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# Chapter 55: Modern Techniques, Strategies, and Methods of Teaching Computer Science

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## 1 Introduction

My name is Ahmed Mohsen Samhan Al-Qarni. I'm from the city of Jeddah, in the Kingdom of Saudi Arabia (KSA). I graduated in 2008 from the Teachers College with a Bachelor's Degree in Computer Science and started working in the Ministry of Education in 2010. I sought to develop my teaching skills by attending training courses and reading in the field of educational technologies. In 2014, I was admitted to King Abdulaziz University in the Department of Educational Technologies and graduated in 2016 with a Master's Degree in Educational Technology. In 2019, I was sent to train in the Building Leadership for Change through School Immersion (BLCSI) program to visit American schools and transfer the learning and knowledge upon returning to Saudi Arabia.

I am interested in modern techniques, strategies, and methods of teaching, and how they can be applied to teach computer science in an easy way, especially programming curriculum. I acquired this knowledge during the period of visiting American schools and attending classes in programming science. I benefited from the knowledge of teachers by attending classes directly and interviewing them.

I am interested in studying ways to make computer science interesting because I teach computer science in Saudi Arabia. I commonly find that students are not interested in learning computer science. I struggle to find ways to make it easier and more interesting. However, students often find the material to be boring and/or difficult because of the mathematics involved.

I conducted my study by interviewing teachers in the United States and asking them about ways to the make computer science curriculum interesting and fun for students. I also observed best practices in American schools by visiting classes daily. From this, I learned new ways to make computer science teaching more effective with students in class.

Upon returning home to KSA, I plan to use what I learned here in the United States by testing new methods in my own classrooms, and if they are successful, I will recommend them for rollout to other classes within the Saudi Ministry of Education.

## 2 Literature Review

In 2018, a study entitled "Exploring How Integrating Art & Animation in Teaching Text-Based Programming Affects High School Students' Interest in Computer Science" was conducted in Michigan. The study's author was Hadeel Jawad. In this experimental study three groups of high school students were targeted to explore the integration of art, animation, and code sharing in programming that affects their interest in computer science. The study also explored the effects of social factors and attitudes of the students toward programming and computer science. Pretest-posttest survey questionnaires were used to measure the study variables before and after taking a programming course. A new web-based learning

environment was developed and used as a treatment in this study. The tool developed includes the use of art, graphics, animation, and code sharing to further motivate students to learn computer programming. The results of this study showed that the use of art, animation, and code sharing increased students' knowledge, enjoyment, and motivation in learning computer programming. This increased their interest in developing computer science proficiency.

Also in 2018, Utah University conducted a study entitled “How Mother and Father Support Affect Youths’ Interest in Computer Science.” The study authors were Jody Clarke-Midura, Frederick Poole, Katarina Pantic, Chongning Sun, and Vicki Allan. The study revealed that parental support is a predictor of child interest and aspirations in computer science. To understand how perceived mother and father support affect interest in computer science, the study used two path models using both mother and father support gains to predict youths’ interest in computer science. The study assumed that perceived father and mother support would relate to youths’ interest in computer science via youths’ perception of computer science utility value as a mediator. The result of the study found that both mother and father support leads to interest in computer science. Father support was found to affect computer science interest more than mother support.

In 2015, Washington University conducted a study entitled “Computing Whether She Belongs: Stereotypes Undermine Girls’ Interest and Sense of Belonging in Computer Science.” The study authors were Allison Master, Sapna Cheryan, and Andrew Meltzoff. The study aimed to examine the stereotype of studying computer science for girls, as girls are less likely to enroll in introductory computer science courses. Two experiments investigated whether high-school girls’ lower interest than boys in enrolling in computer science courses is influenced by stereotypes of the field. The study tested whether these stereotypes can be communicated by the physical classroom environment and whether changing this environment alters girls’ interest. 269 students participated in the tests. The study results suggested there was a significant gender difference in classroom choice; girls were more likely than boys to choose the non-stereotypical classroom. Additional comparisons revealed that girls were more likely to choose computer science courses without stereotypical classrooms. The study revealed a significant main effect from the classroom environment.

In 2014, Virginia University conducted a study entitled “Teaching Computer Programming through Game Design: A Game-First Approach.” The study authors were Giti Javidi and Ehsan Sheybani. The study aimed to examine the effects of learning computer programming using game design on high school students' attitude and interest in computing careers. The study used the mass appeal of game design and creation to introduce students to programming and algorithmic thinking. The authors set out to evaluate how game designing could be used to encourage interest in computer science. The study results found that game design work is effective at increasing students’ understanding of computing principles and programming associated with games, suggesting that students have positive perceptions of

Computing. Overall, results indicated that game design appeals to students and is a powerful teaching tool in getting students exposed and interested in programming.

In 2017, Georgia University conducted a study entitled “Reviving Computer Science Education through Adaptive, Interest-based Learning.” The study authors were Karen Aguar, Saeid Safaei, Hamid Arabnia, Juan Gutierrez, Walter Potter, and Thiab Taha. Despite the support of governments, institutions and society to promote computer science education,

there are still obstacles hindering students from learning computer science at the high school level. This research aimed to reduce these challenges by testing a new adaptive learning system for teaching introductory programming in a unique and interesting way. The research takes a new approach to the curriculum with practice problems and examples based on a student's interests and aptitudes. Results of this research revealed that interest-based learning improves intrinsic motivation, leading to better learning and achievements.

## 3 Methodologies

This research was conducted at Timber Creek High School in Orlando, Florida, USA.

### How was the data collected?

In this research, I made sure to attend computer classes for the various educational stages in the school in programming to observe the methods of teachers in teaching programming for students from the first levels of learning programming until the student reaches professional courses of programming that will increase student interest in programming and help them learn methods and logical steps in various programming languages. These courses make the programming process easy and fun for students, which increase student creativity. Teachers were asked questions about teaching programming, and what strategies and methods they used with students.

Observation is one of the methods of evaluation and data collection, as it is possible through its use to obtain a set of information and data that is difficult to obtain through the use of another method. The observation is the observation and accurate visual follow-up of the behavior or phenomenon during the actual performance in normal situations.

The interview is important because the response rate is high, and it also contributes to gathering basic information related to the research. The interviews also have many strengths, among them that the interviewer can explain some of the questions that are difficult to understand on the part of the participants, and even try to obtain more information by identifying the reason for answering that question in that way. Interview questions that I aimed to ask included:

What do you find most challenging about promoting interest in computer coding among students?

1. Which aspects of coding do students find most interesting vs. least interesting?
2. What tactics do you use to promote interest in coding among students?
3. Which tactics have you found to be most effective vs. least effective?
4. Is interest in coding necessary for students to do well in coding?
5. Do you have any recommendations for coding teachers in other countries?

Note: Due to the coronavirus pandemic, I was severely limited in my ability to interview teachers. As such, most of my results stem from my observations in school during the immersion program.

## 4 Results

January 14, 2020 was my first day in immersion at Timber Creek High School. Timber Creek High School of Orange County was opened in 2001 and has approximately 3,500 students and 170 teachers, with an estimated ratio of 1:21. The school has a counseling team consisting of 8 counselors to guide students.

We were received by the administrative staff in the school, the principal of the school, the assistant principals and the media center specialist. A meeting was held and the rules and regulations of the school were explained to us. We were informed in this meeting of the basic policies that we must follow while we were in school.

The first day after our meeting with the administrative staff, the principal of the school took us on a tour to explore school facilities, buildings, classrooms, theater, laboratories, sports stadiums, technical facilities available in each class or laboratory according to the educational process needs ... etc. To know the school facilities completely.

At the end of each school day, there was a special meeting for us with the Media Center specialist to tell us more about the regulations and educational systems that are running in the school in detail. The staff answered our inquiries about what we saw while we attend classes during the school day.

The school day at Timber Creek consists of 7 periods, divided into the following three categories:

1. Core subjects: These classes include science, mathematics, social studies and English.
2. Optional courses: These classes are varied and very rich, from which the student acquires various skills that are useful in determining his academic specialization in college or in helping to define his field of work in the future. Such classes included engineering, agriculture, aviation, army, music, robotics, programming, design, drawing, veterinary studies, child care, and acting.
3. Advanced courses: These are subjects that have previous requirements and specific grades that students must obtain in the required pre-studied subjects. Credit hours are awarded university as if these courses were taken in college.

To encourage and motivate outstanding students, a high school student can study courses at a nearby university or college with some specialization courses that he desires, and this is paid for by Orange County public schools. In the aviation education course, the school provides a flight simulator and the student basics of flying through simulation and practice.

There are meetings of school teachers for each major that are held periodically to discuss the results of students in the previous testing period after analyzing them and identifying weaknesses for students and making plans to overcome weaknesses and enhance their strengths.

The school administration was keen to prepare a daily schedule to attend classes with teachers in various majors to benefit from all the teachers' experiences in the school. It was a very rich experience for me as a each teacher had a special method to teach students. At the end of each class there was time available for us to ask the teachers some questions about the teaching strategies they used.

During the immersion period I made sure to attend classes for computer science and programming, design, and robotics. My focus was on programming classes since my research

topic is about how teachers can make programming an easy and enjoyable process for students in Saudi Arabia. I made sure during my time attending programming classes to ask plenty of questions, but due to the coronavirus pandemic I was not able to conduct the personal interviews as thoroughly as I would have liked. However, my observations and interactions in the school were insightful.

There were two programming courses at Timber Creek High School. The first course is mandatory for students of the first year grade 9, and the second course is optional and is considered one of the advanced subjects (AP). The programming language used is Java.

At the beginning the students start by learning basic programming. It is carried out at an early stage through the CODE.ORG platform, which is a non-profit organization that aims to encourage and teach students programming. It contains free lessons and aims to encourage schools to include more computer science in the curriculum. Students begin to learn programming by playing and moving the avatar of their favorite games through a group of instructions. Lessons on site range from easy to medium to hard, depending on the student level.

The site is distinguished by providing easy programming options that start with blocking programming, whereby the programming commands are written in English in a simple way. The student withdraws the instructions and puts it in the command box in a specific sequence, after which the program is run. A useful feature is available for beginners in converting orders written in English into a program code. During the advanced stages, the student can write the code and dispense with blocks (ready-made software instructions). Through this process, the student learns the basics of logical steps for programming, which is a student preparation or an introduction to programming. The most important feature of the site is that the student learns programming in a very enjoyable and easy way, which increases the fun and excitement as the student plays while he learns. The site is designed to help students solve programming problems through popular games that most students play on the PlayStation or mobile phones or tablets such as Minecraft, Frozen, and Star Wars.

The student continues to arrange the programmatic orders over and over until the program is started correctly and the game’s avatar is moved based on the entered programmatic commands. And if the student get stuck, the platform provides hints so that he does not become frustrated.

The purpose of the first programming course was only to teach the student the logical steps of programming (inputs - processing - outputs) regardless of writing the program in full and running it. The teacher was following a problem-solving method, explaining to students the mechanism of the program's work. The code is written in front of students, but it is incomplete. The student is not required to be able to write the entire program and run it, but the aim is to teach the student the most important stage in programming, which is the processing step. Students are asked to think and discover the missing code, and the students were eager to do this. The students use the CODE.ORG platform to write code and see if the program works properly. Then they repeat and attempt to reach a solution. It is noted that students work individually, and the role of the teacher is only to guide students and give them hints in order to get them thinking about the solution. But the student must discover the solution by himself.

And the advanced programming course (AP) uses free web sites that contain complex problems ranging from easy to difficult levels. For example, on the Domjudge site students have 4 hours to solve each problem, and if the time has ended and he did not finish solving it resets the steps of the problem to the beginning. In this course, the teacher does not interfere at all or try to help the student, and the student should think about solving the problem individually and independently. Domjudge competes with students from all over the world and there is a scoreboard showing the names of members, their levels of progress, and the number of problems they've solved. There is a partnership between the site and universities and technical support companies. Universities attract professional students by giving them free scholarships to study programming and technical support company's contract with them to work from home in order to take advantage of their programming expertise.

In Saudi Arabia, students learn complete computer science and programming without any previous background on programming or establishing logical steps to solve problems in a fun and interesting way. We teach them algorithms in writing before starting to teach them a book of program commands. In my personal belief it is not enough because students don't find it to be easy, fun, or interesting. They can learn by playing a favorite game and solving puzzles through the site CODE.ORG, and the site supports many languages, including Arabic.

## 5 Conclusions

Through my experience in living in American schools, I learned many ways of teaching students programming, and a big difference was observed between teaching programming in Saudi Arabia and teaching programming in the United States of America, so here we rely on electronic sites to be programming education in a simple, easy, fun and visible way for students from Through the Code.Org site.

I will start applying what I learned here from ways of teaching students programming with my students in my classroom by focusing through relying on the Code.Orge site and start teaching students programming with ready-made software orders. The blocks and excite students to learn programming with their favorite games they play in the PlayStation. And focus heavily on teaching them treatment processes.

Upon successful experience with my students, I will conduct training courses and workshops for computer teachers in the school to inform them of the steps of the experiment to benefit from them in educating their students by taking advantage of the free services provided from websites to teach programming.

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