Vol. 06, No. 1 (2024) 37-44, doi: 10.24874/PES06.01.005

Proceedings on Engineering Sciences

www.pesjournal.net

CHALLENGES RELATED TO COMPUTER PROGRAMMING EDUCATION IN SAUDI ARABIA

Faisal Alharthi [1]

Received 21.01.2023.
Received in revised form 05.05.2023.
Accepted 16.05.2023.
UDC – 004.42

Keywords:

Computer programing, Education, Challenges, Saudi Arabia

A B S T R A C T

The economic development of countries depends upon their technological competitiveness. Computer technology is a major component of technology. More the people are competent in computer technology, the greater the chance of economic development. Saudi Arabia is no exception to this common view. Although computer education was started in Saudi Arabia in 1984, the progress had been slow for a long time. However, now, with the implementation of Vision 2030, there is a high focus on elevating the skills of the Saudi workforce to the global levels. Computer technology has a big role in this regard. The full implementation and achievement of developing computer skills among the Saudi workforce are affected by many issues and challenges. This paper reviews these challenges and issues and the possible solutions offered for some of them, using published literature. A systematic review methodology was utilised for this research. A total of 29 papers were shortlisted and reviewed.

Challenges were noted both in learning and in teaching sides. Despite cultural segregation of gender, women are increasingly enrolling in computer programming courses due to government support, family influence, and a stable workplace. Needs and demands on computer skills are rapidly changing with time. This necessitates frequent updating of computer curricula.

Many problems are faced by freshers and their seniors. Lack of knowledge in problem-solving affects their ability to construct algorithms and codes and variables for their programming. This is aggravated by a lack of feedback on errors. Other challenges include inadequate practice, inadequacies of time allocated for labs and tutorials, poor quantity and quality of homework, poor selection of instructors, discouragement by universities on computer use, lack of competency of instructors to motivate students, and absence of quality assurance and monitoring. Solutions have been suggested for some of these like 3D animation software like ALICE and automatic assessment.

Teaching challenges include workloads due to large classes affecting individual attention to weak students and the need to address students' problems listed above. Common problems both students and teachers need to be solved through further research.

Specific computer programming needs of healthcare professionals, hard of hearing students are to be addressed by implementing specific solutions. Some research in the future will also be helpful.

The above challenges can be addressed by adapting solutions from research to the Saudi Arabia context.

[1] Corresponding author: Faisal Alharthi
Email: faisal.t.alharthi@gmail.com

1. INTRODUCTION

A major barrier against the economic development of developing countries is their lack of technological competence. Saudi Arabia is no exception. The Vision 2030 of the country (Saudi Arabia, 2021) has considerable focus on enhancing the skills of the Saudi workforce to global standards. Enhancement of competency in digital technology is an important aspect of this endeavour. Computer education in Saudi Arabia started with the establishment of a dedicated college for this purpose, e College of Computer and Information Sciences (CCIS) in 1984. The college started courses at all levels with an open-door admission policy to accelerate the process of skilling the maximum number of people on computer technology (Al-Wakeel, 2001). However, even after this, the progress of computer education was slow in the country. Certain difficulties and challenges have been encountered in teaching and learning computer programming. These challenges hamper the progress of computer education in Saudi Arabia. In this paper, these challenges are discussed with the help of published literature.

2. METHODOLOGY

The methodology used for this paper is a systematic literature review. The main search terms used to identify relevant studies were "computer programming", "education", and "Saudi Arabia". A comprehensive search was conducted using the Google Scholar database, which returned 100 results from the first ten pages. These results were narrowed down to 29 papers through a strict selection process that focused on English language papers only, full paper availability, and relevance to the topic at hand. These 29 papers were then reviewed and discussed in detail.

3. RESULTS AND DISCUSSION

Learning challenges

One major issue of computer programming education is related to the gender of the student or the faculty. Gender differences among faculty members on some aspects of internet usage for education purposes (Alshankity & Alshawi, 2008) and among students on computer attitudes (Al-Jabri, 1996) could be observed. In the latter study, male students were less anxious about learning and using computers, more confident in their ability to use and learn about computers, and liked or even enjoyed working with computers more than female students. These differences were observed despite gender segregation as a cultural requirement in the country.

Contrary to the trend of the lower number of female students opting to study, computer courses, in Saudi Arabia, more female than male students are interested in computer science courses. In the investigations of Alghamdi (2017), the reasons for this were found to be the family influence, government support, and a stable workplace. This means, despite gender segregation, Saudi women had been ambitious to develop a career for themselves and this fits well with the higher empowerment goal of Vision 2030. This finding and the above seem contradictory. But the two reports are widely separated over time. The latest trend maybe even be better towards women, as shown in the next paragraph.

In rapidly developing Saudi Arabia, many reforms in women's education have been initiated to train them in digital technology so that their employment opportunities increase. The government, the academic institutions, and the business organisations are responding to these changes to enable this transformation rapidly. However, cultural and social barriers stand in the way of increasing the participation of women in these programmes (Gadi, 2021).

The current and future skills of IT professionals working in some Saudi organisations were investigated by Al-Jabri and Fraihat (2005). The study revealed some possible changes in the importance of several IT skills and knowledge after 3 years compared with the current status. In line with the demand for skills, it was found necessary that IT curricula, especially MIS, have to be changed towards more knowledge and skills in computer programming languages and database systems. Hence, corresponding changes need to be made in computer education curricula. The shift in the ranking of importance for many programming languages after three years was particularly noteworthy. This meant the need for a constant watch of the market demand and rapid adaptation of computer education curricula to the new set of demands.

It has been widely accepted that the students of engineering and science subjects will be benefitted by learning computer programming. In a recent study, Ahmed, Nayeemuddin, Ayadat, and Asiz (2021) assessed the computing competency of civil engineering students and compared the recent developments on the topic in Saudi Arabia with those in the USA. The current Saudi civil engineering graduates do not match the computer skills required in the construction industry. This could be due to the absence of required achievement levels in computer courses. Most of the Saudi and US universities have two or three courses related to computer skills.

Considering cloud computing as a part of computer education, Alamri and Qureshi (2015) tested four proposals to solve the problems in using cloud computing technology in Saudi higher education system. The first of these proposals was related to preparing the students to involve in cloud computing technology by introducing the basic cloud computing

courses. The majority of students and faculty agreed to this proposal.

Students of introductory computer programming courses have difficulty using variables. Visualisation of variables into small comprehensible roles has been suggested as a solution. Tests by Al-Barakati and Al-Aama (2009) revealed that only debugging skills of female students improved by the visualisation method.

In a survey study, Zualkernan, Allert, and Qadah (2006) compared the learning styles of introductory computer programming courses by science and engineering students at the American University of Sharjah (AUS) and the University of Minnesota—Duluth (UMD). One initial difference was that AUS students taking the course were predominantly sophomores and UMD students were freshers. The learning styles of AUS and UMD students were largely similar to those of students from comparable universities in the United States and Latin America. Recommendations were given based on the finer analysis of the results. These results may apply to Saudi Arabia too.

Various reasons for not adopting the 'Hour of Code' concept of the Code.org in Saudi Arabia given by Sami Al-Wakeel were mentioned in the paper by Du, Wimmer, and Rada (2016). It is not relevant to Saudi Arabia, because the Saudi students had already been introduced to computer courses. As Saudi Arabia recognised the importance of computer science education for all students at all levels, networked computer labs were installed in all secondary schools and most elementary schools of the country. Also, new teacher training departments were created in teacher education colleges to maximise computer-educated teachers.

The need for enhanced computer literacy for healthcare professionals for effective use of electronic medical records was demonstrated by Alasmary, El Metwally, and Househ (2014) through a survey of the doctors and nurses at a Saudi healthcare facility. Thus, the education of doctors and nurses in computer technology will be useful.

Object-Oriented Programming (OOP) is taught to improve programmer productivity and improve modelling of real-world objects. The students need to connect steps in developing an algorithm for problem-solving with the visualization of objects and their behaviours. New techniques of 3D animation environments such as Alice are used for this purpose. Al-Linjawi and Al-Nuaim (2010) studied on the performance of novice programmers in KAU's female CS department in Saudi Arabia, and the effectiveness of the Alice in teaching inheritance as a concept of OOP. In the experimental study, the use of Alice was found to enhance their OOP performance due to the visualisation of objects. The students developed good intuition about objects and OOP as they could see and relate to the objects and their animation actions. The students were comfortable as they used Alice to use methods of invoking on the objects. They were able to analyse what went wrong, debug and correct them and thus were able to learn from mistakes.

Normally to assess the students on computer programming, cognitive levels are used to make questions with the manual assessment of performance. Instead, Bloom's taxonomy was used for this purpose by This rule-based assessment method was applied by Ullah, et al. (2019) to students using programming code in an introductory Java course. The new assessment method compared well with the manual method.

Some challenges of learning computer programming perceived by students at Saudi universities were listed by Alakeel (2015) based on survey results. The challenges identified were inadequacies of time allocated for labs and tutorials, poor quantity and quality of homework, poor selection of instructors, lack of competency of instructors to motivate students, and absence of quality assurance and monitoring.

The need for students to learn many concepts of object-oriented programming, insufficient time to teach object-oriented programming in introductory courses by solving large problems, lack of facilities for graphical presentation lead students to difficulties in comprehending objective orientation contexts and visualising such contexts themselves and inability to implement some of the objective orientation concepts (Al-Nuaim, Allinjawi, Krause, & Tang, 2011).

The inability to analyse the problem is a major challenge faced by computer programming students. Alshaye, Tasir, and Jumaat (2019) developed a conceptual framework for online problem-based learning to improve the ability of learners to analyse problems and find programming solutions. The framework developed in Malaysia may be useful for adaptation to Saudi Arabia, as the same challenge exists in the country.

Computer curriculum was made compulsory for Saudi middle school children in 2009. The obstacles of orientation, notional machine, the rules, and the structures of programming language are faced by the middle school learners, especially learning of coding and variables. Therefore, the possibility of Lego Mindstorms Robotics Programming to increase computational thinking and thus, make computer programming learning easier for Saudi middle school children was discussed by Alalawi and Said (2020).

Social and cultural values could play a negative role by discouraging learners from acquiring vocational skills like computer programming from the Saudi College of Technology. Although technology has changed the way

manual works were being done. So, the social stigma associated with manual works needs to be changed. The tendency of a large number of Saudi workers to leave manual jobs and opt only for office jobs or start their own business has led to a mismatch between the labor market demands and the supply from Saudi Arabia. This issue is important in the case of computer programming because of its complexity and learning problems (Mellahi, 2000).

The need for teamwork and good background in maths to learn computer programming skills of Saudi school children was stressed by Berglund, et al. (2015) in two poster presentations of participants' projects in a staff development course jointly conducted by the University of Uppsala, Sweden and Al Baha University, Saudi Arabia.

The learners' challenges in computer programming were discussed by Alhazbi (2016). Students usually find learning computer programming difficult because they lack the skills of applying problem-solving methods to write computer programmes. Without the skill to develop the correct algorithms, they hurry to write the codes. They are impatient to analyse, identify, and correct mistakes to arrive at the correct and complete solution to the problem. Students lack fundamental knowledge about the nature of the subject. Along with the skills of programming, they also need the skills of syntax and recognising data types, analysing problems, developing algorithms, writing code, debugging, and fixing errors. These skills can be developed only through continuous practice outside the classroom, but the students do not take the trouble of practicing the classroom lessons. The awareness of students about their limitations is less than what teachers identify, showing the tendency to overconfidence in their abilities and underestimating their weaknesses. Freshers find understanding programming concepts and abstract design difficult to comprehend. These challenges lead to students getting demotivated and frustrated. They may drop out or continue with fear of computer programming and choose a career that does not require computer programming skills. One of the best methods of motivating the students is continuous interaction of teachers with them and support to solve difficulties reported by them, even outside the classroom. Social media can be used for this. Active blended learning is another effective solution. In addition to the above problems, Middle-East students have inadequate English language skills. Culture and community characteristics of Middle-East countries also contribute to these problems. The high level of failure of these students in computer programming courses can also be attributed to these problems.

The learning difficulties of deaf and hard-of-hearing students in Saudi Arabia in computer programming were researched by Abuzinadah (2020). The author evaluated the usefulness of an avatar created for teaching computer programming using Arabic sign language (ArSL) to these students. Six lessons were covered in the evaluation all related to the fundamentals of Java programming consisting of Java language introduction, Main rules of Java language, creating a New Program, Variable definitions, Java package, project and write a program, and Arrays and strings. Usability and interaction tasks increased. The ArSL with augmented reality module was more exciting, entertaining, and motivating than the other two interaction modes. The proposed ArSL solution demonstrated that the Arabic text to sign translation task was consistent and can be improved and applied over different types of architecture, avatar, and video mechanisms. Both mechanisms improved the remembering, understanding, application, and usability of the ArSL. Incorporation of both avatar and video modes appropriately into the system was recommended as both were effective.

Saudi students used computers for about 45 hours per week on average and they had positive attitudes about using them for learning. However, they did not use computers for learning because they were not required or even prevented from using computers at universities and universities did not provide the required facilities. English proficiency, location, and parental encouragement, but not gender, predicted computer attitudes of Saudi universities in a qualitative study by Alothman, Robertson, and Michaelson (2017).

Teaching and learning computer programming are difficult tasks. High rates of disapproval and dropout have been observed due to the lack of motivation of students. The use of flipped classrooms has been proposed by many authors to improve their motivation leading to high success rates and reduced dropout. A flipped classroom is essentially an inverted class model. The traditional order is changed to students coming to the class after learning the subject, using videos, texts, online tests to check their knowledge or other material. The classroom sessions are reserved for discussions, clearance of doubts, application of the acquired knowledge, and other matters related to the subject. Sobral (2021) evaluated the scientific production of flipped classrooms for use by freshers. The analysis showed that flipped classrooms can help only highly motivated freshers and may be counter-productive in the case of students who dislike programming and do not want to programme. The nature of the subject is that doing homework before going to class may be difficult for students. Finding that there is no use of this arrangement, students may stop attending lectures. The quality of videos may be a problem if teachers are to make them without any expertise. Instead of that getting links to YouTube videos may be a good alternative.

From the survey findings of Alaqsam and Ghabban (2021) it appears that the majority of Saudi students are yet to try programming language courses available in

Massive Open Online Courses (MOOC), which is widely recognised as a good method to enhance programming language learning.

Teaching challenges

Interviews with teachers by Hegazi and Alhawarat (2015) showed the student-side challenges in teaching introductory computer programming courses to freshers. These challenges were inadequate competency in the English language of students, inappropriate learning strategies of students including spoon-feeding and mugging, inadequate skills in problem solving and logical thinking, lack of motivation, low attendance, low rate of completion of lab exercises and homework, insufficient efforts to study and practise and bad impressions spread by senior students who scored low marks. Recommendations have been given to improve teaching to address the challenges.

The teaching challenges, in the case of computer programming courses at Saudi schools, included a lack of a basic understanding among both students and teachers of how the equipment functions; a lack of mastery of ICT teaching techniques, and a lack of teacher training to bridge the gap, a lack of mastery of electronic equipment; problems with repairs and their timeliness, lack resources and failure to take initiative (Alkahtani, 2017).

Learning computer coding is one of the challenges of Saudi computer programming students. One solution to this problem was the mobile-enabled Little Programmer application to teach computer coding to children in the age range of 8-12 years. The trial results of this application by Meccawy (2017) showed that the application was helpful as it developed curiosity among the users to identify the concepts of computer programming. The learner could easily acquire innovative knowledge through the visualisation of objects and linking difficult or newer concepts to familiar entities.

For preparing Saudi teachers to teach maths and science, Etukudo (2012) proposed some content for e-learning material in the online environment, containing some courses in basic computing and computer programming. These courses will enable them to teach maths and science in an online environment, as they will possess the required ICT knowledge using learning packages made by themselves.

The problems related to teaching computer programming were discussed by Alhazbi (2016). Many teachers ignore the nature of this subject and instead of first training the students on problem-solving skills, start teaching syntactic details using the highly unsuitable traditional teaching methods. Students are not provided immediate feedback on their problem-solving exercises. The teachers do not provide personalised attention to very weak students. Also, there is no teacher support for students to practice outside the classroom. More active teaching methods in the classroom demonstrating problem solving, algorithms, syntax and codes need to be adopted. Active blended learning can be integrated into the learning management systems.

There is increasing interest in substituting graphical user interfaces (GUI) with tangible user interfaces (TUI), claiming more effective teaching of computer programming to children. An experimental comparison of the two methods among Saudi children of 6-7 years (Almjally, Howland, & Good, 2020) showed higher learning benefits for GUI than TUI. However, the post-activity increases in attitude toward computing were significantly higher for the TUI than for GUI. There was no difference between the two in the high enjoyment scores.

Instructors are unable to provide the programming skills of introductory programming students, as they are overloaded with work due to a large number of students in their class. Feedback regarding the errors of students in programming practices becomes a casualty in this situation. To address this issue, several automatic assessment systems like eGrader, CourseMarker, and ASSYST, have been developed. These systems assess the students' programs and provide feedback on the errors. A Saudi study, Ullah, et al. (2018) compared a few of these automatic assessment systems for their advantages and limitations and suggested some specifications for novice programming. The main recommendations are to use a web-based platform, select appropriate analytical approaches, use an intelligent tool to create a well-designed application, sufficient test cases to cover maximum variabilities, complete grading or partial correction of programmes, support for common grading metrics, provide comprehensive instant feedback, provide re-evaluation capability, desirable to have the flexibility for multiple languages, interoperability, maintainable and extensible.

4. CONCLUSIONS

Enhancement of technological competence is essential for the economic development of developing nations including Saudi Arabia. A major aspect of technology is computer education and programming is its backbone. Although Saudi Arabia started computer courses in 1984 itself, its progress had been slow till recently. With the implementation of Vision 2030, some corrections towards the rapid development of computer programming education have been initiated. However, certain challenges exist and if not corrected, these challenges may hamper the progress of the initiatives and affect the Vision 2030 goals.

This paper reviewed the challenges of computer programming education in Saudi Arabia using published literature. The first challenge is related to the cultural

segregation of gender. However, despite this segregation, more women have been studying computer courses due to family influence, government support, and a stable workplace. On the other hand, female students were more anxious and less confident about their computing competence.

The changing needs and demands for computing skills over time necessitates frequent updating of the computer curricula. Even currently, the market requirements are not matched by what the students are taught.

Freshers learning introductory programming face many challenges like language problems, subject complexity affecting comprehension, understanding, and constructing algorithms and codes to develop their programmes as they lack problem-solving skills, and lack of feedback on errors, the inadequate practice of lessons, inadequacies of time allocated for labs and tutorials, poor quantity and quality of homework, poor selection of instructors, discouragement by universities on computer use, lack of competency of instructors to motivate students and absence of quality assurance and monitoring. Solutions have been suggested for some of these like 3D animation software like ALICE and automatic assessment.

There are specific needs to enhance the computer technology skills of healthcare professionals and hard-of-hearing students. Augmented or virtual reality-based Arabic texts could be one option. Similarly, not enough attention has been paid to teaching cloud computing to students, considering its current and future scope.

Over-crowded classes increase the workloads of instructors, due to which, they are unable to pay attention to weak students. Teachers also need to rectify the problems of the students listed above. Using teaching tools like Little Programmer and standardised automatic assessment systems can partially solve these problems. Sometimes, the teachers may be using the wrong teaching methods. These teachers can be helped by e-learning of teaching methods for computer programming to update their styles.

Overall, many challenges exist both in learning and teaching computer programming in Saudi Arabia. Some of these have solutions from research, which can be adapted for implementation. In the case of others, more research needs to be done to evolve desirable solutions.

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References:

Abuzinadah, N. E. (2020). An avatar-based system for Arabic sign language to enhance hard-of-hearing and deaf students' performance in a fundamentals of computer programming course. *Department of Computing. University of Surrey*. Retrieved January 10, 2022, from https://s3.eu-central-1.amazonaws.com/eu-st01.ext.exlibrisgroup.com/44SUR_INST/storage/alma/18/9E/F6/86/0C/E6/1B/AA/0A/EB/AF/B4/F0/BD/DE/8D/Nihal%20Abuzinadah%20PhD%20final%20thesis%20after%20corrections.pdf?response-content-type=application%2Fpdf&X-Amz-A

Ahmed, D., Nayeemuddin, M., Ayadat, T., & Asiz, A. (2021). Computing Competency for Civil Engineering Graduates: Recent Updates and Developments in Saudi Arabia and the US. *International Journal of Higher Education, 10*(6), 57-71. doi:10.5430/ijhe.v10n6p57

Alakeel, A. M. (2015). Investigating Difficulties of Learning Computer Programming in Saudi Arabia. *Universal Journal of Educational Research, 3*(9), 567-577. doi:10.13189/ujer.2015.030901

Alalawi, W. A., & Said, M. N. (2020). Using Lego Mindstorms Robotics Programming in Enhancing Computational Thinking among Middle School in Saudi Arabia. *International Journal of Psychosocial Rehabilitation, 24*(5), 5367-5373. doi:10.37200/IJPR/V24I5/PR2020243

Alamri, B. H., & Qureshi, M. R. (2015). Usability of cloud computing to improve higher education. *IJ Information Technology and Computer Science, 9*(1), 59-65. doi:10.5815/ijitcs.2015.09.09

Alaqsam, A., & Ghabban, F. M. (2021). Online Programming Language Learning Using Massive Open Online Coursesin Saudi Universities 1. *International Journal, 9*(2), 116 – 131. doi:10.30534/ijeter/2021/16922021

Alasmary, M., El Metwally, A., & Househ, M. (2014). The association between computer literacy and training on clinical productivity and user satisfaction in using the electronic medical record in Saudi Arabia. *Journal of medical systems, 38*(8), 1-13. doi:10.1007/s10916-014-0069-2

Al-Barakati, N. M., & Al-Aama, A. Y. (2009). The effect of visualizing roles of variables on student performance in an introductory programming course. *Proceedings of the 14th annual ACM SIGCSE conference on Innovation and technology in computer science education* (pp. 228-232). ACM. doi:10.1145/1562877.1562949

Alghamdi, F. (2017). Why do female students choose to study CS in the Kingdom of Saudi Arabia? *International Conference on Learning and Teaching in Computing and Engineering (LaTICE), 20-23 April 2017, Hong Kong, China* (pp. 49-53). IEEE. doi:10.1109/LaTiCE.2017.16

Alhazbi, S. (2016). Active blended learning to improve students' motivation in computer programming courses: A case study. In M. Abdulwahed, M. Hasna, & J. Froyd (Eds.), *Advances in engineering education in the Middle East and North Africa* (pp. 187-204). Springer, Cham. doi:10.1007/978-3-319-15323-0_8

Al-Jabri, I. M. (1996). Gender differences in computer attitudes among secondary school students in Saudi Arabia. *Journal of Computer Information Systems, 37*(1), 70-75. doi:10.1080/08874417.1996.11647249

Al-Jabri, I. M., & Fraihat, H. (2005). Assessing Skills and Knowledge of IT Professionals in Saudi Arabi. *Communications of the IIMA, 5*(3), 63-75. Retrieved January 11, 2022, from https://scholarworks.lib.csusb.edu/cgi/viewcontent.cgi?article=1272&context=ciima

Alkahtani, A. (2017). The challenges facing the integration of ICT in teaching in Saudi secondary schools. *International Journal of Education and Development using ICT, 13*(1), 32-51. Retrieved January 10, 2022, from https://www.learntechlib.org/p/180215/

Al-Linjawi, A. A., & Al-Nuaim, H. A. (2010). Using Alice to teach novice programmers OOP concepts. *Journal of King Abdulaziz University: Science, 22*(1), 59-68. doi:10.4197 / Sci. 22-1.4

Almjally, A., Howland, K., & Good, J. (2020). Comparing TUIs and GUIs for Primary School Programming. *51st ACM Technical Symposium on Computer Science Education* (pp. 521-527). ACM. doi:10.1145/3328778.3366851

Al-Nuaim, H., Allinjawi, A., Krause, P., & Tang, L. (2011). Diagnosing student learning problems in object oriented programming. *Computer Technology and Application, 2*(11), 25-32. Retrieved January 10, 2022, from https://gpml.foi.hr/laboratory/data/uploads/CTA--Vol.2,%20No.11,2011.pdf#page=28

Alothman, M., Robertson, J., & Michaelson, G. (2017). Computer usage and attitudes among Saudi Arabian undergraduate students. *Computers & Education, 110*(July), 127-142. doi:10.1016/j.compedu.2017.02.010

Alshankity, Z., & Alshawi, A. (2008). Gender differences in internet usage among faculty members: The case of Saudi Arabia. *Conference on Human System Interactions, 25-27 May 2008, Krakow, Poland* (pp. 830-833). IEEE. doi:10.1109/HSI.2008.4581550

Alshaye, I., Tasir, Z., & Jumaat, N. F. (2019). The conceptual framework of online problem-based learning towards problem-solving ability and programming skills. *IEEE Conference on e-Learning, e-Management & e-Services (IC3e) 19-21 Noember 2019 Pulau Pinang, Malaysia* (pp. 1-4). IEEE. doi:10.1109/IC3e47558.2019.8971780

Al-Wakeel, S. S. (2001). Innovation in computer education curriculum for the computerization of Saudi Arabia: a model for developing countries. *31st Annual Frontiers in Education Conference. Impact on Engineering and Science Education. Conference Proceedings (Cat. No. 01CH37193), 10-13 October 2001, Reno, NV, USA. 3*, pp. S3D2-S3D7. IEEE. doi:10.1109/FIE.2001.964058

Berglund, A., Pears, A., Nylén, A., Ahmad, F., Alghamdi, B., Alghamdi, K., & Alhabish, A. e. (2015). Teaching and Learning Computer Science at Al Baha University, Saudi Arabia: Insights from a Staff Development Course. *International Conference on Learning and Teaching in Computing and Engineering 9-12 April 2015 Taipei, Taiwan* (pp. 1-6). IEEE. doi:10.1109/LaTiCE.2015.50

Du, J., Wimmer, H., & Rada, R. (2016). " Hour of Code": Can It Change Students' Attitudes Toward Programming? *Journal of Information Technology Education: Innovations in Practice, 15*, 52-73. doi:10.28945/3421

Etukudo, U. E. (2012). E-learning and teacher preparation in science and mathematics: The paradigm for utilization of interactive packages. In A. N. Nosike, S. Nelasco, N. S. Oguzor, L. M. Csorba, J. A. Opara, & S. M. Alredaisy (Ed.), *1st International Technology, Education and Environment Conference September 5-8 2011, Omoku-Nigeria. Volume 1, Number 1&2*, pp. 246-249. International Society for the Scientific Research (ISSR). Retrieved January 10, 2022, from https://www.researchgate.net/profile/Samir-Alredaisy/publication/268957725_proceeding_of_first_international_conference_of_technology_education_and_environment_editor_vol1/links/547c1fc00cf205d16881cd89/proceeding-of-first-international-conference-of-tech

Gadi, N. H. (2021). Exploring the Relevance of Appropriate Training in Digital Education for Women's Employment in Saudi Arabia. *Open Journal of Business and Management, 9*(6), 2988-3010. doi:10.4236/ojbm.2021.96167.

Hegazi, M. O., & Alhawarat, M. (2015). The challenges and the opportunities of teaching the introductory computer programming course: case study. *Fifth International Conference on e-Learning (econf), 18-20 October 2015, Manama, Bahrain* (pp. 324-330). IEEE. doi:10.1109/ECONF.2015.61

Meccawy, M. (2017). Raising a Programmer: Teaching Saudi Children How to Code. *International Journal of Educational Technology, 4*(2), 56-65. Retrieved January 10, 2022, from https://files.eric.ed.gov/fulltext/EJ1167310.pdf

Mellahi, K. (2000). Human resource development through vocational education in Gulf Cooperation Countries: The case of Saudi Arabia. *Journal of Vocational Education and Training, 52*(2), 329-344. doi:10.1080/13636820000200119

Saudi Arabia. (2021). *Vision 2030 Laying the foundation of our future.* Retrieved September 15, 2021, from Saudi Arabia: https://www.vision2030.gov.sa/

Sobral, S. R. (2021). Flipped classrooms for introductory computer programming courses. *International Journal of Information and Education Technology, 11*(4), 178-183. doi:10.18178/ijiet.2021.11.4.1508

Ullah, Z., Lajis, A., Jamjoom, M., Altalhi, A. H., Shah, J., & Saleem, F. (2019). A rule-based method for cognitive competency assessment in computer programming using Bloom's taxonomy. *IEEE Access, 7*(May), 64663-64675. doi:10.1109/ACCESS.2019.2916979

Ullah, Z., Lajis, A., Jamjoom, M., Altalhi, A., Al-Ghamdi, A., & Saleem, F. (2018). The effect of automatic assessment on novice programming: Strengths and limitations of existing systems. *Computer Applications in Engineering Education, 26*(6), 2328-2341. doi:10.1002/cae.21974

Zualkernan, I. A., Allert, J., & Qadah, G. Z. (2006). Learning styles of computer programming students: a Middle Eastern and American comparison. *IEEE Transactions on Education, 49*(4), 443-450. doi:10.1109/TE.2006.882366

Faisal Alharthi
Ministry of Education,
Saudi Arabia
faisal.t.alharthi@gmail.com
ORCID 0009-0000-2941-0159