Cypriot Journal of Educational Sciences

Volume 13, Issue 3, (2018) 388-399

www.cjes.eu

To STEM or not to STEM? That is not the question

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Suggested Citation:

Kubat, U. & Guray, E. (2018). To STEM or not to STEM? That is not the question. *Cypriot Journal of Educational Science*. *13*(3), 388-399.

Received from January 10, 2018; revised from June 26, 2018; accepted from September 17, 2018.
Selection and peer review under responsibility of Prof Dr. Huseyin Uzunboylu, Near East University.

Abstract

The aim of this study is to identify the faults in Science, Technology, Engineering and Mathematics (STEM) education and to provide an approach to how these deficiencies can be eliminated. The STEM approach can provide students with an interdisciplinary point of view to gain creativity, critical thinking, high-level skills of thinking and problem-solving. STEM abbreviation consists of the initials of the words 'Science', 'Technology', 'Engineering' and 'Mathematics'. Conventional educational systems dictate student to learn specific topics separately and expect from them to make these knowledge and experience useful, functional in their life. In this research, a qualitative research method was used. This study was performed by using document analysis method. A novel, integrated education system called as the STEM is investigated with its methodology and problems in application outcoming so far. The importance of such an integrated programme is highlighted and some remedies to create an effective integrated education programme are emphasised.

Keywords: STEM education, integrated programmes, interdisciplinary education.

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1. Introduction

The most important features that should be gained by students today are production, creative thinking, problem-solving, easy access to information, collaboration and critical thinking. The Science, Technology, Engineering and Mathematics (STEM) approach can provide students with an interdisciplinary point of view to gain creativity, critical thinking, high-level skills of thinking and problem-solving. STEM abbreviation consists of the initials of the words 'Science', 'Technology', 'Engineering' and 'Mathematics'. The demand for individuals approaching problems in a scientific and interdisciplinary way, planning with details and taking critical decisions in the case of an emergency has been increased in the 21st century (Akaygun & Aslan-Tutak, 2016).

Interdisciplinary approaches related to scientific knowledge and skills are very important in everyday practice (Beane, 1996). This leads to specific innovations in education and revealed STEM education. In traditional science teaching, scientific concepts are taught abstractly from their contextual origins (Sadler, 2009). Science teaching in this way is not adequately effective for students to acquire scientific knowledge and skills. Being able to use interdisciplinary knowledge and skills instead of a single disciplined knowledge has become one of the main aims of the science education. Because the integration of different disciplines in the solution of the problems encountered today is a necessity. The STEM is one of the most up-to-date approaches to integrate subjects in various disciplines.

STEM education which treats these four disciplines to be taught as a holistic and an undistinguished collective, rather than teaching these four disciplines independently, is based on an interdisciplinary approach. As an integrated education system, STEM education is an approach that is built upon natural connections between STEM subjects for the purpose of (1) furthering student understanding of each discipline by building on students' prior knowledge; (2) broadening student understanding of STEM disciplines through exposure to socially relevant STEM contexts and (3) making STEM disciplines and careers more accessible and intriguing for students (Wang, Moore, Roehrig & Park, 2011). The fact that individuals have knowledge of science, technology, mathematics and engineering and that they produce new knowledge by solving problems with this information should be one of the main objectives of STEM training (Bybee, 2010). STEM education aims to educate qualified individuals in science, mathematics and engineering fields. STEM education in this context (Barnett, 2005; Fllis & Fouts, 2001; Thomas, 2014);

- Allows interdisciplinary work
- Provides information to connect with everyday life
- Teaches science and mathematics which help to educate literate individuals
- Enables children developing critical thinking and upper thinking skills
- Empowers to motivate students to learn mathematics and science by introducing them current and innovative approaches
- Provides the training of well-equipped individuals needed for the business world
- Provides industry-school cooperation
- Makes contributions to the economic and technological development of the people.

The STEM curriculum consists of four areas: science, technology, engineering and mathematics. It is of utmost importance for children to teach the technology in a planned and controlled way. Children are now acquainted with technology very early today. Nowadays, it is very difficult to keep children away from technology so at least it is very important to use the technology properly. Especially early on, children are starting to use mobile phones, tablets and laptops. Therefore, engineering education is essential for students to learn in depth and develop scientific process skills. Opportunities can be created to develop knowledge and skills for children in STEM fields (science, technology, engineering and mathematics). Thus, creativity, problem-solving, high-level thinking and critical thinking skills these children need for the 21st century can be improved. As an integrated education system, STEM education can make learning more relevant and meaningful for students. It can improve students'

attitudes toward STEM subjects, support higher level thinking skills and increase mathematics and science achievements.

STEM is important for the nations to compete in the global world, especially for developing country such as Turkey. In addition to that, the STEM is important for the individuals to take a meaningful place in the 21st century. Encouraging STEM growth in developing countries is important because many new jobs are being created in the booming medicine, computer and IT industries worldwide. Developing countries working to educate the next generation in STEM receive many benefits from these classes as students receive valuable experience and skills that translate to the workforce. STEM education in developing countries can play a big role in creating job opportunities and reducing poverty as well as in developing countries. The STEM is an important academic area for the United States in order to effectively compete in the global markets, economy and innovation (Chen & Soldner, 2013).

There are many teaching methods and techniques in improving the knowledge and skills of children on STEM methodology. The project-based learning method and the play method, which allow children to learn by doing or living, are among the top of them (Snow, 2011). Giving engineering education to children at an early age makes a great contribution to the lives of children (Cunningham & Hester, 2007). Children are born as engineers, designing materials by splitting and combining the materials which are performed by their hands. In this process, problem-solving skills and creativity skills develop (Cunningham, 2009). In this context, the STEM approach integrates these four disciplines—science, technology, engineering and mathematics—to provide realistic, collaborative, thought-provoking and problem-solving learning experiences. In short, STEM creates a consistent learning model based on real-world applications rather than teaching four disciplines as separate topics. STEM is regarded as the greatest educational movement of the last decade and support many ongoing educational movements (Daugherty, 2013).

STEM is all well-spread in the daily life of the modern world. There is much more that can and should be learned about the outcomes, nature and design and implementation of STEM education. The nation's changing demographics and continuous need to remain globally competitive make it clear that colleges and universities must increase the number of teachers trained in the STEM education (Katehi, Pearson & Feder, 2009).

Education for students in STEM has received increasing attention over the past decade with calls both for greater emphasis on these fields and for improvements in the quality of curricula and instruction. In response, numerous new instructional materials, programmes and specialised schools are emerging. While most of these initiatives address one or more of the STEM subjects separately, there are increasing calls for emphasising connections between and among the subjects (Honey, Pearson & Schweingruber, 2014).

For STEM integration to be successful in K-12 schools, teachers will need a new and interdisciplinary content knowledge base (Stohlmann, Moore & Roehrig, 2012). When teachers are not comfortable with teaching a topic, they tend to avoid teaching the topic or teach the subject superficially (Bursal & Paznokas, 2006). In order to ensure that teachers are successful, it is important that they receive support for developing their content knowledge to be able to effectively teach STEM integration. We need more STEM teachers who are well prepared to teach more challenging standards and who can help all the students to learn.

1.1. Aim of the research

The aim of this study was to identify the faults in STEM education and to provide an approach to how these deficiencies can be eliminated. In the first section, the importance of an integrated education was pointed out and the problems and disruptions were underlined. In the second section, the importance of technology and engineering in an integrated programme was discussed. In the third

section, some remedies were suggested for a well-organised integrated programme and finally, a list of remarkable results was summarised in the conclusion.

2. Method

In this research, a qualitative research method was used. This study was performed by using document analysis method. Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Bowen, 2009). Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted in order to elicit meaning, gain understanding and develop empirical knowledge (Corbin & Strauss, 2008).

3. Findings

3.1. What is not well-existed in the application of stem?

Teaching is the one of the oldest activity which is very necessary from the ancient pre-historic ages to modern times. During the complete human civilisation period, even from the beginning of the industrial age to now, the methodologies, sources and the necessities are all changing time by time. As described in the initial part of this study, a reform is required in teaching-education applications to make students more prepared to understand better the behind-scene of technology and to be productive to create innovative ideas in the area of technology and engineering. In addition to this, the students of our country do not fare well in international tests like as US students. An innovative approach may be required for both countries educational systems. STEM is stated as one of the greatest approaches for the students from primary to high school classes such that, USA's old President Barrack Obama stated that it is a national duty to grow 100,000 students educated in a STEM curriculum, at a facility organised by American Chemical Society. Any effort for STEM will play an important role in the teaching profession of the 21st century, not only in the USA but also in Turkey. Here, in this specific part of the article, two specific components of the STEM, these are technology and engineering, are to be investigated in details beside some points cleared about science and math components.

It is stated in the USA, in the National Academy of Engineering and the National Research Council's report (2009), the math and science are two separate branches that are still taught to students as two individual topics. Teachers cannot construct a good relationship between natural sciences, as like physics, chemistry, etc., with mathematics. A good teacher must have in-depth knowledge of both scientific and mathematical fields in order to approach scientific topics with mathematical methods. In addition to the inadequacies of science and mathematics that are required for a good STEM programme, technology and engineering issues are almost entirely excluded. In this respect, it is stated that technology cannot be included into the educational programme and engineering is either ignored or causes some confusion while relating them with the science or math curricula (Vest, 2009). Unfortunately, it is observed that the teachers are not well qualified to integrate with the STEM curriculum.

To achieve a well-developed standardised educational system containing STEM methodology, the teachers must have enough qualifications to apply such different training programmes. Because of this reason, the teachers or lecturers in all periods from primary classes to high school years should have a good knowledge about the STEM contents and a good understanding of applications to construct STEM curricula for these students. They should gain expert knowledge on pedagogical approaches as project-based learning. They should use strategies and sources to integrate technology into the STEM teaching and learning programme for all students. These teachers must develop their expertise and knowledge on differentiating the STEM education from the conventional educational programmes for students from different linguistic and cultural bases. The duties and the responsibilities of school

advisors must be well highlighted and it should be well understood that a well-organised coordination of teachers is very essential in a STEM programme.

When the issue is approached more in depth, not just only of science and math but also of technology and engineering topics are not introduced well-adequately in the education system of primary and secondary school in USA (Green, 2014). This fact is absolutely valid for our country too. The educational programmes can be dealt with three headings in Turkey, generally (Duman, 2008). These approaches can be classified as a subject-based, student-centred and problem-solving dependent (Demirel, 1997; Varis, 1997). In subject-based education systems, it is enough that the student has gained knowledge or superficial knowledge. This information is not intended to be grasped in any application area. Students are assessed by examinations. This type of educational approach is teacher-centred not student. Since the teacher take place as a leader, the student is being tempered with hard work and discipline. In such a method, students are not asked for answers, no discussion techniques are used and no time is lost with these activities. In this type of training programme, the teacher is the main factor and the student is the passive member (Sonmez, 1991). Student-centred education programmes are designed entirely according to the needs of the student. Such an educational programme is progressive that the school is treated like the life itself, everything about life can be carried to the school from nature. In the education phase, applications take place more than the theoretical instructions. In this kind of educational programme, the teacher is not only a teaching leader but a guiding person. In the case of the problem-solving dependent educational systems, the main philosophy can be defined as the reconstructive studying. Such a type of education is being developed against the inadequacies of subject-centred and student-centred approaches. This kind of approach is exactly the same as the STEM type education mentioned above. For this reason, this approach aims to teach subjects by establishing-experiencing to construct an interrelationship between various subjects.

3.2. Significance of integrating technology and engineering to the stem

Since the issues in various disciplines are important separately, one should not be described separately from the other (Gatewood, 1998). Integrated teaching programmes are of great importance for both teachers and students in realising problem-solving skills. The integrated curriculum has a great prospect for students to understand the relationships between concepts and to teach them high-level thinking methods (analysis, synthesis and generalisation) and to give information about them (Erickson, 1995). Moreover, these curricula are of great value in terms of enabling students to look at complex problems from multiple perspectives and to develop problem-solving skills that are important for being an effective individual.

In recent years, the need to integrate curricula has gained a great deal of intensity due to many reasons (Duman, 2008). These reasons are described in several chapters: information development, fragmented schedules and the relevance of curriculum schedules. In all areas, branches of today's world, information is increasing at a certain rate. Therefore, one who is making an education programme should have a view not only of what should be taught but also of what is in the programme. However, there are also some problems those arise, for example, in the social sciences, the challenges of choosing cultures will arise, as the cultures of all the countries, human communities, tribes and various other groups in the world are not individually known or studied. Current issues, for instance, some epidemic diseases, need to be included in courses' subjects, for example, some common diseases require the renewal of existing curricula to prevent students, who are the future's adolescents, from being infected. An accumulation of information about technological developments, especially on informatics and computation forces a new education system.

The fragmented education system has many problems. The English philosopher Lionel Elvin has an expression to describe this problem; when a person is on a nature walk, e.g., trekking, he or she does not only encounter with animals in a certain time interval but only with flowers and another time interval. It is highly instructive that these beings in nature be treated as a whole during the trip.

However, in schools, topics are mostly handled in different lecture hours and are actually handled by a method, not modelling a similarity like in the case of the real life. A student continues his education life, especially when he or she does not have enough capability of understanding or defining the world faced with, without knowing where to use the mathematics subject but he or she know only that mathematics is a lesson held in morning time in some limited duration. In this way, like in the case of the mathematics, fragmented educational programmes cause the students to be unable to relate other subjects like social studies, science, art, music and physical education to each other, and to treat each of these issues as if they were separately settled. It is seen that lessons these compressed into a certain period of time, cannot be beneficial in the high school period as the subjects are getting more roots and deeper narrated in upper classes. It is not surprising that high school students, especially in adolescence, who are in explorations of their own character and cognitive level, seeking personality and experiencing periodic difficulties, find these issues out of real life. The fragmented education system does not reflect the content of real life.

One last reason, the relevance of curriculum is another issue for the reason for the development of an integrated curriculum. The students generally think that the contents of a course is in the opposite direction of the real life or do not reflect the events, facts or subjects in the daily life. In addition to the fragmented curriculum, the fact that the course content does not reach the realities of life is also a problem. There is no problem with teaching the specific subjects in any manner, but presenting the contents of these subjects in a periodic way to show the relationships with the life is a necessity. To make some interpretations and coming to a conclusion at the end of each chapter is very essential to make the changes in student lives. On this view, students will able to observe the importance of each discipline.

In the conventional educational systems, instruction of a subject is conceived mainly as a procedure of knowledge and experience transmission. This kind of an education system makes students well-educated, wise and intelligent and makes them get useful knowledge to use in the real life and make get them an upper level in their profession, however they cannot understand even the most simple problems and cannot find a practical solution to the problems which they can easily face within their everyday life. These problems may require an engineering solution. To solve engineering problems requires a coordinated, sophisticated knowledge and experiences of the interdisciplinary subjects. Mathematics and science, as well as a strong problem-solving process and the use of mental skills in this process are very necessary, particularly. In the process of problem-solving, mathematical and scientific models should be constructed, applied and adapted to predict, explain and interpret the behaviour of the complex systems (Zawojewski, Hjalmarson, Bowman & Lesh, 2008). In general, while a person is sleeping 6–8 hours in a day, he/she spends his remaining long time in a day interacting with the world and objects created by people. In spite of the fact that, most people have no idea about how this world is equipped with such well-organised systems and sophisticated machines and find difficult to explain how they work. One of the reasons for that can be stated as; engineering and the technology are not toughed in the schools competently. Being able to read and understand the technology can be achieved by engaging in these issues. Students should meet with these disciplines when they start primary school (Cunningham, Lachapelle & Lindgren-Streicher, 2005).

But there are still problems in teaching even science and math subjects. It is still very weak that the science and the math education are not adequately taught in a coordinated curriculum. Even in the universities, in the engineering curriculums, as an example, the numerical methods are given as a separate subject as a mathematics course. The instructor is mostly from math departments and is not able to give some benchmarking applied mechanics problem in the class. Most of the time, the student should discover a relationship between the topics taught in the numerical methods course and their applications in the real-life problems, modelled in mechanics courses. For example, a falling mass with subjected to air-resistance and gravity can be modelled with a non-linear differential equation and can only be solved by imposing an approximation to the displacement derivative. Another example can be given for kinematics relations in classical mechanics or in a physics course. Integral of a function can be presented to the students simultaneously or before teaching the graphical approaches for the kinematics relations. Solving an engineering problem will require many

subjects taken previously, as given in the examples. A good knowledge of physics and math is well compatible to model a real-life problem, such that an organised, innovative education curriculum like STEM is very necessary for the future's students.

3.3. How to make it possible?

The interdisciplinary approach considers a large contribution to the success of teaching when participating in the curriculum development process. The studies on interdisciplinary programmes point out that, this approach has motivated students to develop their communication, problem-solving skills and creativity and provide them with a more permanent learning (Jacobs, 1989). Conventionally, to separate subjects is the most common curriculum pattern (Mc Neil, 1990). The subjects are given to students separately, without constructing a relationship between them. In the schools, in the case of the old teaching models, teachers are related to his/her topic. An organisation in teaching all these subjects could be achieved by means of some curriculum techniques as correlated and the broad fields curriculums (Herschbach, 2014). In the first, each teacher teaches physics, math, etc., individually and a well programmed coordination is required to form a combined education programme. A high level on-going coordination should be formed that is one of the challenges seems to be in this type of curriculum. Instead of leaving the student to construct an interrelation through subjects, a coordinated work of the involved instructors and an updated planning is required to overcome the difficulties. In addition to a high-level coordination and a detailed planning for integrating the subjects in a correlated manner, the teachers should learn to instruct topics and evaluate the students in different ways. In the method of the broad fields curriculum, a number of different subjects are organised as a single course. A general course can be held containing topics from physics, chemistry, biology and math in a convenient sequence. On the other hand, science and math topics are not easy to be organised effectively in the broad fields curriculum since the original concepts in these subjects can be lost necessarily. In contrast to this fact, the engineering and technology subjects can be held in an efficient way in the broad fields curriculum.

The interdisciplinary curriculum approach is defined as the use of more than one discipline's method and knowledge to examine a theme, concept, problem when it is theoretically addressed (Jacobs, 1989). According to another definition, an interdisciplinary approach is the conceptual integration of concepts in different disciplines (Erickson, 1995). These definitions show that interdisciplinary studies are based on a great deal of understanding concepts and such educational programmes are also called 'cognitive teaching'. A concept is the image of an object or fact in the mind (Merill, 1983). The image itself belongs to one single kind of something but the concept determines every general occurrence, shape, size of the object or the fact. Interdisciplinary programmes should combine with not the specific images but concepts. The complexity of the outer world and a simple interpretation will easily been realised when the objects and the facts are observed, analysed with a looking behind concepts. This kind of understanding will provide making generalisations and abstractions from the environment. By this way, the power in thoughts is increased. It will be helpful to construct or determine relationships between them and idea can be manipulated effectively. At that point, it can be stated that courses including design assignments are to be helpful for the development of an interdisciplinary programme. They can be well-established to give students a chance for making analysis, to learn specific properties of the materials used and to integrate to construct a product. It is possible to hold a design study in a curriculum by combining project studies, these requiring the abilities of problem-solving and creativity skills, and facility and laboratory works with the education programme (Ringwood, Monaghan & Maloco, 2005).

New trends in the educational system are researched so far. A course in an interdisciplinary manner is programmed with some applied studies. There is a magic word, defined so far, 'Learning by doing' is well emphasised as a group work subjects are well integrated to form a final design. Students have difficulties in some pre-requisite courses and may need to live some back-and-forths while designing an object (Yazici & Yazici, 2013). In the civil engineering schools, a concrete beam which is one of the

fundamental structural element, carrying dead and live loads at a concrete made building, is first analysed that requires the knowledge and the capability of structural analysis. To do this, the student should know math to solve a system of equations, to derive them. He or she can decide the type of the materials by knowing the material behaviour of the cementitious material and aggregate; finalise the design of the beam by determining the cross-section size and the diameter of the reinforcement bars. In Turkey, most procedures explained above, are very well applied, but as differently from European schools, the manufacturing stage that can be called as a final stage is one of the missing points. The beam can be produced in the laboratory conditions, which will give the capability of experiences about form construction, locating the reinforcement and preparation of concrete mix design. Not only teaching in the class, or giving examples and or homework assignments but also organising students to apply their knowledge to experience in the field or in the laboratory is one of the requirements for the future of the education systems. The governments and the school directors must take notice of that issue relevantly and use the sources for the establishment of such application studies.

Heidi (1989) reviewed and reached various models and approaches in 15-year (1980s) interdisciplinary training programme work. Even though the teachers approach the task in an efficient way in this regard, the courses given in an integrated manner in the education system do not have a lasting power. Especially, there are very big problems in content selection. These problems are called the problem of Potbourri and the problem of polarity. The first problem is defined as follows; many chapters in a course become examples of information from every discipline. As stated in the book (Heidi, 1989), if the subject is antic Egypt, ancient Egypt, it consists of literature, art, as well as some history. However, such an approach lacks focus (Bloom, 1987; Hirsch, 1987). Curriculum designers have not succeeded in transferring their specific topics to another topic or index in order to address them. The scope and order must be sorted appropriately. Another problem is the polarity problem. Teachers of individual subjects are in a disagreement in developing their concepts to convert the classical approach to an integrated methodology. The polarisation occurs through instructors and their subjects. In order to able to create an interdisciplinary training programme, teachers need to be open-minded, be encouraged to learn more, be open to new topics and struggle to develop an interdisciplinary programme. Design-based work should be emphasised in order to overcome these problems and to create a good interdisciplinary programme. Scope and sequence should be considered as priority, thinking skills should be encouraged and a well-qualified evaluation programme should be followed. Just like teachers, students should be aware of this issue as they are in line with the curriculum of a subject, as well as being compatible with the interdisciplinary curriculum.

While interdisciplinary programmes are being prepared, it should be possible to contribute to the preparation of the programme by people from various subject areas as much as possible. For example, for the beam design lesson mentioned earlier, various specialists such as mathematics, structural statics, material sciences and construction management need to come together to prepare this course. It should be considered that a course programme for insects and crustaceans is prepared by not only with the contributions of biology experts but the physics and technology studies as well. Otherwise, the programme may be under the dominant influence of a particular discipline.

Interdisciplinary programmes can be very much out of the ongoing education programmes. Instead of giving students directly discrete disciplines, new courses can be introduced. In addition to these discrete courses, the subjects in which the topics are integrated can be applied not only in advanced education institutions like universities but also in primary schools. As an example, a design course, which may be a university course, can be turned into a course with many topics in itself.

In doing so, first of all, the subject must be clearly defined. The subject can be a theme, a concept, an area, an event or a problem. However, some criteria must be considered when choosing the subject to be centralised. The central issue should be neither too general nor too narrow enough to limit the elements of work. Teachers can draw attention to some global issues at the same time as they prepare a programme based on the interdisciplinary approach. In this way, the life itself can be content in lessons. A student who is undergoing even a technical education may produce a playable

game, his or her CV or a literary article in the future, effectively. They can contribute to this process by helping to select the topic (Jacobs, 1989). Students can be included into the studies with their ideas when choosing the appropriate subject for the students and can be well-motivated when cooperated with them (Mason, 1996). After the topic selection is completed, sub-topics related to the topic and the disciplines that these topics may be related to are determined. At this stage, brainstorming is done to investigate the subjects in terms of all disciplines. The topic is focused and interrelated topics are defined around it. The topics and disciplines are to be associated with the participation of both experts and students with their brainstorming. In this way, the central subject and auxiliary areas are identified. At this point, the centering of the student is very valuable (Gatewood, 1998). If the student is located in the centre, students can sense interdisciplinary connections more effectively if concepts are related to disciplines are discovered by asking them. They can determine the content for themselves better than the educators can. At this point, the brainstorm must be the keyword. By brainstorming, free thought is encouraged and ideas are handled in detail in quantitative contexts. Centre topic and all subtopics are interrelated systematically. The common points between the topics are discovered and some problems can be gathered out from these intersections. The problems produced by this way may refer to many various subjects, disciplines.

In the preparation stage of an interdisciplinary education programme, the main issue is not giving many subjects completely, without remaining any missing topic in them. Since all integrated disciplines are presented in an interdisciplinary approach, any subject should be neither overestimated nor underestimated. The central topic is the main point in a class, and all interrelated disciplines, sub-topics just helps to have a rich content.

In a successful integrated education system, teaching techniques that are different from classical approaches are held. In addition to giving the opportunity to work individually with the students, it is also essential to force them to work as a number of groups. Students will have the chance of brainstorming, idea sharing and discussions by this way. Experiences can be shared through the group and lead to a self-organising, teaching organisation. Workshops can ben be held in which students from various disciplines are conducted. The primary objective of the workshops is to be informing the students of some individual disciplines on the collaborative efforts required when working on a common design project. A check and approval mechanism can be driven between these students. The design work can be completed in a coordinated manner (Turkyilmaz & Yazici, 2012).

4. Summary and suggestions

Many benefits are provided to the students with the interdisciplinary approach. It enables students to focus on learning and teaching, allowing them to think in detail and make high-level generalisations. This programme enables students to participate in activities (student-centred activities, brainstorming and design studies, etc.). In this way, the student acquires characteristics for conducting research and for using various disciplines in different fields of information. The use of ‘concepts’ improves the ability to think about analysing and achieving a synthesis. Integrated information is provided in different areas. It gives rise to an awareness of things about the environment and the real world’s issues. In order for a multidisciplinary teaching programme to achieve and to make successful:

- It is first of all necessary for teachers to undergo an interdisciplinary training-oriented programme. Such pre-programme will have the chance to observe interdisciplinary programme development. In addition, teachers need to be trained not only before servicing but also in service (Mason, 1996).
- Teachers always organise meetings regularly and opinions should be expressed to ensure that, in the context of an integrated education programme, to increase wealth in terms of 'concepts' and keep productivity high. Teachers should get together; hold meetings in educational institutions, to be in constant harmony, for exchanging ideas, making brainstorms. Efforts should be taken into account in order to incorporate technological developments into lessons, especially in the effort to increase practical courses.
- It is necessary to remove obstacles between different disciplines. Universities have been more positive in this regard in recent years. From various fields, projects are being prepared with the contributions of disciplines from scientists and students, and artifacts are emerging which are worthy of literature.
- To achieve a high level of interdisciplinary programme, a great coordination should be satisfied, the important task falls into school administrators. The school administration must fulfil its responsibilities.
- Design works, studies with applications, 'do and learn' activities must be held. Workshops with a number of different disciplines' contributions are to be organised to provide a self check and approve education systems.

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