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**Integrated Science Approach in  
Secondary Education**

Integrated science refers to interdisciplinary study between at least two or more disciplines. There are some advantages and disadvantages of teaching integrated or separated natural science courses in secondary schools. In this article, It is investigated the problems of teaching integrated-science or separated-science course. The new approach of integrated chemistry-biology-physics disciplines in foreign countries is searched and some solutions of problems of integrated teaching are determined.

There are advantages of each integrated and separated course teaching. If it is implemented as integrated, students have opportunity like interdisciplinary study between each course. They learn courses interdisciplinary and teaching is qualified. When the teaching courses are implemented separately, each branch teacher can give lesson, so this is also advantage. The branch teacher give his or her lesson professionally and decrease the erroneous ideas and knowledge. In teaching process, if both integrated and separated approach are used together, the qualified teaching may be provided. Therefore, if there is opportunity to use together both approaches, while the integrated courses are taught, we should be aid from the advantage of the implementation of separated courses.

**Key words:** Interdisciplinary study, integrated science, natural science courses, secondary education

Йылмаз Сатилмис  
**Орта білім берудегі кешенді  
ғылыми тұғыр**

Интеграцияланған ғылым кем дегенде екі немесе одан да көп пәндер арасындағы қатынасты зерттейді. Орта мектептерде жаратылыстану пәндерін интеграциялап немесе бөлектеп оқытудың кейбір артықшылықтары мен кемшіліктері көзделеді. Бұл мақалада жаратылыстану пәндерін интеграцияланған немесе бөлінген түрде оқытудың мәселелері зерттеледі. Шет елдерде кешенді химия-биология-физика пәндерінің жаңа көзқарасы арқылы оқыту проблемаларының кейбір шешімдері анықталады.

**Түйін сөздер:** пәнаралық зерттеу, интеграцияланған ғылым, жаратылыстану пәндері, орта білім беру.

Йылмаз Сатилмис  
**Комплексный научный подход  
в среднем образовании**

Интегрированная наука относится к области междисциплинарного исследования по меньшей мере между двумя или более дисциплин. Рассмотрены некоторые преимущества и недостатки обучения предметов естествознания путем интеграции и дифференциации в средних школах. В этой статье автор исследовал вопросы преподавания дисциплин путем интеграции и дифференциации. Определяются новые подходы интегрированных химико-биолого-физических дисциплин в зарубежных странах и некоторые предложения по решению проблем комплексного обучения.

**Ключевые слова:** междисциплинарное исследование, интегрированная наука, естественнонаучные курсы, среднее образование.

**INTEGRATED  
SCIENCE APPROACH  
IN SECONDARY  
EDUCATION****Introduction**

Many educators know that traditional teaching process has low features: interdisciplinary study, technology interaction with education, technology competence, group work, laboratory study student-centered learning. They focus on dependence of textbook-emphasized and teacher-centered teaching. In traditional teaching, teachers have not enough interdisciplinary subject matter knowledge and technology-based competence. In this study, we aim to consider the teaching integrated science courses with interdisciplinary approach and determine actual solutions for the problems during the implementation of teaching of integrated science. This paper covers the implements about integrated course teaching in some countries; the short description of interdisciplinary study; the advantages of the teaching integrated and separated science courses; and some problems on the implementation of the integrated science courses.

Integrated science refers to interdisciplinary study between at least two or more disciplines. In science education, the more preferable study is interdisciplinary because it is an alternative indicator to qualify both teaching and learning activities. There are some advantages and disadvantages of teaching integrated or separated natural science courses in secondary schools.

Science is study of nature in an attempt to understand it and to form an organized body of knowledge that has predictive power and application in society [8, 90]. Curriculum programs emphasize environmentally and socially relevant content in addition to important science concepts, principles, and skills [191 p.]. The Integrated science courses provide to link other discipline's concepts and themes. Relevant concepts between disciplines are taught in exploration and benefiting from other science disciplines. When a teacher designs and implement learning activities across more than one concept, such curriculum integration should be coherent [4].

**The view of integrated approach**

Curricula that consisted of a large number of different subjects learnt in separate courses made it difficult for students to integrate their knowledge later on in other courses and in their

future work. Basic disciplines are important in our thinking: mathematics, physics, chemistry, biology, economics—these are the starting points of learning and instruction. But more and more, the borders between these disciplines have become a problem and important developments are interdisciplinary [1]. The boundaries between traditional scientific disciplines such as biology, chemistry, and physics are becoming increasingly blurred as the scientific problems we attack are becoming more complex. With this blurring of boundaries, modern science is evolving into a fundamentally interdisciplinary and collaborative endeavor [2]. *Interdisciplinary*: A knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience [13]. Integrated approach can be realized by the light of interdisciplinary curriculum by integrating disciplines and contents.

In the United States, integration is the approach used to improve understanding of academic content [3]. The approach supports such interactions between disciplines that concern their common problems and issues that relate to natural concepts and social phenomena [4]. The Integrated Science Curriculum expands the scope of traditional science courses by encouraging students to apply knowledge and skills to important societal problems (food, energy, health, environment, etc.) and by exploring new approaches to common questions about nature and life [2]. In addition to meeting disciplinary learning outcomes in biology, chemistry, mathematics, physics and statistics, ISC students develop skills in teamwork, real problem solving, and communication (2).

Biology-chemistry, mathematics-physics, mathematics-informatics integrations have implemented in teaching process at last decades. The integration of science disciplines is mostly integrated three science disciplines; biology, chemistry, and physics. The next type of integration is the processes of integration are visible in science, technologies and economy including Education (Lamanauskas, 2010). The next is about integrated mathematics and science. The popular and new trend is about technology integrated science courses. Many countries have been aware of benefits of technology in life. They have been supported that their students who have more technology literacy. These countries wish to be more qualified students who possess computer and software knowledge. The next step of integration is between technology and science disciplines. Therefore, many countries

implement the integrated science curriculum especially integration natural science and technology. For example, Indonesia and Turkey have integrated science and technology course and their objectives focused are followings.

In Indonesia, In general, the objectives of the science curriculum are as follows [5, 27]:

- To develop scientific knowledge, skills and attitudes;
- To develop process skills in acquiring and applying scientific and technological knowledge, concepts, and invention;
- To develop the ability to apply knowledge, understanding and skills in science and technology for improving the quality of life, and facilitate progress through advanced learning experiences for higher education; and
- To promote the learners' intellectual, physical, emotional and social well being.

In Turkey, since 2004-05 educational year, integrated natural science course is got new and technology perspectives are focused on natural science disciplines. The name of this course is science&technology course. Science is integrated in a course called «Life Knowledge» in the first three years which means that the curriculum involves only the Science and Technology courses from the fourth grade to the eighth [7]. Science subjects are integrated for 4-8 grades in both primary and lower secondary curriculum in Turkey. Science subjects starts as integrated natural science at 5<sup>th</sup> grade in Kazakhstan but natural science disciplines are taught from grade 6. Integrated science course starts 4<sup>th</sup> grade as 'Science and Technology' subject in Turkey. The perspectives that meaningfully supported the objectives are followings;

- Active learning;
- Learning by doing
- The integration science-technology-and society
- Linking with nature, daily life and solving common problems
- Self-assessment
- Introduction to industrial places and materials

Integrated science teaching is mostly popular in many countries because technology integrated science helps to prepare students for life, industry, economy and other technologies. It improves their attitudes and behaviors to natural science and develops skills of communication, thinking, decision-making, and group work.

The following main objectives make the dignity of integrated teaching evident (Lamanauskas, 2010):

- To conclude and classify knowledge imparted by sciences;

- To reveal the affinity of the key (general science) concepts;
- To reduce the flow of secondary information, to concentrate on teaching how to use the sources of information (for example, encyclopedia, reference books, dictionaries, audio-video material, etc.);
- To make teaching/learning interesting, attractive, true to life, etc.
- To train pupils to adopt various classified courses in higher forms, etc.

### **The problems of the implementation of teaching integrated and separated science courses**

First difficulty is to integrate classroom activities and out-of-school activities in to the learning process. Students must learn fundamental scientific facts, concepts, principles, laws, theories, and models. These ideas must be integrated into students' cognitive structures so that they can be recalled and applied in their decision-making activities [8]. Classroom activities and outside activities could not be integrated into science disciplines. Outside classroom activities such as field trips, visiting technological and industrial places could not organized less by school administrators or teachers. The most important activity is project work that is very useful for interdisciplinary activity and integrated science subjects. Learning activities where two or more disciplines have to be combined by students in project work is one way that seems to be fruitful; another is basing learning activities on problems that originate in the context of students' daily lives, future roles in society or further learning. Solutions for some actual problems are investigated with project work or other out of classroom activities in which are linked to other science disciplines. Learners studies with each other. An interesting programme design is a series of learning units where a combination is made of project work that requires integration of different subjects and disciplines, and traditional instruction on basic science subjects that are needed for this particular project work [1]. But, some of lacks of implementing project works can be seen by the different reasons. These are; teachers can have low other content knowledge and interests to study together in group. The next is as mentioned by Lamanauskas (2010) that is `the integrated courses of natural sciences should be coordinated with the systemic ones. The integrated course of teaching has to be undertaken by the complex of training aids/resources for learning such as textbooks, workbooks, didactic material, teacher's book (teaching methodology), visuals, etc.

They guarantee increased activities that are directly proportional to the efficiency of teaching/learning`.

Second is insufficient curriculum study and lack of approach for organization of integrated curriculum. Integration science course can include three types: indented themes of one type of discipline, integrated but focused one discipline themes, balanced-integrated disciplines' themes. Indented themes are relevant to only each of **biology, chemistry, physics and other natural science**. In the only one discipline focus, one discipline is focused, while other discipline is supporter. In the balanced integrated disciplines, themes are equally distributed. In Germany [9], the secondary curriculum clearly distinguishes the separate sciences and, even if science is taught in an integrated manner, it is usually as a succession of the separate subjects. Current movements for science curricula aim to have a more integrated focus. Therefore, if there is a trend, it is that school science is becoming more integrated across Europe, **although the pace of change is relatively slow**. Lamanauskas (2010) pointed next problem that the educational curricula have to reflect the integration of the content of the teaching/learning process. **The integrated and systemic courses of natural sciences should be combined**. The integration of the educational process has to be coordinated with didactic differentiation that is determined by unequal pupils' knowledge, different interests and teaching motivation, unlike intellectual motivation, self-control skills, etc.

The third is about the training of teachers. The quality of teacher training programs is one of the tasks of educational sphere. When the issues of education are discussed around the world, the improving teaching quality is primarily promoted. Raising the level of education of students and individuals, is depending on the school and the teacher. This starts from the preparation of teachers in higher education institutions. There should be integrated courses during the preparation of teachers in higher education, and should be supported the teaching materials. Lamanauskas (2010) wrote that the integrated teaching course has to be guaranteed by the means of teaching/learning such as textbooks, workbooks, didactic material, visual aids, etc. as well as by the teacher's proficiency to work at qualitatively new level in a new century. Besides, the advantages of integrated science course, there is the problem is to be adequate teacher of integrated science course. Sometimes, biology teacher has been taught other disciplines or opposite. The view of the group, though, was that the trend was

towards teachers being required to teach more than one science – partly because of the increasing interdisciplinary nature of science-as-it-is-practiced and partly because the old division of biology, chemistry and physics is difficult to defend when the astronomical, environmental and earth sciences can make legitimate claims for their importance. Nevertheless, because teachers' own education tends to be in one specific discipline, there is some resistance to this trend, as in France, where teachers generally do not wish to teach integrated science [9]. The professional integrated science teacher is educated with covering other disciplines. In universities, the special teacher of integrated science program should be entered.

The last is about the difficulty of teaching natural science courses separately. The early separation of biology, chemistry and physics results in the cultivation of specific 'languages' for each of these subjects [10, 87]. Some relevant concepts and themes are taught independently and learners can gain some misconceptions. Harrell (2010) supported this idea he said that the use of an integrated curriculum is a powerful way to communicate scientific knowledge. Unfortunately, the failure to assure that teachers have acquired broad scientific knowledge in biology, chemistry, physics, and Earth science prior to an attempt to implement an integrated curriculum will perpetuate science misconceptions and result in the creation of gaps in that scientific knowledge that is needed to achieve scientific literacy and to function in a global society. However, separated science teaching has an advantage that is teaching by professional content teachers like chemistry teacher or biology teacher.

### Conclusion

Integrated natural science is not only the combined subjects of each discipline. Teaching activities and other curriculum components must be integrated and the special integrated science teachers are trained.

There are advantages of each integrated and separated course teaching. If it is implemented

as integrated, students have opportunity like interdisciplinary study between each course. They learn courses interdisciplinary and teaching is qualified. When the teaching courses are implemented separately, each branch teacher can give lesson, so this is also advantage. The branch teacher give his or her lesson professionally and decrease the erroneous ideas and knowledge. In teaching process, if both integrated and separated approach are used together, the qualified teaching may be provided. Therefore, if there is opportunity to use together both approaches, while the integrated courses are taught, we should be aid from the advantage of the implementation of separated courses.

We have some recommendations about the studies of integrated science and integrated science and technology courses. These are:

- actively contribute to the training integrated topics and enhance method materials during the implementation of special training courses and seminars;
- prepare the teaching guidelines for integrated courses and additional materials for training;
- support lifelong learning for teachers on the basis of extra-curricular education;
- contribute to increase the interest of students' attendance with active methods;
- consider effective ways to use the new technology in the field of teaching integrated courses;
- Contents and activities should be qualified on integrated course curriculum
- The special teaching training program must be and is highly innovative in its use of technology and be as a good example of a learning technological tools and apparatus. The 'program' is a teaching methodology that enriches technology integrated natural science instruction by technological tools and apparatus designed well for teachers to use their skills and knowledge.
- Teaching separated-science course can decrease the misconceptions because of the professionally teaching by own branch. Sometimes, during teaching integrated science course, should be taken help to branch teachers.

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