

STEAM Games Are Good for Learning: A Study of Teacher Professional Development in the Philippines.

JANE HUNTER

University of Technology Sydney
jane.hunter@uts.edu.au

TERRY FITZGERALD

University of Technology Sydney
terry.fitzgerald@uts.edu.au

In a study on digital game-based learning in five high-poverty elementary schools in the Philippines, the teachers' professional development experiences were investigated. Research conducted for the study was part of a university-industry partnership with the developer of a new platform designed to give teachers and students experience of integrated Science, Technology, Engineering, Arts and Mathematics (STEAM) curriculum in an innovative digital game-based format with elements of coding, robotics and project-based learning. Findings suggest that teachers found it highly effective for engaging students more in learning, with fewer student absentees recorded across the five-week intervention. While noteworthy satisfaction with the program was expressed by teachers about the in-class effectiveness of digital game-based learning, and with the professional learning provided to up-skill themselves in the platform prior to implementation of the program, it was found that significant contextual and language improvements could enhance the overarching aims of this digital game-based resource for STEAM teaching and learning.

Keywords: digital game-based learning, student engagement, teacher professional development, STEAM, creativity

INTRODUCTION

The phrase in the title of this paper, *games are good for learning*, conjures up Professor James Gee's (2003, 2004, 2005) renowned scholarship on video games, literacy and learning. Some scholars argue that games are, first and foremost, learning systems and that this accounts for the sense of engagement and entertainment in the player's experience (Squire, 2012). Digital game-based learning (DGBL) supports learning through play and is designed to create a complex problem space or world that players come to understand through self-directed exploration. Its meta-game and quest systems are designed to deliver just-in-time learning and use data to help players understand how they are doing, what they need to work on, and where they should go next. Games create for players a compelling need to examine, assimilate and master specific skills and content areas (Steinkuehler, Squire, & Barab, 2012).

An important part of DGBL activities in school education is to understand how teachers use them in classrooms. Over the past two decades, the (almost) exponential growth in hardware device capabilities, combined with a relative decrease in costs and the now-ubiquitous availability of wi-fi, has provided the infrastructure needed for teachers to use DGBL in their classrooms. A 2013 study conducted by the Joan Ganz Cooney Centre at Sesame Workshop (Takeuchi & Vaala, 2014) surveyed 700 K–8 teachers in the United States to explore how they used digital games in the classroom. Nearly 75% of these K–8 teachers reported using digital games for instruction, with 55% saying their students played at least weekly. Teachers using DGBL activities reported the use of these games to deliver content mandated by local (43%) and state/national curriculum standards (41%), and to assess students on supplemental (33%) and core knowledge (29%) (p. 5).

While some school teachers consider that DGBL activities foster the development of 21st Century skills, others focus on the need for games to cover mandated content areas (Osterweil & Klopfer, 2011). Various commentators (for example, McGowan, 2019) argue that some 65% of jobs that our current students will have as adults do not yet exist, and these jobs will predominantly require non-routine cognitive skills (Heath, 2017). Another challenge for teachers in schools is how they might prepare students for jobs that have not yet been created, to tackle societal challenges that they cannot yet imagine, and to use technologies that have not yet been invented. Education systems around the world recognize this challenge and are increasingly investing in technology programs and digital curricula that pay close attention to technology-enhanced learning in school-based education that moves beyond 'edutainment' (Hunter, 2015). Accompanying this focus is better re-

sourcing and ongoing support of teacher professional development (PD) in new technologies. Despite it being necessary, teacher PD is very often ‘one-off’ and not sustained due to the technological world moving quickly and apps, devices and hardware soon becoming obsolete (Hamari et al., 2016; Netolicky, 2020; Southgate et al., 2019).

THE STUDY

This research study of a five-week DGBL intervention was conducted in five elementary schools in a large city in the Philippines. It is testament to the desire of one technology company (here called ‘Steamers Education’) to create better DGBL tools for students to use in the content areas of Science, Technology, Engineering, Arts and Mathematics (STEAM) and provide well-targeted interactions for the development of their 21st Century skills, in particular, critical thinking, problem solving, and creativity (P21 Network, 2019). Equally, the study sought to understand what worked well and where improvements to teacher professional support for DGBL using an online software program might be made after intervention. Through seven online focus groups, a university-based researcher examined the professional learning experiences of teachers (N=15) from the five schools. Additionally, data were collected in a series of surveys administered by the company but assessed by the authors; there is not space here to report these data in detail.

All, Castellar, and Van Looy’s (2015) conceptual framework for assessing the effectiveness of DGBL informed the data collection and was applied to the collated data prior to analysis. This conceptual framework for DGBL comprises three categories – learning, motivational, and efficiency outcomes – with each category serving as lens through which to view the data in order to respond to the main research question of the study:

How can a DGBL platform focused on STEAM support teachers of students in high-poverty schools to teach these disciplines, develop 21st Century skills, and experience success in project-based learning?

Two sub-questions underpinned the overarching research question:

1. What were teachers’ perceptions of the PD they received prior to and during implementation of the program?
2. What significant recommendations would teachers make to improve both their professional learning experiences and the opportunities for DGBL in elementary school classrooms?

In this paper the names of technology company (here ‘Steamers Education’), the DGBL platform (‘Steamers’), the schools and teachers, and all participants in the study design are given pseudonyms. The research was approved by the University of Technology Sydney, Human Research Ethics Committee, Approval No. ETH19 - 4070.

Although elementary school enrolment reached 100% in the Philippines in 1970s, and today in Manila, for example, almost all elementary students’ complete school, there are significant regional variations. In some areas, less than 30% of students finish school. Filipino adults have high literacy rates and most, if not all, can speak and read English. Despite this, however, poverty levels in the Philippines remain disproportionately high and income disparity has been reported as the highest in Asia (Pennington, 2017). It is for this reason and because of the physical and economic location of the schools that the term *high poverty* is used to describe the socio-economic context for the study. Funding for the DGBL platform and the associated PD was provided to each school by the local education authority as part of a broader Philippines government STEAM grants initiative.

FINDINGS

After using the Steamers DGBL platform, all focus group participants spoke about the high-calibre knowledge of the Steamers Education instructors and the materials they engaged with prior to the five-week in-class intervention. For example, one teacher said:

I attended the training ... the Steamers Education people imparted their knowledge. As trainers they were are well prepared and made sure we knew how to use the game properly ... any issues we had were immediately addressed. (Teacher 4)

A few teachers spoke about how the training had acted to reinforce their passion for teaching and what it means to be a professional:

I have been feeling quite lost as a teacher but using Steamers and a lot more technology means I am feeling enthusiastic again. (Teacher 6)

We were using fairly basic technology like PowerPoint up until recently. Using Steamers means we can now teach in a different way ... the pupils are so much more involved in the teaching and learning process ... the game-based approach really enhanced what I can do as teacher in the

classroom. For me at first it was difficult but later it was exciting ... so much so that I downloaded it to be able to play at home on my computer. (Teacher 1)

While there was strong endorsement from teachers for developing 21st Century skills in the PD program, they frequently suggested points of enhancement such as the technology developers needing a better sense of what was important for creativity, problem solving, critical thinking, and teamwork in school education contexts. Recommendations for improvements were noted in tandem with requests for localized content in the DGBL platform (60% of teachers). The following remark was typical:

The DGBL experience is a breath of fresh air to not just be sitting down and following a text please but please make it localized ... if students can see their local context it will bring them in more ... it is important that they can relate what they are learning to their local environment. (Teacher 5)

Accompanying this endorsement, 80% of teachers asked for more PD because it was vital for ensuring that their teaching and learning with new technologies remained relevant. This sentiment is echoed in the following comment:

The training and then doing the work in the classroom have helped me to learn about coding, robotics and how games can make learning fun. Two hours was not enough. I now want more training to learn how to better integrate other subjects like the Arts not just Science. Young people know how to use computers ... the pupils know this, so we have to keep up our learning at the same time. (Teacher 8)

Commentary on the development of 21st Century skills arose throughout the focus group discussions and in survey data (as mentioned earlier but not reported here). Teachers noted improvements in students' research skills, but it was difficult to link this back solely to the DGBL experience. However, the teachers (100% agreement) believed "it was a huge motivator." This comment from a teacher was typical of the excitement of the PD experience and what it meant for schools in the STEAM grants program:

It was exciting to introduce coding to public schools in our country as it's seen as something private schools do. It is the first time public elementary schools have done this ... when I saw it could be done at elementary school, I was like ... wow – it was new to the learners and when they go

to higher grades, they will understand the various programming knowledges. (Teacher 10)

DISCUSSION/IMPLICATIONS

Over recent years, governments and education jurisdictions globally have been investing significant resources into the teaching of STEM (without the A) in elementary schools, yet there is increasing evidence that STEAM, with the addition of the Arts, is essential for teaching the STEM disciplines effectively, as teachers quite naturally integrate the Arts when focusing on the other four disciplines (McDonald, Hunter, Wise, & Fraser, 2019).

Teacher perceptions of Steamers as a learning resource to teach robotics and the coding aspects of STEAM were mentioned often in the focus groups, with the Arts aspect related to students' "personalization of avatars." Significantly, some teachers commented that they had not previously witnessed such positive responses to the subject matter of STEAM. Their students' renewed interest in learning in these subjects also motivated these teachers to maintain their own learning at the same level, especially coding and programming skills (Hunter, 2015). Every teacher in this study recommended Steamers as a useful teaching resource for elementary schools. They had embraced the opportunity to try something different in their classrooms, and their students responded positively.

As a resource to develop 21st Century skills, Steamers' most effective role was to ignite student engagement in creativity and design thinking using a digital game; this was followed by greater motivation for digital literacy, technology skills, and problem solving. Specific lessons taught over the five weeks involved personalised avatar creation, robotics and coding, and a unit of work on matter and properties. In the focus groups, teachers frequently referred to growth in students' self-esteem and confidence. New pedagogies such as those afforded through Steamers allow for the boosting of student self-efficacy to develop personal agency. This point is congruent with Dweck's (2017) work in the field of 'growth mindset'. It is worth noting that students in the study had no access to computers outside what was provided at the schools.

The study revealed great satisfaction with the PD programs delivered by the team from Steamers Education. While participating teachers expressed overt delight with the training they received, they also said there was scope for strengthening teachers' experiences with DGBL for STEAM. Skills learned in each PD session were valuable for improving professional

growth and developing teaching proficiencies, with some teachers speaking of how their sense of professionalism was reignited. Using dashboards in a digital game, creating avatars, and gaining confidence in basic Scratch coding were typical of these new skills.

When asked about whether the PD program improved their teaching of STEAM lessons in robotics and coding, or the setting up of project-based experiences, most teachers agreed it developed their proficiencies. In particular, their knowledge of robotics and coding grew, as these were new competences that they had had limited or no experience of previously. Integration and alignment of STEAM with core concepts in their school context were more of a challenge, however. Teachers spoke about wanting the DGBL resources for students in the younger years to be provided in the local language and the content in the platform to be more locally aligned; for example, in the study of natural disasters, typhoons could be included rather than volcanic eruptions, as the former are phenomena students can relate to.

Education research has demonstrated that ongoing PD as a subset of long-term teacher professional learning is desirable (Bybee, 2018; Hudson, English, Dawes, King, & Baker, 2015). Schools require sustained commitment and resourcing in the form of allocated funds for initial and refresher courses to support the creation of robust teacher professional learning communities (Hunter, 2017). There are many global examples of online networks that link teachers, enable their ongoing conversations, and assist with questions or concerns that arise along the way. Networks such as Teach For All (<https://teachforall.org/>) are especially important when new skills or curricula are being rehearsed and taught.

While this small-scale, five-week intervention study was limited in scope, it has prompted a number of recommendations for future trials of the program. For example, classroom observations and the development of more comprehensive survey instruments might strengthen and extend research into teacher and student perceptions of DGBL more broadly. As well, the class teachers themselves could be involved in future iterations of the DGBL activities so that they are aligned with local contexts and the latest curricula. And at the classroom level, educational jurisdictions could improve teacher dashboards and student-computer ratios.

This study found that the DGBL activities offered by Steamers allowed participating teachers to alter their usual teaching practices and, in most cases, enthusiastically up-skill themselves in STEAM concepts like coding and robotics, which were areas of the curriculum they had never imagined embracing. Throughout their conversations with the first author there was a palpable sense of renewed professionalism and personal growth through this DGBL experience. In countries like the Philippines, and particularly in

high-poverty urbanized school communities, changes to pedagogy can be supported when jurisdictions allocate scarce resources well; it seems that partnerships between industries and universities can offer ongoing encouragement for this.

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