CURRICULUM MODELS, STEM EDUCATION AND BLOOM'S TAXONOMY

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Abstract

This article stated that the curricular models, STEM education and also Bloom's taxonomy with objectives and goals of a mathematical topic. In this article, I mentioned about the three different curricular models which were crossover, enrichment and differentiated by discussing the common and distinct points of them. Next, I expressed what the STEM education mean. Besides, I discussed whether the mathematics could be integrated into other subject areas. Finally, I gave an example of a mathematical subject and determined its goals and objectives thanks to Bloom's taxonomy.

Key words: curricular models, STEM education, goals and objectives, Bloom's taxonomy

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Introduction

The purpose of this article was firstly to explain the major differences among crossover model, enrichment model and differentiated model. To do this, I critiqued each model in detail according to their suitability for mathematics education curricula used in Turkey. Secondly, I talked about definition of STEM education and mathematics integrated into other disciplines. And finally, I determined the goals and objectives of a topic, which was quadratics, by using Bloom's taxonomy.

Curriculum Models, STEM Education and Bloom's Taxonomy

Curriculum Models

The NCTM's Principles and Standards for School Mathematics (2000) recommended an integrated curricular model rather than traditional sequence of algebra, geometry, measurement, etc. Since the Common Core State Standards described desired outcomes for each grade level whereas the core curriculum was a 3-year program of study intended all high school students(Brahier, 2010). In NCTM standards, three possible curricular models were defined: the crossover, enrichment**,** and differentiated. In all curricular models, all high school students addressed the same set of objectives in a 3 year sequence. However, there were some differences among them. First, in the crossover model, two parallel tracks were established one of which was for college-bound students and the other one was for students not planning to go to college. Unlike traditional model, it was possible for the students in a lower- average mathematics class to switch to the other class without a loss of continuity. Also, these students could explore the same objectives with the college-bound students. Moreover, in this model, there was a fourth-year advanced course for college-bound students. Therefore, all students might enrich the same major core objectives.(Brahier, 2010). Second, in enrichment model, different from the crossover model, classes were heterogeneously grouped. And, any group of students who completed the core content of a particular unit before the rest of the class had opportunity to expand their knowledge with an enrichment model(Brahier, 2010). Besides, if students had shown an apprehension of the common objectives, they would have explored enrichment topics. Finally, in the differentiated model, students were separated with respect to their level of depth. This separation depended on the needs of students in the class. Additionally, in this model, classes were heterogeneous similar to the enrichment model; but, according the students' levels of depth. Hence, the differentiated model looked like the crossover model. I other words, each group learnt the same subjects but the content of the subjects would be chosen appropriate level for each group. To sum up, it was common to all models that every student had the right to explore the same core of objectives regardless of their abilities.

Those three curriculum model given above could be criticized with respect to their use in Turkish mathematics courses. In MONE curriculum, as in the differentiated model, the topics were not differ regardless of the students, the schools or the areas. On the contrary, there were two distinct contents, namely, the basic and advanced levels, by pursuant of the students' needs, choices or their career plans for the future. Although the individual and cultural differences in objectives were not possible to be observed, the depth of the subjects and the differences among the students' cultural and individual features should have been paid attention while the program was being implemented(MoNE). In IGCSE curriculum, candidates might follow either the core curriculum only, or the external curriculum which involved both the core and supplement. For example. the students aiming for grades A-C should follow the extended curriculum(IGCSE). Lastly, in the IB curriculum, students were required to choose one subject from each of the six academic areas. Normally, 3-subjects were taken at higher level (HL) and the rest were taken to standard level (SL). Also, the IB recommended 240 teaching hours for HL and 150 hours for

SL. Subjects at HL were studied in greater depth than at SL. There were four different levels of IB curriculum, namely, mathematical studies SL, mathematics SL, mathematics HL, and further mathematics HL(IB).

STEM Education

In order to succeed in public life and an understanding of scientific and technological knowledge, engineering principles and qualitative methods are sufficient for notions in the world(President's Council of Advisors on Science and Technology, 2010). The integration of science, technology, engineering and mathematics is called STEM education. Since the STEM literacy is an interdisciplinary area of study, a STEM classroom can shifts the students away from learning discrete bits toward questioning the all situations in the world(National Governors Association., 2007). "STEM education includes the knowledge and skills that are collaboratively constructed at the intersection of more than one STEM subject area." (Çorlu, 2012). Besides, subjects of the STEM education are formed the core requirements at the K-12 level(President's Council of Advisors on Science and Technology, 2010). In brief, STEM education can increase the understanding of students across STEM disciplines and other subject matter(Gallant).

In addition, mathematics can be integrated into other subject areas since even people who will never become mathematician should have the knowledge, conceptual understanding and critical thinking skills of mathematics. For example, for data analysis or to run for a public office, anyone should need the mathematics knowledge. So, for instance, teaching mathematics is a part of science as well as teaching science entirely is a part of mathematics(Furner&Kumar, 2007). Also, if students understand the concepts and principles of mathematics with science, engineering and technology, their overall level of STEM literacy will be enhanced(Williams, 2011). Moreover, students can be motivated to use process skills, such as reading, writing, reporting, researching, problem solving, data collection or data analyzing, by STEM education(Robinson,1994). Robinson also pointed out that this strategies are necessary for the preparation of interdisciplinary instruction. As Furner and Kumar say, in growing competitive global environment, making a big difference for the future of the students depends so heavily on mathematics, technology and sciences(2007).

Goals and Objectives of Quadratics in 9th Level

Supposing I was in charge of assessing students for the topic *quadratics,* I determined the main goals and objectives of the subject. I listed below two goals and eight objectives. *The first goal* was that 'the student will understand the connection between quadratics roots and x-intercepts of a parabola'. *The second goal* was that ' the student will develop the use of factorization in solving nonlinear equations.

On the other hand, I explained the objectives in three different parts one of which was affective objective, other one was psychomotor and the lasts were cognitive objectives. Thanks to Bloom and Krathwohl(1956), the classification of six levels of cognitive objectives were described and the scheme was known as Bloom's Taxonomy. Hence, according to Bloom's Taxonomy, I listed the cognitive objectives as: *Evaluation:*"The student will determine whether the quadratic equations is best solved by factorizing, the method of extraction of roots or the method of completing the square and the student will explain her or his reasoning." *Synthesis:*"The student will be able to understand the logic underlying the method of completing the square." *Analysis*: " The student will distinguish between the zero-factor of the real numbers and the extraction of roots." *Application*: "The student will become more proficient at using the five-step method for solving applied problems." *Comprehension:* "The student will solve quadratic equations using the quadratic formula." *Knowledge:* "The student will be able to define the general formula of quadratics."Finally, I expressed the *affective* and *psychomotor* objectives as "The student will appreciate the historical meaning and origin of quadratics." and "The student will be able to find and interpret the intercepts by using graphing calculator.", respectively.

Conclusion

The purpose of this article was to express curricular models, to define STEM education and determine some objectives and goals for any topic of mathematics. Therefore, thanks to related articles, I learnt what kind of the relations or distinctions there were among the crossover model, enrichment model and differentiated model. Besides, I had an idea about an interdisciplinary area of study which was STEM education as an integrated approach to curriculum design. At the end of this article, I discussed the objectives and goals of a mathematics topic so I experienced how an assessment could be constructed.

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"A Bilkent student does not lie, cheat, or steal or tolerate those who do. On my honor, as a Bilkent student, I have neither given nor received unauthorized aid on this academic work."

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