını etkilediği Tobin ve Gallagher'in çalışmasının bir başka sonucudur. Tobin'in 1987 yılında gerçekleştirdiği çalışmada da öğretmen beklentilerinin ve öğrencilerin nasıl öğrendikleri ve neler öğrenmeleri gerektiği konusundaki inanışlarınında öğretim programı uygulamasını etkilediği görülmüştür.

Yapılan pek çok çalışmada öğretmenlerin görüş, düşünce, beklenti, inanış ve bilgilerinin öğretim programı uygulamalarını etkileyen önemli unsurlar olduğu rapor edilmektedir. Bununla birlikte öğretmenlerin hedeflenen öğretim programı uygulamalarını gerçekleştirme konusunda çeşitli nedenlerle kısıtlandıklarıda yapılan çalışmalar sırasında ortaya çıkan önemli sonuçlardandır. Örneğin Kimpston'un (1985) çalışmasında öğretmenlerin kendi yetersizlikleri ve uygulama sürecinin tanımlanmamış olması, öğretmenleri programın uygulanışı sırasında zaman yetersizliğinden sonra en çok kısıtlayan unsurlardandır. Tobin de (1987) yüklü program içeriğinin öğretmenleri programı hedeflendiği biçimde uygulamak konusunda engellediğini aktarmaktadır. Sınıf yönetimi, sınavlar ve ders kitabı Tobin'in çalışmasında öğretim programı uygulaması sırasında öğretmenleri kısıtlayan diğer unsurlar olarak belirlenmiştir. Lederman da (1999) öğretim programları uygulamasında sınıf yönetiminin yeni öğretmenler için önemli bir sorun teşkil ettiğini ve sınıf kontrolünü kaybetmek endişesinin öğretmenleri geleneksel yöntemlerle öğretime yönelttiğini belirtmektedir.

Scott’un (1994) çalışmasında ise öğretmenleri öğretim programı uygulaması sırasında kısıtlayan etkenler zaman, kaynak ve olanakların kısıtlı olması, sınavlar, program içeriğinin yüklü olması, öğrencilerin ilgisiz olmaları, farklı seviyede öğrencilerin aynı sınıfta olması ve öğretmenlerin kendi yetersizlikleri olarak belirlenmiştir.

Yapılan araştırmalarda öğretmenlerin bazı özelliklerinin de öğretim programlarının uygulanışını etkilediği görülmüştür. Örneğin Evans (1986) öğretmenlerin yaş, cinsiyet, öğretmenlik deneyimi ve eğitim geçmişleri gibi bazı özelliklerinin öğretim programlarının uygulanışında etkili unsurlar olduğunu rapor etmektedir. Benzer şekilde Lederman da (1999) farklı yıllarda öğretmenlik deneyimine sahip olan öğretmenlerin öğretim programı uygulamalarında farklılıklar olduğunu aktarmaktadır. Lederman’a göre deneyimli öğretmenler sınıflarında buluş ve sorgulama yöntemlerine ağırlık verirken, deneyimsiz öğretmenler sınıflarında hedefledikleri uygulamaları gerçekleştirememektedirler. Cho’nun (2001) çalışmasında da deneyimli ve deneyimsiz öğretmenlerin öğretim programı uygulamalarında farklılıklar olduğu görülmektedir. Deneyimli öğretmenler öğrencilerin ihtiyaçları doğrultusunda sınıf içi etkinliklere yer verirken deneyimsiz öğretmenler öğretim programını takip etmekte ve öğretmenlik becerilerini geliştirmeye çalışmaktadırlar.

Mitchener ve Anderson (1989) öğretmenlerin günlük programlarının genel olarak meslektaşlarıyla olan etkileşimleri ve öğrencilerinin sınıf içi davranışlarından etkilendiğini belirtmektedir. Öğretmenlerin genel olarak yeni öğretim programlarıyla gelen yenilik ve değişikliklere uyum sağlamaya çalıştıklarını aktaran Mitchener ve Anderson, pek çok çalışmada öğretmenlerin yeniliklere karşı tutucu olduklarının belirlendiğini de aktarmaktadır. Yee ve Kirst (1994) öğretmenlerin çoğu zaman program geliştirme uzmanlarınca alınan yeni kararları yeterince anlamadan uygulamaya başladıklarını belirtmektedir.

Program geliştirme uzmanlarının öğretmenlerin günlük programlarını ve sorumluluklarını gözönünde bulundurmadan aldıkları kararların uygulanmasında sorunların yaşanmasının olağan olduğunu belirten Shkedi (1998) uzmanların öğretmenlerin programları nasıl uygulayabileceklerini göz önünde bulundurmaları gerektiğini önemle vurgulamaktadır. Bu nedenle öğretmenlere ulaşmak için kullanılan dilin açık ve anlaşılır olması gerekmektedir. Van Den Akker de (1988) öğretim programlarının öğretmenler için yeterince açık bir dille yazılması ve uygulama konusunda detaylı bilgi vermesi gerektiğini belirtmektedir. Bununla birlikte merkezi olarak geliştirilen öğretim programlarının öğretmenler tarafından kullanılmadığı Coles, Allison ve Gray'in (1985) literatürde yaptığı inceleme sonunda ortaya çıkan önemli bir sonuçtur. Bu çalışmanın önemli bir başka sonucu öğretmenlerin uzun vadeli planlama dışında öğretim programlarını kullanmadıklarıdır.

Öğretim programlarının öğretmenler tarafından kullanımının sağlanması için mevcut özelliklerinden farklı özelliklere sahip olması gerektiğini belirten Shkedi (1998), programların program geliştirme uzmanlarının ve öğretmenlerin programla ilgili görüş ve düşüncelerini yansıtacak biçimde geliştirilmesi ve bunun için de uygun ortamların hazırlanması gerektiğini vurgulamaktadır.

Olson (1982), Aikenhead (1984) ve Mitchener ve Anderson'a (1989) göre öğretim programlarının geliştirilmesi sürecinde öğretmenler ve program geliştirme uzmanlarının beraber çalışması gerekmektedir. Böylece öğretmenlerin program hedeflerini sınıflarında uygulamaları kolaylaşacak, hedeflenen ve uygulanan öğretim programları arasındaki farklılıklar en aza inecektir (Kimpston, 1985). Bu nedenle öğretmenlerin öğretim programlarını sınıflarında uygulamaları gereken pasif bireyler olarak değerlendirilmemeleri gerekmektedir. Uygulamaların etkililiğinin arttırılması amacıyla öğretmenlerin istek ve dilekleri ve öğretim programı uygulamasında karşılaştıkları sorunlar yakından takip edilmelidir.

Kwakman da (2003) öğretmenlerin yeni öğretim programlarıyla sınıf içi davranışlarında beklenen değişikliklerin gerçekleşmesi için desteklenmeleri gerektiğini belirtmektedir. Geleneksel olarak öğretmenlerin alınan yeni kararları uygulamalarının kolaylaştırılması için hizmetiçi eğitim kursları ve programlar düzenlenmekte ve bu amaçla hazırlanan dökümanların detaylandırılarak öğretmenlere yardımcı olması beklenmektedir. Bununla birlikte Kwakman bu tür yardımların öğretmenlere hedeflenen öğretmen davranışlarını öğrenmek konusunda yeterince yardımcı olamadığını aktarmaktadır. Öğretmenlerin bu davranışları sınıf ortamında bizzat tecrübe etmeleri gerekmektedir. Davis de (2002) yeni öğretim yöntem ve tekniklerini hizmet içi eğitim kurslarında dinlemek yerine uygulayarak öğrenmenin öğretmenler için en etkili yol olduğunu söylemektedir.

Öğretmenler arasındaki sürekli iletişimin de öğretim programı uygulamalarında önemli bir rol oynadığı, öğretmenlerin yaşadıkları sorunlar ve çözümleri konusundaki fikir paylaşımlarının programların etkili bir biçimde uygulanmasını kolaylaştırdığı görülmüştür (Davis, 2002). Bu nedenle öğretmenlerin birbirleriyle etkileşim ve sürekli iletişim içinde bulunabilecekleri ortamların hazırlanması ve öğretmenlerin bu konuda desteklenmeleri gerekmektedir. Anderson ve Helms (2001) bu amaçla geleneksel hizmet içi eğitim programlarından uzaklaşılması gerektiğini vurgulamaktadır. Benzer şekilde Sanchez ve Valcarcel de (1999) öğretmenlerin bu tür geleneksel programlara katılmak konusunda istekli olmadıklarını ve bu nedenle öğretmenlerin görüş ve düşüncelerini rahatça ifade edebilecekleri ve uygulama yapabilecekleri yeni fırsatların yaratılması gerektiğini belirtmektedir.

Öğretim programlarının uygulanması üzerine yapılan çalışmalarda sınıflardaki öğrenim ortamlarının da uygulama etkililiğini belirleyen önemli bir unsur olduğu görülmüştür. Suarez, Pias ve Membiela (1998) sınıf içi öğretim ortamlarının farklı sınıflarda ve okullarda öğretim programı uygulamalarında farklılıklara neden olduğunu aktarmaktadır. Shymansky ve Kyle da (1992) okullardaki mevcut koşul ve olanakların ve öğretmenlerin iş yükünün okul düzeyinde öğretim programı uygulamalarında farklılıklara neden olduğunu belirtmektedir. Strage ve Bol (1996) ise öğretim programlarının uygulanışını etkileyen faktörler olarak sınıflardaki öğrenci sayılarının ve okulların mevcut koşullarını sıralamaktadır.

Daha önce yapılan çalışmaların ışığında öğretim programlarının başarısının sınıflarda nasıl uygulandıklarına bağlı olduğunu belirten Suarez, Pias, Membiela ve Dapia (1998) öğretmen ve öğrencilerin sınıf içi öğrenim ortamları hakkındaki görüş ve düşüncelerinin bu nedenle incelenmesi gerektiğini vurgulamaktadırlar. Benzer şekilde Gwimbi ve Monk da (2003) öğretmenlerin okullarındaki mevcut koşul ve olanaklar konusundaki görüş ve düşünceleri ile sınıf içi öğretim davranışları arasında ilişkiler olduğunu varsayarak bu konuda yapılan incelemelerin öğretim programlarının uygulanışı konusunda zengin bilgi sağlayacağını belirtmektedir.

Öğretim programları konusundaki tüm yenilikçi yaklaşımlarda öğretimin öğrenci merkezli olmasının ve buluş ve sorgulama yöntemleriyle deneylerin fen sınıflarında sıklıkla uygulanmasının hedeflendiği görülmektedir. Bununla beraber yapılan çalışmalarda öğretmenlerin sınıflarında geleneksel öğretim yöntem ve tekniklerini kullandıkları rapor edilmektedir. Smerdon ve Burkam'ın (1999) çalışmasında katılımcı öğretmenlerin düz anlatım yönteminin yüklü program içeriklerini öğrencilere aktarmak konusunda en etkili öğretim yöntemi olduğunu düşündükleri görülmüştür. Bu nedenle öğrenciler sınıflarında dinlemeye, not tutmaya ve gösteri deneylerini izlemeye devam etmektedirler.

Gallagher ve Tobin'in (1987) çalışmasında ise öğretmenlerin konuların yetiştirilmesi ve programda belirtilen etkinliklerin yapılması konusuna özellikle önem verdikleri görülmüştür. Bu çalışmaya katılan öğretmenler öğrencilerine karşı olan sorumluluklarını program içeriğini aktarmak olarak tanımlamışlardır. Bu nedenle sınıf içi etkinlikler konuların yetiştirilmesi ve öğrencilerin aktarılan bilgiyi ezberlemesi şeklinde gerçekleştirilmektedir. Tobin ve Gallagher'in çalışmasının bir başka sonucu düşük seviyeli öğrencilerin sınıf içi etkinliklerinin gerçekleştirilmesi konusunda öğretmenlerini olumsuz yönde etkilediği ve öğretmenlerin bu öğrencilerin olduğu sınıflarda konuları basitleştirerek anlattıkları ve ders yapma konusunda isteksiz olduklarıdır.

Tobin (1987) bir başka çalışmasında öğretmenliği ağır sorumlulukları olan bir meslek olarak tanımlamakta, her sınıf için ayrı bir ders planının yapılması gerektiğini vurgulamaktadır. Öğretmenlerin sınıf içi sorumlulukları yanında pek çok başka sorumluluğu da bulunduğunu belirten Tobin öğretmenlerin sınıf içi yönetimiyle ilgili karşılastıkları sorunları öğretim programı uygulamasını etkileyen önemli bir unsur olarak tanımlamaktadır.

Hofstein ve Lazarowitz (1986) öğretmenlerin sınıf içi öğrenim ortamlarıyla ilgili görüş ve düşünceleri ve davranışları gibi öğrencilerin sınıf ortamıyla ilgili algılarının da öğretim programı uygulamalarını etkileyen önemli bir unsur olduğunu belirtmektedir. Gess-Newsome ve Lederman da (1995) öğrencilerin öğretmenlerin hangi konuları nasıl öğretecekleriyle igili verdikleri kararlarda önemli rolleri olduğuna dikkat çekmektedir. Benzer şekilde Smerdon ve Burkam (1999) öğrencilerin konuya olan ilgi ve meraklarının, sınıf içi davranışlarının, öğretmenleri ve sınıf arkadaşlarıyla olan ilişkilerinin öğretimle ilgili yargılarında önemli etkenler olduğunu belirtmektedir. Talton ve Simpson da (1987) öğretmenleri, sınıf arkadaşları ve sınıflarıyla ilgili görüş ve yargılarının öğrencilerin hedeflenen davranışlara ulaşmaları konusunda etkili olduğunu belirtmektedir. Bu nedenle öğretmenleri gibi öğrencilerin de sınıf içi öğrenim ortamıyla ilgili görüş ve düşünceleri incelenmelidir. Böylece öğrencilerin ilgi ve merakını uyandıracak sınıf içi etkinlikleri tasarlanarak sınıfların zengin öğrenme ortamları olması sağlanabilir. Bu amaçla yapılacak inceleme ve araştırmaların öğretim programlarının geliştirilmesi ve iyileştirilmesi konusunda yararlı olacağına inanılmaktadır.

Ülkemizde öğretim programlarının uygulanışıyla ilgili çalışmalar sınırlı sayıda olsa da mevcut çalışmalar biyoloji eğitiminin sınıflarda nasıl gerçekleştiği konusunda bilgi sağlamaktadır. Bu çalışmada yeni lise biyoloji dersi öğretim programının biyoloji sınıflarında uygulanışını tanımlamayı ve bu süreçte etkili olan faktörleri belirlemeyi amaçladığından son yirmi yıl içinde ülkemizde biyoloji eğitimiyle ilgili yapılan çalışmalar da ilgili literatürde incelenmiştir.

Yılmaz (1998) tarafından değişen eğitim sistemlerinin biyoloji eğitimi üzerindeki etkilerinin araştırıldığı çalışmada cumhuriyetin ilk yıllarından itibaren biyoloji eğitiminin ülkemizde kalabalık sınıflar, yüklü program içerikleri, ders saatlerinin ve laboratuvar koşullarının yetersizliği ve öğrenciler arasında ezbere öğrenmeye olan eğilim nedeniyle sorunlar yaşadığı rapor edilmektedir.

Biyoloji sınıflarında kullanılan öğretim yöntem ve tekniklerini araştırmak amacıyla gerçekleştirdiği çalışmasında ise Ekici (1996) öğretmenlerin sınıflarında geleneksel yöntemlerle öğretime devam ettiklerini rapor etmektedir. Bunun sebeplerini ise öğretmenlerin geleneksel yöntemlerle öğretimin daha etkili olduğuna inanmaları olarak açıklayan Ekici, öğretmenlerin kullandıkları öğretim yöntem ve tekniklerinde yaşları, öğretmenlik deneyimleri ve hizmet içi eğitim programlarına katılımlarının belirleyici unsurlar olduğunu aktarmaktadır. Öğretmenlerin sınıf içi etkinlikleri konusundaki kararlarında çalıştıkları okulların mevcut koşul ve olanaklarınında etkili olduğunu belirten Ekici, genel olarak bütün okullarda sınıfların kalabalık olması ve teknik yetersizlikler nedeniyle sorunlar yaşandığını vurgulamaktadır. Ekici gibi Yaman da (1998) öğretmenlerin geleneksel öğretim yöntemlerini yaygın olarak kullandıklarını ve öğretim sırasında laboratuvar çalışmalarına nadiren yer verdiklerini aktarmaktadır. Benzer şekilde biyoloji sınıflarında görsel ders araç ve gereçlerininde nadiren kullanıldığını aktaran Yaman öğrencilerin derslere aktif olarak katılmadığını belirtmektedir.

Turan'ın (1996) çalışmasında da okullardaki koşul ve olanakların yetersizliği nedeniyle derslerin öğretmen merkezli olarak işlendiği ve öğrenciler arasında ezbere öğrenmenin yaygın olduğu görülmüştür. Erten'in (1993) çalışmasında da laboratuvar koşullarının yetersiz ve sınıfların kalabalık olmasıyla birlikte kısıtlı zaman nedeniyle laboratuvar çalışmalarının genel olarak ayda bir ya da iki kere gerçekleştirilebildiği rapor edilmektedir.

Akaydın ve Soran'ın çalışmasında ise öğretmenlerin derslerde genel olarak yazılı ders araç - gereçlerini kullandıkları ve düz anlatım yöntemini tercih ettikleri görülmüştür. Biyoloji eğitimini devlet, özel ve Anadolu liselerinde karşılaştıran Özbaş ve Soran'ın (1993) çalışmasında da yüklü program içeriği ve uygulama için ayrılan zamanın kısıtlı oluşunun bütün okullarda karşılaşılan esas sorunlar olduğu, bununla birlikte devlet ve Anadolu liselerinde kalabalık sınıflar, koşul ve olanakların yetersiz olması nedeniyle daha çok sorun yaşandığı belirlenmiştir.

Ülkemizde biyoloji eğitimini araştıran çalışmalar arasında Öztürk'ün (1999) durum çalışması doğrudan yeni lise biyoloji dersi öğretim programıyla ilgilidir. Bu çalışmada öğretmenlerin öğretim programı uygulaması sırasında rollerini araştıran Öztürk, hedeflenen ve uygulanan lise biyoloji dersi öğretim programları arasında farklılıklar olduğunu rapor etmektedir. Genel olarak programın geleneksel yöntemler kullanılarak uygulandığını aktaran Öztürk öğretmenlerin kısıtlı zaman ve yüklü program içeriğiyle birlikte üniversite giriş sınavından yakındıklarını belirtmektedir. Öztürk'ün çalışmasının bir başka sonucu sınıf yönetiminin bazı öğretmenler için program hedeflerini gerçekleştirmede engel teşkil ettiğini göstermektedir. Genel olarak hedeflenen öğretim programının öğretmenlerin sınıf içi etkinliklerinde temel değişiklikler gerektirdiğini belirten Öztürk öğretimin öğrenci merkezli olması gerektiğini vurgulamaktadır.

Bu çalışma yeni lise biyoloji dersi öğretim programının ülke genelinde uygulanışının dördüncü yılında Öztürk'ün durum çalışması dışında başka bir çalışma olmayışı nedeniyle doğan ihtiyacı karşılamak amacıyla gerçekleştirilmiştir. Bu çalışmada programın biyoloji sınıflarında uygulanışını tanımlamak ve bu süreçte bölge, okul ve sınıf duzeyinde etkili olan faktörleri belirlemek hedeflenmiştir. Çalışmaya yön veren iki ana araştırma sorusu bulunmaktadır: (1) Öğretim programı hedefleri biyoloji sınıflarında nasıl uygulanmaktadır? (2) Yeni lise biyoloji dersi öğretim programının uygulanmasında etkili olan bölge, okul ve sınıf düzeyindeki faktörler nelerdir? Bu soruları yanıtlamak amacıyla geliştirilen "Biyoloji Programı ve Öğretimi Değerlendirme Anketi" yoluyla seçkisiz tabaka ve küme örnekleme yöntemiyle belirlenen onbeş ildeki özel/vakıf ve Anadolu liselerinde çalışmakta olan 685 biyoloji öğretmeninden biyoloji derslerinde kullandıkları yöntem ve araç gereçler, program ve okullarında programın uygulanışı için gerekli altyapı desteği, biyoloji öğretimi ve programla ilgili görüş, düşünce ve beklentileri hakkında bilgi toplanmıştır.

Biyoloji Programı ve Öğretimi Değerlendirme Anketi aracılığı ile toplanan nicel ve nitel verilerin çözümlenmesinde betimleyici ve yordayıcı istatistiki yöntemlerle birlikte nitel veri analizi teknikleri de kullanılmıştır. Nicel verilerin çözümlenmesinde betimleyici istatistikler ile yanıtların sıklıkları, yüzdelikleri, ortalamaları ve standard sapmaları hesaplanmış, yordayıcı istatistikler (Ki-kare, kros-tab) yardımıyla ise programın uygulanışı bölge (okullaşma oranının farklı olduğu tabakalar), okul (devlet, özel/vakıf, Anadolu liseleri) ve sınıf (öğretim metot ve teknikleri, öğretim araç gereçleri, laboratuvar çalışmaları) düzeyinde karşılaştırılmıştır. Yordayıcı istatistikler sınıf düzeyindeki diğer farklılıkların (yaş, cinsiyet, hizmetiçi eğitim programlarına katılım ve öğretmenlik deneyiminin, öğretmen görüş ve düşüncelerinin kullanılan öğretim yöntem ve araç-gereçleri üzerindeki etkisi vs.) karşılaştırılmasında da kullanılmıştır. Nitel veriler için kodlama sırasında kullanılacak tematik kategoriler oluşturulmuş ve veriler bu kategoriler altında gruplandırılarak frekansları alınmıştır.

Biyoloji Programı ve Öğretimi Değerlendirme anketini dolduran 685 biyoloji öğretmeninin yanıtları programın okullardaki olanaksızlıklar ve kötü koşullar nedeniyle hedeflendiği biçimde uygulanamadığını göstermektedir. Sınıfların kalabalık oluşu, eski ve yetersiz laboratuvar koşulları, öğretim araç ve gereçleri çalışmaya katılan öğretmenlerin programın uygulanışı sırasında karşılaştıkları sorunların başında yer almaktadır.

Programın uygulanışı sırasında okul ve ilgili sınırlılıklar yanında öğretmenlerin biyoloji eğitimi, öğrenciler ve yeni programla ilgili görüş ve düşüncelerinin de etkili olduğu görülmüştür. Her ne kadar öğretmenlerin biyoloji eğitimi; amaç, içerik ve öğretim sırasında kullanılması gereken öğretim yöntem ve teknikleri, öğretim araç ve gereçleri, öğretmen ve öğrenci rolleri ve öğrenim ortamı ile ilgili görüş ve düşünceleri yeni lise biyoloji dersi öğretim programı felsefesiyle benzerlikler gösterse de, öğretmenlerin yaşları, cinsiyetleri, öğretmenlik deneyimleri, hizmetiçi eğitim programlarına katılımları gibi bazı özelliklerinin, öğrencileri ve yeni lise biyoloji dersi öğretim programıyla ilgili görüş ve düşüncelerinin uygulama sırasında etkili faktörler olduğu belirlenmiştir.

Programı genellikle öğretim planlarının hazırlanması, ders sırasında takip edilecek öğretim yöntem ve tekniklerinin belirlenmesi amacıyla kullandıklarını belirten öğretmenlerin, programla beraber biyoloji öğretiminde olumlu ve olumsuz bazı değişiklikler yaşadıkları bu çalışmanın önemli bulgularından biridir. Çalışmaya katılan öğretmenler tarafından belirtilen olumlu değişiklikler konuların sırası, öğrencilerin sınıf içi rolleri ve ders sırasında kullanılan öğretim yöntem ve teknikleriyle ilgilidir. Bununla birlikte konuların sırası, ayrılan sürenin kısıtlı olması ve ders kitabının yetersizliği konusunda şikayette bulunan öğretmenlerde bulunmaktadır.

Öğretmenlerin öğrencilerin sınıf içi rolleriyle ilgili görüş ve düşünceleri de programın uygulanışı konusunda zengin bilgi vermektedir. Örneğin, öğrencilerin seviyelerinin yüksek olduğu sınıflarda öğretmenler öğretimin kolaylaştığını, çeşitli sınıf içi etkinliklerinin kolayca gerçekleştirildiğini belirtmektedirler. Bunun yanında düşük seviyeli öğrencilerin olduğu sınıflarda öğretmenler programın hedeflendiği biçimde uygulanması konusunda güçlükler yaşamakta, güçleşen biyoloji öğretimi sırasında öğrencilerin dikkatlerinin kolayca dağılması nedeniyle sınıf yönetimi konusunda sorunlar yaşamaktadırlar.

Farklı seviyede öğrencilerin olduğu sınıflarda sınıf yönetimiyle ilgili sorunlar fazlalaşmakta, öğretmenler düşük seviyeli öğrencilerin konuları kavraması amacıyla sık tekrarlar yaptıklarından yüksek seviyeli öğrencilerin derse olan ilgileri azalmaktadır.

Öğrencilerin genel olarak biyoloji dersi ile ilgilendiklerini, derslere aktif olarak katıldıklarını belirten öğretmenler biyoloji derslerinin öğrencilerin bilimsel düşünme ve araştırma konusunda ilgilerini arttırdığını ve öğrencilerin merak ettiği konulardaki sorularını cevaplayabildiğini de önemle vurgulamışlardır. Bununla birlikte öğretmenler bazı öğrencilerin konuların ayrıntılı olması ve öğrenmede güçlük yaşamaları nedeniyle biyoloji derslerini sevmediklerini de belirtmiştir.

Öğretim sırasında kullanılan öğretim yöntem ve tekniklerinin, öğretim araç gereçlerinin ve laboratuvar çalışmalarının incelenmesi biyoloji öğretiminin sınıflarda nasıl gerçekleştirildiği konusunda zengin bilgi sağlamış, öğretim programının uygulanışının tanımlamasını kolaylaştırmıştır. Örneğin bu çalışmada soru-cevap tekniğinin biyoloji sınıflarında en sık kullanılan öğretim yöntem ve tekniği olduğu görülmüştür. Öğretmenler soru-cevap tekniğinin ardından düz anlatım ve tartışma yöntemlerini de sıklıkla kullandıklarını belirtmişlerdir. Öğretim sırasında kullanılan öğretim yöntem ve teknikleri okul düzeyinde karşılaştırıldığında Anadolu liselerinde çalışan öğretmenlerin derslerinde düz anlatım ve soru-cevap yöntem ve tekniklerine daha sık yer verdikleri, özel/vakıf okullarında çalışan öğretmenlerin ise derslerinde daha çok gösteri, gezi, gözlem ve eğitim teknolojilerine yer verdikleri görülmüştür.

Benzer şekilde farklı özelliklere sahip öğretmenlerin sınıflarında kullandıkları öğretim yöntem ve tekniklerinde de farklılıklar gözlenmiştir. Örneğin 36 yaşından genç öğretmenler gösteri yöntemini, 30 yaşından genç ve 36-40 yaşları arasındaki öğretmenler ise düz anlatım yöntemini diğer yaş gruplarındaki öğretmenlere kıyasla derslerinde daha fazla kullanmaktadırlar. Bayan öğretmenlerin de soru-cevap tekniğini erkek öğretmenlerden daha sık kullandığı görülmüştür. Öğretmenlik deneyiminin öğretim sırasında kullandıkları yöntem ve tekniklerleilişkisi olduğu çalışmanın bir başka sonucudur. Öğretmenlik deneyimi 20 yıldan fazla olan öğretmenler genel olarak derslerinde diğer öğretmenlerden daha fazla düz anlatım yöntemini kullanmakta, öğretmenlik deneyimi 1-5 yıl olan öğretmenler ise gösteri yöntemini tercih etmektedirler. Farklı yıllarda öğretmenlik deneyimi olan öğretmenlerin ortak özelliği olarak gezi, gözlem ve eğitim teknolojilerinin biyoloji sınıflarında nadiren kullanılan öğretim yöntem ve teknikleri olduğu belirlenmistir. Öğretmenlerin hizmet içi eğitim programlarına katılımlarının da ders sırasında kullandıkları öğretim yöntem ve tekniklerini etkileyen bir faktör olarak belirlendiği bu çalışmada, bu tür programlara iki seferden fazla katılan öğretmenlerin gösteri yöntemini diğer öğretmenlere oranla daha fazla kullandıkları görülmüştür. Bu tür programlara daha önce katılmayan öğretmenler derslerinde genel olarak düz anlatım yöntemini kullanmaktadırlar.

Öğretmenlerin yukarıda belirtilen özellikleriyle ders sırasında kullandıkları öğretim yöntem ve teknikleri arasındaki ilişkiye benzer bir ilişki, öğretmenlerin yeni program ve öğrencileriyle ilgili görüş ve düşünceleri ve kullandıkları öğretim yöntem ve teknikleri arasında da gözlemlenmiştir. Örneğin, programın kolay ve pratik kullanım konusunda, dersleri daha etkili ve verimli hale getirme konusunda, öğrencilerin problem çözme ve yaratıcılıklarını arttırma konusunda etkili ve yararlı olduğunu düşünen, programda önerilen öğretim araç - gereçlerini, öğretim yöntem ve tekniklerini etkili bulan öğretmenlerin programda önerilen yöntem ve teknikleri diğer öğretmenlere kıyasla daha sık kullandıkları belirlenmiştir. Program içeriğinin günlük hayatla ilişkili olmadığını düşünen öğretmenler ise derslerinde düz anlatım yöntemini tercih etmektedirler. Bununla birlikte program hakkında ne düşünürlerse düşünsünler genel olarak öğretmenlerin gezi, gözlem ve eğitim teknolojilerini derslerinde nadiren kullandıkları görülmüştür.

Öğretmenlerin öğrencileri hakkındaki görüş ve düşüncelerinin de derslerinde kullandıkları öğretim yöntem ve tekniklerini etkileyen faktörlerden biri olduğu belirlenmiştir. Örneğin öğrencilerinin biyoloji bilimiyle ilgilendiğini düşünen öğretmenlerin sınıflarında gösteri, gezi ve gözlem yöntemleri daha sık kullanılmaktadır. Benzer şekilde öğrencilerinin derse aktif olarak katıldıklarını, derslerin öğrencilerin bilimsel düşünme ve araştırmaya olan ilgilerini arttırdığını, öğrencilerin ders içeriğini günlük yaşamla ilişkilendirebildiğini belirten öğretmenlerin programda önerilen değişik öğretim yöntem ve tekniklerini diğer öğretmenlere kıyasla daha sık kullandıkları görülmüştür.

Çalışmada öğretim yöntem ve tekniklerini takiben, ders sırasında kullanılan öğretim araç ve gereçlerinin incelenmesi de yeni biyoloji programının uygulanışını tanımlamak konusunda zengin bilgi sağlamıştır. Biyoloji Programı ve Öğretimi Değerlendirme Anketini dolduran öğretmenlerin yanıtları genel olarak biyoloji derslerinde kelimeler, yazılı dökümanlar, formüller ve işaret gibi yazılı materyallerin en sık kullanılan öğretim araç ve gereçleri olduğunu göstermiştir. Bununla birlikte okul türlerinin, öğretmen özellikleri, görüş ve düşüncelerinin de ders sırasında kullanılan öğretim araç ve gereçlerini belirlediği görülmüştür. Örneğin görsel araç - gereçler özel/vakıf okullarında Anadolu liseleri ve genel liselere kıyasla daha sık kullanılmaktadır. 30 yaşından genç ve 31-35 yaşları arasında olan öğretmenlerde dia, tepegöz ve slayt, örnek ve modelleri diğer yaş gruplarındaki öğretmenlerden daha sık kullanmaktadırlar. Bayan öğretmenler bitki ve hayvan gibi canlı materyalleri, dia, tepegöz ve slaytları, diagram ve grafikleri ve yazılı öğretim araç ve gereçlerini erkek öğretmenlere kıyasla derslerinde daha fazla kullanmaktadırlar. Yaş ve cinsiyetlerinin aksine öğretmenlerin öğretmenlik deneyimlerinin derslerinde kullandıkları öğretim araç ve gereçlerini etkilemediği görülmüstür. Öte yandan hizmetiçi eğitim programlarına iki seferden fazla katılan öğretmenlerin derslerinde diğer öğretmenlere kıyasla daha çok film, tepegöz, slayt, diagram ve grafikleri kullandıkları belirlenmiştir.

Öğretmenlerin ders sırasında kullandıkları öğretim araç ve gereçlerinin belirlenmesinde yeni programla ilgili görüş ve düşüncelerinin de etkili olduğu tespit edilmiştir. Programın yeterli biçimde tanıtıldığını, program dilinin açık ve anlaşılır olduğunu, program içeriğinin günlük hayatla bağlantılı olduğunu belirten ve programın amaçlarını biyoloji eğitimi için yeterli, önerilen ders araç gereçlerini de etkili bulan öğretmenlerin derslerinde önerilen öğretim araç ve gereçlerini diğer öğretmenlerden daha çok kullandıkları belirlenmistir. Öğretmenlerin öğrencileri hakkındaki görüş ve düşüncelerinin de ders sırasında kullandıkları öğretim araç ve gereçlerini belirleyen önemli bir faktör olduğu anlaşılmıştır. Öğrencilerinin biyolojiyle ilgilendiğini, biyoloji derslerinin öğrencilerin bilimsel düşünme ve araştırmaya ilgilerini arttırdığını, ve öğrencilerin ders içeriğini günlük yaşamla iliskilendirebildiğini belirten öğretmenler programda önerilen öğretim araç ve gereçlerini diğer öğretmenlere kıyasla derslerinde daha sık kullanmaktadırlar.

Bu çalışmada yeni lise biyoloji dersi öğretim programının uygulanışını tanımlamak amacıyla laboratuvar çalışmalarının sıklığı ve bu çalışmalar sırasında takip edilen yollar da incelenmistir. Öğretmenlerin yanıtları laboratuvar çalışmalarının biyoloji sınıflarında genellikle ayda bir yapıldığını göstermektedir. Bu çalışmalar sırasında izlenen yolların ise okul türlerine, bazı öğretmen özellikleri, görüş ve düşüncelerine bağlı olarak farklılıklar gösterdiği görülmüştür. Örneğin laboratuvar çalışmaları özel/vakıf okullarında haftada bir kez yapılırken, genel ve Anadolu liselerinde laboratuvar çalışmalarının yapılma sıklığı ayda bire düşmektedir. Yaşları, cinsiyetleri ve hizmetiçi eğitim programlarına katılımlarının laboratuvar çalışmalarını gerçekleştirme sıklıklarını etkilemediği görülen öğretmenlerin öğretmenlik deneyimlerinin bu çalışmalar sırasında önemli bir rol oynadığı görülmüştür. Örneğin 1-5 yıl öğretmenlik deneyimine sahip öğretmenler sınıflarında haftada bir kez laboratuvar çalışması yaparken diğer öğretmenler bu çalışmaları ayda bir kez yapmaktadırlar. Öğretmenlik deneyimleri gibi öğretmenlerin görüş ve düşüncelerinin laboratuvar çalışmaları sırasında belirleyici faktörlerden biri olduğu görülmüştür. Öğrencilerinin derslere aktif olarak katıldığını ve derslerin öğrencilerin bilimsel düşünme ve araştırmaya olan ilgisini arttırdığını belirten öğretmenler derslerinde laboratuvarı diğer öğretmenlere kıyasla daha çok kullanmaktadırlar.

Öğretmenlerin laboratuvar çalışmaları sırasında izledikleri yollar incelendiğinde gösteri deneylerinin en sık tercih edilen yol olduğu görülmektedir. Öğrencilerin laboratuvarda deneme - yanılma yoluyla deney yapmasını sağlayan yöntemlerin ise nadiren takip edildiği belirlenmiştir. Genel olarak laboratuvar çalışmaları sırasında izlenen yolların okul türleri, bazı öğretmen özellikleri, görüş ve düşüncelerine bağlı olarak farklılıklar gösterdiği görülmüştür. Örneğin genel liseler ve Anadolu liselerinde öğretmenler gösteri deneylerini tercih ederken, özel/vakıf okullarında öğretmenler öğrencilerinin deneyleri yazılı metinlerden takip etmelerini ve laboratuvarda verilen hipotezleri test etmelerini istemektedir. Öğretmenlerin yaşları, cinsiyetleri ve öğretmenlik deneyimlerinin laboratuvar çalışmaları sırasında tercih ettikleri yollar hakkında belirleyici olmadığı görülürken, hizmetiçi eğitim programlarına katılımın bu konuda etkili bir faktör olduğu belirlenmiştir. Bu tür programlara katılan öğretmenler öğrencilerinin deneyleri yazılı metinlerden takip etmelerini diğer öğretmenlere kıyasla daha çok teşvik etmektedirler.

Çalışmada öğretmenlerin program ve öğrencileri hakkındaki görüş ve düşüncelerinin de laboratuvar çalışmaları sırasında izledikleri yollar konusunda etkili bir faktör olduğu görülmüştür. Programın dersleri daha etkili ve verimli hale getirdiğini belirten öğretmenler, öğrencilerinin laboratuvardaki mevcut araç gereçlerle deney düzenekleri hazırlamalarını diğer öğretmenlere kıyasla daha çok teşvik etmektedir. Benzer şekilde öğrencilerinin derslere aktif olarak katıldıklarını ve derslerin öğrencilerin bilimsel düşünme ve araştırmaya olan ilgilerini arttırdığını belirten öğretmenler de öğrencilerinin laboratuvarda verilen hipotezleri test etmelerini ve mevcut araç gereçlerle deney düzenekleri hazırlamalarını diğer öğretmenlerden daha çok teşvik etmektedir.

Öğretim sırasında kullanılan öğretim yöntem ve teknikleri, öğretim araç gereçleri, laboratuvar çalışmaları ve bu çalışmalar sırasında izlenen yollar yeni lise biyoloji dersi öğretim programının biyoloji sınıflarında uygulanışını tanımlamak konusunda oldukça zengin bilgi sağlamıştır. Bu çalışmada öğretim yöntem ve teknikleri, araç gereçleri ve laboratuvar çalışmalarının yanısıra biyoloji öğretimi sırasında karşılaşılan sorunlarda araştırılmıştır. Öğretmenlerin programı hedeflendiği şekilde uygulayamamak konusunda en sık yakındıkları sorun yüklü program içeriği nedeniyle laboratuvar çalışmalarını sıklıkla yapamamalarıdır. Öğretmenler ayrıca kalabalık sınıflardan ve çok sayıda öğrenciyle deney yapmaktan da yakınmaktadırlar. Laboratuvar ve öğretmen kılavuz kitaplarının eksikliği ise öğretmenler tarafından belirtilen bir başka önemli sorundur. Bu sorunlar okul ve bölge düzeyinde incelendiğinde aralarında farklılıklar olduğu gözlemlenmiştir. Örneğin oranının %50-59 olduğu dördüncü tabakada bulunan okullarda çalışan biyoloji öğretmenleri ders sırasında laboratuvar çalısmaları yapamamaktan, sınıfların kalabalık oluşundan ve çok sayıda oğrenciyle deney yapmaktan, öğretmen ve laboratuvar kılavuz kitaplarının eksikliğinden okullaşma yüzdelerinin farklı olduğu diğer tabakalardaki öğretmenlerden daha çok yakınmışlardır. Benzer şekilde genel liselerde belirlenen bu sorunların özel/vakıf okullarına ve Anadolu liselerine kıyasla daha çok yaşandığı görülmüştür. Genel liselerde çalışan öğretmenlerin ayrıca farklı kaynaklara ulaşmak konusunda sınırlılıklar yaşadıkları da anlaşılmıştır. Öğrencilerle iletişim, laboratuvar çalışmaları sırasında bilgi eksikliği nedeniyle yaşanan aksaklıklar genel liselerde çalışan öğretmenler tarafından özel/vakıf okullarında ve Anadolu liselerinde çalışan öğretmenlere kıyasla daha sık yaşanan sorunlardandır.

Yeni bir öğretim programının hedeflendiği biçimde uygulanabilmesi için okullardaki koşul ve olanakların yeterli olması gerekmektedir. Öğretmenlerin derslerinde sorgu ve buluş yöntemlerini kullanabilmelerinin kolaylaştırılması için sınıf ve laboratuvar ortamlarının mümkün olduğunca zenginleştirilmesi gerekmektedir. Bununla birlikte bu çalışmanın sonuçları okulların mevcut durum ve koşullarının programın hedeflendiği biçimde uygulanabilmesi icin uygun olmadığını göstermiştir. Genellikle sınıflar kalabalık, laboratuvar ve öğretim araç gereçleri yetersiz eski ya da bakımsız durumdadır. Programda hedeflenen oluşturmacı yaklaşımların uygulanabilmesi icin okulların mevcut olanaklarının iyileştirilmesi, araç ve gereç konusunda desteklenmesi gerekmektedir. Bu nedenle farklı bölgelerdeki farklı özelliklere sahip okullar ziyaret edilerek sınıf gözlemleri yapılmalı ve okullardaki kaynaklar incelenmeli, gerektiğinde okullar programın hedeflendiği biçimde uygulanabilmesi icin desteklenmelidir.

Bu çalışmanın önemli bulgularından biri de öğretmenlerin biyoloji sınıflarında uygulanması konusundaki hayati rolüyle ilgilidir. Bunun yanısıra öğretmenlerin yaşları, cinsiyetleri, öğretmenlik deneyimleri, hizmetiçi eğitim programlarına katılımları gibi bazı özellikleri ve biyoloji eğitimi, yeni program ve öğrencileriyle ilgili görüş ve düşüncelerinin de programın uygulanışını etkileyen önemli faktörlerden olduğu görülmüştür. Çalışmaya katılan öğretmenlerin ortak özelliği olarak, gerek programda hedeflenenin gerekse kendi inançlarının aksine, öğretmenlerin sınıflarında halen öğretmen merkezli ders işledikleri ve öğrencilerin tanımları öğrenmeleri konusuna daha çok önem verdikleri görülmüştür. Her ne kadar öğretmenler programı belirlenen süreler içerisinde bitirmek zorunda olduklarından ve zamanın kısıtlı olmasının kendilerini öğretmen merkezli öğretim yöntem ve tekniklerini kullanmaya yönlendirmesinden bahsetseler de, biyoloji öğretiminin ana gereklerinden biri olarak derslerin öğrenciler merkez alınarak işlenmesi gerekmektedir. Bu nedenle öğretmenlerin genel öğretim davranışlarını değiştirmeleri ve bu konuda desteklenmeleri gerekmektedir. Öğretmenleri değişiklikler konusunda bilgilendirmek yerine sınıf içi öğretim davranışlarını incelemeleri ve eleştirebilmeleri icin fırsatlar yaratılmalı ve beklenen davranışları sınıflarında tecrübe etmeleri kolaylaştırılmalıdır. Öğretmenlerin diğer öğretmenlerle iletişim içinde olmaları ve fikir alışverişi yapmaları öğretimin etkililiğini de arttıracaktır. Beraber çalışan öğretmenlerin belirli zaman aralıklarında biyoloji öğretimi konusunda uzman kişilerin desteğini almaları da sağlanmalıdır. Ülke genelinde bütün öğretmenlerin hizmetiçi eğitim programlarına katılmaları mümkün olmadığından, bu tür programlara katılan öğretmenlerin deneyimlerini meslektaşlarıyla paylaşmalarını kolaylaştıracak ortamlar yaratılmalıdır. Öğretmenlerin etkili öğretim stratejileri geliştirmeleri, bilgi ve becerilerini arttırmaları için okumak konusunda motive edilmelidir. Aynı zamanda yapılan araştırmalarında uygulamaya yönelik bir takım çıkarımları olmalı, bu sonuçlar öğretmenlere ulaştırılarak öğretimin iyileştirilmesi sağlanmalıdır. Benzer şekilde öğretmen adaylarının da öğretim programlarının hedeflendiği biçimde uygulanması konusunda eğitilmeleri gerekmektedir. Hem öğretmenlerin hem de öğrencilerin biyoloji öğretimi konusunda yapılacak çalışmalara katılmaları uygulamaların etkililiğini arttıracaktır.

Çalışmanın bir başka önemli bulgusu öğretmenlerin programı hedeflendiği biçimde uygulama konusunda daha çok rehberliğe ihtiyaçları olduğunu göstermiştir. Bununla birlikte Milli Eğitim Bakanlığı Tebliğler Dergisinde (no. 2485) yayımlanan program kitapçığı öğretmenlerle program hakkında iletişim kurmak konusunda kullanılan tek araç olmaya devam etmektedir. Bu nedenle çalışmaya katılan öğretmenlerin de belirttiği gibi programın hedef ve ilkelerini daha anlaşılır biçimde sunan öğretmen ve laboratuvar kılavuz kitapları hazırlanmalıdır.

Öğretmenlerin program içeriğini belirlenen kısıtlı süreler içinde bitirme zorunluluğu çalışmanın program geliştirme uzmanlarının ilgilenmesini gerektiren önemli bir başka bulgusunu oluşturmaktadır. Öğretmenlerin pek çok konuyu 2 ders saatinde anlatmak zorunda oluşlarının onları derslerinde düz anlatım yöntemini kullamaya ve öğrencilerinin basit gerçek ve tanımları öğrenmeleri üzerine yoğunlaşmalarına neden olduğu belirlenmiştir. Programda hedeflenenin aksine öğretmenler sınıflarında öğrencilerinin problem çözme, bilimsel düşünme ve yaratıcılıklarını arttırıcı uygulamaları nadiren gerçekleştirebilmektedirler. Öğrenciler ezbere öğrenmeye eğilim göstermektedirler. Bu nedenle program geliştirme uzmanlarının programın hedeflendiği biçimde uygulanmasını sağlamak için program içeriğini ve konuların işlenmesi icin ayrılan süreleri tekrar gözden geçirmeleri gerekmektedir. Programın geliştirilmesi sırasında yapılan çok yönlü planın programın uygulanışı içinde yapılması gerekmektedir. Bu ve benzer çalışmaların sonucları ülkemizdeki program geliştirme, uygulama ve değerlendirme konusunda yapılan araştırmalara katkıda bulunabilir ve mevcut uygulamaların iyileştirilmesini sağlayabilir. Yapılacak daha kapsamlı çalışmalarla ülkemizdeki fen eğitimi iyileştirilebilir. Unutulmamalıdır ki yeni geliştirilen programların sınıflarda nasıl uygulandığını bilmeden bu programların başarıları konusunda değerlendirme yapmak mümkün değildir.

VITA

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