Serious Gaming & Computational Thinking – An Introduction in the UK

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The concept of 'serious games' was first introduced by the researcher Clark C. Abt in his book *Serious Games* (Abt, 1970). Abt proposed the concept that simulations and games can improve education in the classroom. The definition of the 'Serious Game' has been updated many times since 1970. In his white paper Serious Games Initiative , Ben Sawyer linked serious games with the connection between a serious purpose and the knowledge and technology now present in the video game industry (Ahrens, 2015).

In their work, *A serious game for developing computational thinking and learning introductory computer programming*, Kazimoglu et al. put forward the design of an innovative educational game framework focused on the development of Computational Thinking (CT) skills (Kazimoglu et al., 2012). They propose a new strategy to encourage the improvement of teaching and learning of introductory computer programming through the use of video games as a platform to teach and learn from in some cases.

Through this they strive to improve on the education of development of CT skills in children and young people of primary and secondary school age. Developing skill in children to enable them to think in a different perspective such as fostering CT to boost economic growth, fill job vacancies in ICT and prepare for employment.

The National Curriculum in England (Department for Education, 2013) states that '*A high-quality computing education equips pupils to use computational thinking and creativity to understand and change the world.'* They also emphasise that computing has deep connections with mathematics, science and design and technology and provides insights into both natural and artificial systems. The core of computing is computer science, in which pupils are taught the principles of information and computation, how it all works and how to apply this knowledge to use through programming.

However, there is a shortage in fully trained teachers when it comes to the study in computing and therefore in some cases there is only one teacher per school assigned with the task of delivering CT classes. The survey also found that most teachers primarily responsible for CT also teach other subjects, such as business studies and mathematics. These teachers also need support in order to adapt. They require high-quality CPD (continuing Professional Development), therefore training is a must in order to increase their

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knowledge of CT while they also need to acquire experience in teaching the subject.

Although at present 70% of students in England attend schools that offer GCSE computer science, 11% of those students actually enrolled in the school's computer science classes (Department for Education, 2013).

Another issue highlighted by the Royal Society Report (After the reboot: Computing education in UK schools, 2017), are the gender issues in relation to the study and workforce of computing. CT is a male dominated subject throughout the UK. With an uptake of 20% from girls at GCSE, and only a 9% uptake from girls at A level, there is an imbalance that has remained unchanged for several years. The government must work closely together with teaching institutions and employers to find innovative ways to tackle this matter. As part of the progress made, the amount of £2.4 million of government money was allocated to fund for a greater gender balance when it comes to qualifications and study of computing in schools.

As computational thinking aims to create an area where digital technologies and other areas of study such as Arts and Humanities can interconnect effectively, an example of this would showcase one instance with the development of a video game by two UK students aged 13–14 (de Paula et al., 2018). 'Playing Beowulf' was produced in collaboration with the British library and the DARE centre (University College London Institute of Education/Knowledge Lab) in an inner-London school as part of the British Library's Young Researchers programme, using Mission Maker (a software developed at UCL Knowledge Lab). The first-person 3D game was a project funded by the Arts and Humanities Research Council with the aim of promoting *'further engagement with epic Anglo-Saxon poem Beowulf by bringing together a thousand year old text, digital technologies and new means of creative expression.*' This poem was chosen due to its medieval fantasy narrative, quite popular in the video game culture. It should also be noted that this particular concept was chosen because it gives the perfect circumstances for implementing algorithmic loops: the sudden appearance of monsters, the fight starts, rewards are collected by the hero. From a CT perspective, the game showcases several patterns, such as coherent game mechanics and some more complex features in coding, like the use of Boolean Operators (formed from the basis of mathematical sets and database logic).

With this case study, it is shown that CT can successfully be integrated into linking subjects, such as mathematics. ScratchMaths project also provides a good example, developed by University College London and funded by the Educational

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Endowment Foundation, which further explores the way students engage with mathematics through coding ("UCL ScratchMaths", 2021). The project aims to demonstrate that during a CT lesson, students can learn how the brain functions, while learning computer science concepts at the same time.

To support teachers providing CPD classes, a tool guide for teachers is offered by Discovery Education Community who are a global network of teachers and education professionals passionate about enhancing the learning experience of their students ("Discovery Education | Your Daily Learning Platform", 2021). To achieve this, they take the approach of using digital media in order to connect members across the UK and around the world. The main goals of the Discovery Education Community are: to strengthen the way teachers teach and students learn, and to add meaning and relevance to the school curriculum. This in turn helping students and teachers to reach their potential. The Discovery Education Coding focuses on providing support for teaching coding to students in primary schools. This ensuring that pupils acquire a *'secure understanding of coding concepts like algorithms, sequences and variables – as well as developing computational thinking skills the decomposition, logical reasoning and problem-solving'*, this allowing both students and teachers to enhance their creativity through the creation of their own apps and by sharing with peers. Offering: Guided lessons, video tutorials, interactive resources for students, social media support, virtual conferences, and face to face events.

Aspire-igen undertook a survey of 20 UK students aged 12-15 years of age (12 males and 8 females). Overall, students reported that they enjoy playing educational games that include problem solving activities related to mathematics. Just under half of them reported spending more than 8 hours per week playing. In addition to this, most of the participants stated they prefer the games that are challenging and therefore learn more effectively when playing these educational games if they already have some pre-existing knowledge. They also stated that receiving feedback on their actions in-game helps them to progress and understand better. Furthermore, most of the students feel they can understand a subject being taught to them if they can experiment with the ideas that are presented to them and feel more engaged in the games when using prior knowledge about the game's story and world to solve problems as well. Adding onto this, most participants feel they are more engaged in the game if the rewards/bonuses are adjusted to the difficulty of the performance.

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