# DIGITAL STEM: MODERNISING EDUCATION

**Roxanne Boodhoo**
Research student

**Theme of the Article:** Digital STEM Education

**Research Objectives:** to investigate the lack of computational science training in teacher education programs, with a specific focus on learning to program calculators. The method involved analysing the current education system in the UK, particularly looking at the availability of computer-based activities and resources for teachers.

## BIO

**Roxanne Boodhoo** is an accomplished professional with a diverse and versatile background. Her extensive academic training has equipped her with a wide range of skills and knowledge, enabling her to excel in various roles. Roxanne is known for her strong work ethic, diligence, and commitment to undertaking any responsibilities assigned to her. She is deeply passionate about helping and supporting others, making her a compassionate and empathetic individual. Throughout her career, Roxanne has consistently demonstrated a dedication to making a positive impact, whether through her professional work or community involvement, striving to uplift those around her.

## Abstract

This study aims to investigate the lack of computational science training in teacher education programs, with a specific focus on learning to program calculators. The method involved analysing the current education system in the UK, particularly looking at the availability of computer-based activities and resources for teachers. Results indicate that only a small percentage of teachers have a background in contemporary computational science, and even fewer have proficiency in foreign languages. This lack of training filters down to students, impacting their learning experience. The study highlights the importance of incorporating computational science into teacher training programs, especially at Key Stage 4 (KS4) where curriculum content overlaps

with computer science. Furthermore, the focus on STEM subjects in the UK educational system may contribute to the siloing of subjects, with an emphasis on science, technology, engineering, and mathematics.

The conclusion emphasises the need for a modern approach to education, focusing on new instructional materials and technologies that go beyond traditional integrated science. The Digital Technologies Education community is identified as a valuable resource for developing modern standards and curricula to address the gaps in STEM education. By bridging the gap between traditional subjects and contemporary technology, educators can better prepare students for the future.

***Keywords:***

STEM, UK, Education, Technology, Digital

## 1.0 Introduction

In the European context, STEM (formerly called the nature) education was first defined as a cohesive subject that integrated science, technology, engineering, and mathematics. Later, after science, technology, engineering, and mathematics were redefined, crossing each discipline and teaching related human behaviour art such as music and art, the STEM education of the United States began to explore the human behaviour field of education itself, as shown in Figure 1. Although there are differences in the definition of the meaning of STEM education, all existing definitions consider the development of human resources as the overall goal of STEM education.

Considering the fact that STEM education refers to improved unith muti-disciplinary achievement including education in the 21st century education, within the natural and human sciences, and, perhaps, other fields representing other fields and integrating into (PA) centric multi-disciplines, for the purpose of this study, STEM education refers to the position of relevant disciplines within (PA) centric, nature and human sciences areas. Digitalisation of the teaching process or other aspects has been considered already since the early 1970s, but the main battle for Digitalisation started and became accessible to civil society, for instance, from the 1980s, with the personal computer to the World Wide Web (Su et al., 2022).

Extensive research has established the importance of STEM education in (target) and its cultivation of 21st century top talents. However, the knowledge and skills advocated by current STEM education seem insufficient for this purpose. Therefore, none of these aspects alone can represent the true content of natural science scientific literacy. To balance these two aspects, i.e., the optimisation of the internal structure of natural science scientific literacy and the intervention of digital innovation consciousness, natural science education needs to integrate more diversified and more closely related to reality knowledge and skills (Borovský et al., 2023). The general appearance of new educational technolo-

gies is expected to greatly influence teaching and learning processes, goals, and strategies, determinants of change in schools and museum learning places, knowledge counselling services, in-service teacher professional development, and teacher education approaches. Like other educational technologies, digital educational technologies and related practices have embedded pedagogical assumptions that guide design and use. Educational technologies, especially digital educational technologies, consist of a multitude of specific types, each amounting to diverse practical opportunities, influencing resulting change patterns. Most technologies focus on communication and help to perform societal activities, such as meeting friends and family in video calls, booking travels, and work tasks.

In the proposed IQbl, since it is a combination of a traditional LMS and a digital portfolio, every teacher that gets engaged will have the opportunity to create and manage digital educational resources, open and manage digital spaces for students, in order to create and manage digital student work, monitor the digitised evaluation, etc. Teachers will also have to assign digital personalised feedback, plan educational resources, learning activities, evaluation tools, communication mechanisms, adaptive paths, in a collaborative acquisition of participatory learning. Furthermore, teachers may be able to create and assign exercises about ordered and unordered lists, coordinates and simple plane geometric figures useful for a flipped classroom model. Moreover, there will be a module available to monitor and foment the usage of MOOCs in each class. This will be linked to the room with MOOCs in Micel, in order to have immediate access to the MOOC that a teacher would like to have the students follow. The availability of a digital portfolio can encourage students, teachers and families to participate in the learning process.

STEM education is facing challenges of evolving rapidly so as to cover the revolution of industry 4.0 and related issues. As a result, schools redesign their STEM curriculum by designing new activities for engineering and technology. In this context, information and communication technologies should be regarded as tools in support of innovative educational methods able to foster an integrated approach to Science, Technology, Engineering and Maths (STEM), since ICT tools may provide resources not only for teaching but also for learning the main STEM concepts (Selim, 2021).

## 1.1 Aim

The aim of the research study is to develop and assess a learning environment that assists teachers in creating digital STEM learning paths aligned with the updated national curriculum. This will involve educators working with students to modify and enhance current learning paths related to engineering, emphasising the interdisciplinary link between science and technology. Teachers will be spurred to incorporate technology into their lessons, enabling them to produce and oversee digital teaching materials, tailor learning paths and digital resources to individual student learning preferences, and recommend MOOCs digital educational resources beneficial for a flipped classroom approach.

## 2.0 Methodology

The methodology for conducting this research study involved an investigation into the role of teachers in effectively utilising digital technologies for learning. One key aspect that was considered was the various obstacles that teachers faced, including balancing multiple roles and responsibilities within their profession. These roles included teaching in physical or digital spaces, managing communication with colleagues and students, organising classes and digital activities, and staying updated on new technologies. The study also explored how these new responsibilities impacted teaching practices, motivation, and creativity. For example, teachers struggled with learning new technologies, addressing connectivity issues, ensuring privacy and digital security, and managing their time effectively.

Additionally, the research focused on how digital technologies could be used to transform traditional teaching methods into more engaging practices that promoted deeper understanding and active student involvement. This included implementing a digital STEM mediation model that encouraged critical thinking, creativity, and autonomy in using digital tools. Furthermore, the study investigated the importance of restructuring curricula, didactic materials, and teacher training to support the effective use of digital technologies in education. This included promoting respect for students' ideas and individual skills while fostering a culture of learning and collaboration in a digital society.

## 3.0 Results and Discussion

### 3.1 Teaching

The teacher has a decisive role in the effective use of digital technologies. Moreover, the teaching work poses several obstacles in this regard. The first one is the conflict between various roles with numerous responsibilities, all united in the educator's profile (Rivera-Vargas & Cobo, 2023). For example, teaching must be done in the same, if physical/digital, space in which learning happens and also manages the communication and relationships with co-workers and students as well as those in the extracurricular world. To all this is added the management of classes, as well as laboratory and digital activities, whose organisation can be very heavy. Digital technologies can represent an extra challenge and a solution but these new responsibilities change the practices hitherto identified as effective and can undermine the motivation, improvement and creativity of the teacher. Just think of the extra time spent learning new technologies, starting work,

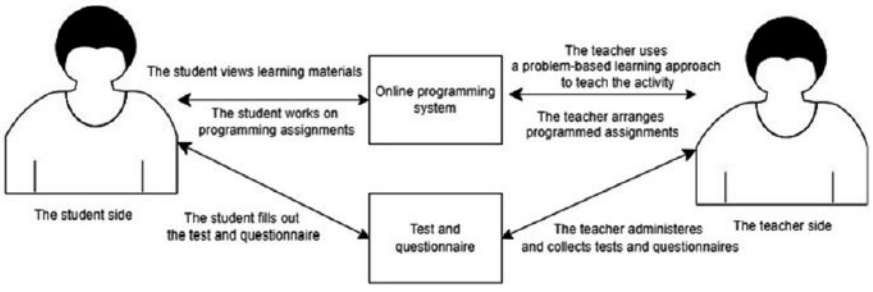


*Fig 1. (Su, Y., et al, 2022)*

solving problems with the connectivity, privacy constraints, taking care of the digital security of students. Figure 1 depicts the online programming system and the problem-based learning approach for STEM programming administrators.

### 3.2 Digital Technologies

Digital technologies offers the privileged occasion to revamp traditional didactics into stimulating practices that actively involve students and aim for a deeper understanding of concepts and relations. In order to change schooling methods and promote a cultural change, capable of spurring the transition towards a digital society in which people focus on learning and constructive coexistence with others and nature while embracing global challenges, an encompassing digital STEM mediation model1 is essential (Borovský et al., 2023). To this end, rather than only providing the tools for specific pedagogical insights, it is necessary to renew the structure of curricula and didactic materials and, above all, to form teachers who are able to critically, creatively and autonomously use digital technologies in their daily practice, as well as to promote the development of respect for students' ideas and individual skills (Marín-Marín et al., 2021).

### 3.3 Computer modelling

In addition, the general course structure and relevant and adequate school scientific background are to be thoroughly presented. Chronologically, carrying out experimental work (Etkind et al., 2008) is one of the main principles in teaching methods and that is confirmed in the developed concept of distance learning. Computer modelling with the use of a method of minimal mathematical model can be an indispensable tool to achieve this goal. The mechanism of the number of different breeding programs for separation completely distinguishes various withdrawal families of barley and the Indian hen population (Xuan Quang et al., 2015). Results of the modelling allow to estimate success of a method of group selection of barley and other selection indices of animals. Variability of a frequency of elite genes changed with increasing of the number of the used markers of the DNA which are located in close proximity as well as recombination frequency of unlinked loci and number of phenotypic traits.

The crisis of 2020 forced education to develop new digital forms, among them digital pedagogy in the sphere of STEM education (Ipek & Ziatdinov, 2018). The technology caused not only a change in the school teaching process, but also led to promoting mathematical and scientific thinking, increasing the motivation and interest of school youth in science: the victories at various All-Russian Olympiads prove it. The hygienic and epidemiologic restrictions caused by the virus did not allow for holding traditional laboratory classes and students' individual problems solving (Somani, 2021). Therefore, the authors had to develop a new course for a distant learning process at the basic level, and a model of a hybrid course, "Digital and computer means in biology", distinguishing the laboratory work parts and obtained data processing, as well as the activation of independent work (individually or

in groups) with the use of simulation modelling in the scientific-investigational (research) mode. The main aspect of the experimental work is computer training of the research activities for a teacher and for a learner at a particular subject.

## 4.0 Conclusion

The research sought to categorise the direction of this research and to understand what "modernisation" of STEM education means in practice. The research responses bolstered the importance of digital tools to transform education for a modern world. In line with this, the data shared were approximately four times more likely to include references to tools and technologies than they were to mention curriculum. When references to curriculum were made, they were often in relation to finding a balance within the curriculum and to identify the areas most suitable to the modernisation provided by the digital tools and technologies. At the same time, 62% of the data mentioned practices in society and technology. These references to the social nature of the practices, the idea that students need additional skills and the transfer of learning between school and society, underscore the importance of society for modernisation.

As we have seen, the education landscape is changing (Rivera-Vargas & Cobo, 2023) (Marín-Marín et al., 2021). This digital transformation is impacting every aspect of the industry, and the fields of science, technology, engineering, and mathematics (STEM) are no exception. STEM education and the delivery of these subjects are under strain to maintain both curriculum coverage and student engagement.

With digital and computational technologies becoming central in the economy, in society and in most areas of STEM, the delivery of these subjects has become unmoored from incompatible traditional foundations, sports and media effects. As such, there is a clamour for educational reform, with educators keen to adopt digital and computational technologies in order to "modernise" STEM education. At the same time, many researchers in the areas of education technology and human–computer interaction are keen to define exactly what "modernisation" should look like.

## References


**Borovský, D., Hanč, J., & Hančová, M. (2023).** Scientific Computing with Open SageMath not only for Physics Education. [PDF]

**Ipek, I. & Ziatdinov, R. (2018).** New Approaches and Trends in the Philosophy of Educational Technology for Learning and Teaching Environments. [PDF]

**Marín-Marín, J. A., Moreno-Guerrero, A. J., Dúo-Terrón, P., & López-Belmonte, J. (2021).** STEAM in education: a bibliometric analysis of performance and co-words in Web of Science. ncbi.nlm.nih.gov

**Pllana, S., Huber, F., Hrdlicka, Z., Mettouris, C., Veber, A., Ocsovszky, Z., Gary, C., Boulomyti, E., & Smith, P. (2016).** SciChallenge: Using Student-Generated Content and Contests to Enhance the Interest for Science Education and Careers. [PDF]

**Rivera-Vargas, P. & Cobo,**

**C. (2023).** Digital learning: distraction or default for the future. osf.io

**Rose Stringer, L., Maree Lee, K., Sturm, S., & Giacaman, N. (2022).** A systematic review of primary school teachers' experiences with digital technologies curricula. ncbi.nlm.nih.gov

**Selim, F. (2021).** Connecting science fundamentals and career proficiency -- Development of multi-disciplinary science curriculum. [PDF]

**Somani, P. (2021).** The Role of Education During and After COVID-19. The Journal of Social Sciences Studies and Research, 34-40 1(1).

**Su, Y. S., Chang, C. Y., Wang, C. H., & Lai, C. F. (2022).** A study of students' learning perceptions and behaviors in remote STEM programming education. ncbi.nlm.nih.gov

**Xuan Quang, L., Huy Hoang, L., Dinh Chuan, V., Hoai Nam, N., Thi Tu Anh, N., & Thi Hong Nhung, V. (2015).** Integrated Science, Technology, Engineering and Mathematics (STEM) Education through Active Experience of Designing Technical Toys in Vietnamese Schools. [PDF]