Routledge
Taylor & Francis Group

Education 3-13

International Journal of Primary, Elementary and Early Years Education

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rett20

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To cite this article: Kate Hoskins, Asma Lebbakhar & Mike Watts (09 Oct 2024): ‘It hooks them in, it’s straight in there’: leveraging game culture for learning in the Key Stage 2 science curriculum, Education 3-13, DOI: 10.1080/03004279.2024.2402050

To link to this article: https://doi.org/10.1080/03004279.2024.2402050

Published online: 09 Oct 2024.

EDUCATION 3-13
https://doi.org/10.1080/03004279.2024.2402050

'It hooks them in, it's straight in there': leveraging game culture for learning in the Key Stage 2 science curriculum

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ABSTRACT

Engagement with game culture is an important component of young peoples' lives yet little is known about the potential of drawing on this culture in the primary classroom science curriculum to improve engagement across diverse socio-economic cohorts. Therefore, the aim of the study was to understand the engagement potential of the distinct pedagogy of Checkpoint Magazine's prepared lesson materials for Key Stage 2 Science, and to evaluate feedback on any perceived enhanced classroom learning that takes place. Using mixed methods, five teachers from four schools delivered a Key Stage 2 science lesson on classification. The teachers were interviewed, and we gathered questionnaire data from most of the children who participated in the lesson in each school. The findings were positive with both teachers and children reporting increased enjoyment and engagement with the learning process. The outcomes of this project have the potential to deliver more inclusive learning for young people.

ARTICLE HISTORY
Received 5 June 2024
Accepted 30 August 2024

KEYWORDS
Game culture; Sonic; Key Stage 2; science; curriculum

Introduction

Many parents in the global north and south will have observed the importance of video gaming in their child's lives. Research confirms that in the past two decades there has been a marked increase in children's time spent on gaming activities with children aged 812 typically spending 5.5 h per day gaming (Common Sense Media 2022). This study uses Yosso's (2005) theory of cultural wealth to explore how gaming culture, as a significant aspect of young people's cultural wealth, can be integrated into the primary science curriculum to enhance learning engagement across diverse cultural and socio-economic student cohorts. This study confirms that engagement with game culture is an important component of young peoples' lives, and yet little is known about the potential of drawing on this culture in the primary-level science curriculum to improve learning engagement across diverse cultural and socio-economic student cohorts.

Given the importance of Science, Technology, Engineering and Mathematics (STEM) for future labour market growth (REDACTED) Checkpoint Magazine developed a Key Stage 2 science lesson to support engagement. Checkpoint Magazine is an interactive digital magazine dedicated to creating educational resources that blend the interest of video games with learning (Checkpoint 2021). They work closely with schools and universities to design materials that make diverse school subjects more engaging for children. They incorporate popular video game elements in educational resources to help teachers deliver lessons in a way that enhances students' engagement and makes learning more interactive and enjoyable.

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Key Stage 2 (years 3–6) is the second stage of primary education in England for children aged 7–11 and aims to foster their understanding of scientific concepts and develop essential scientific skills (DfE 2013). The aim was to understand the engagement potential of the distinct pedagogy of Checkpoint's prepared lesson materials for Key Stage 2 Science, and to evaluate feedback on any perceived enhanced classroom learning that takes place. The following research questions were addressed:

- What is the 'engagement value-add' of Checkpoint Learning Materials (CLM)?
- How do Checkpoint Learning Materials (CLM) enhance student engagement in Key Stage 2 science lessons?

Using a mixed method inquiry, research was conducted with five classroom teachers in four schools who delivered a prepared Key Stage 2 science lesson on classification. We also gathered questionnaire data from most of the children who participated in the lesson in each school. The findings were overwhelmingly positive from students and teachers alike with both groups reporting increased enjoyment and engagement with the learning process. Indeed, leveraging students' cultural wealth (Yosso 2005), such as their familiarity and engagement with game culture, teachers can create more relevant and motivating learning experiences. Thus, we argue here that the outcomes from this project have the potential to deliver better learning outcomes to more schools and centres of learning for young people.

Background

Game culture has become an integral part of many children's lives, as videogames have progressed from an occasional activity to a mainstream form of entertainment (Hamlen 2011). The concept of game culture refers to a blend of actions, attitudes, and implicit rules that all video gamers accept and enjoy, as discussed in the following section. Yosso's (2005) theory of cultural wealth highlights the various forms of culture that marginalised communities possess, including social, linguistic, and familial. In this context, game culture can therefore be seen as a form of cultural wealth that students bring to the classroom, which can be leveraged to enhance learning.

Children often dedicate a considerable amount of time to playing videogames, with some studies estimating that the average young person accumulates more than 10,000 h of gaming by the age of 21 (McGonigal 2011). According to a recent report by Ofcom (2023), the UK's communications regulator, nine out of 10 children play videogames. This figure includes both primary and secondary school-aged children with many spending several hours per week on this activity. Therefore, the concept of gaming culture has evolved alongside the growing integration of videogames into mainstream culture over time (Hewett 2022). The widespread popularity of videogames can be attributed to several factors, such as the immersive nature of gaming experiences, the increased sophistication and realism of game graphics, and the sense of achievement and emotional reward that games can provide (Vorderer, Klimmt, and Ritterfeld 2004).

Additionally, gaming culture has been further enhanced by the rise of online gaming, which provides young people the opportunity to connect with others around the world from diverse cultural contexts and engage in collaborative and competitive games (Granic, Lobel, and Engels 2014). As gaming culture has become increasingly prevalent in children's lives, teachers and researchers have begun to explore the potential educational benefits of videogames and their impact on learning (Gee 2007; Prensky 2003). Some studies have demonstrated that videogames can improve cognitive skills; such as problem-solving and critical thinking, as well as enhance motivation and engagement in learning (Adachi and Willoughby 2013; Wouters et al. 2013). This has led to a growing interest in understanding the elements of gaming culture that can be effectively incorporated into teaching and learning to create more engaging learning experiences for students (Kapp 2012). Indeed, the UK's Conservative government introduced a Videogames Research Framework

in May 2023 signalling the political commitment to better understand 'how videogames have impacted individuals, consumers, communities, industries and societies' (Rodden 2023).

This research started with an examination of the existing research on incorporating students' game culture in primary education, with a special focus on Key Stage 2 science lessons, without directly promoting the use of games in the classroom. However, viewing game culture through the lens of cultural wealth (Yosso 2005), the depth and breadth of how game culture could be integrated in formal learning and teaching environments as a valuable resource for educational engagement continue to evolve. Educational theorists and practitioners have long recognised the potential of games to foster engagement, motivation, and learning (Laine and Lindberg 2020; Yu, Gao, and Wang 2021; Zainuddin et al. 2020). The cognitive benefits related to gaming, such as enhanced problem-solving skills, critical thinking, and collaboration, align closely with educational objectives across the curriculum (Hewett 2022). Yet, the direct application of game culture to curriculum design and materials, particularly in core subjects like science, remains an area for further exploration. This emerging paradigm in educational research and practice focuses on the effective integration of game culture elements and features to enhance teaching and learning experiences.

Gee (2013) argues that games embody many of the features that teachers should seek out when designing educational resources, aligning with Yosso's (2005) notion that students bring valuable skills and knowledge from their cultural contexts. In addition, he emphasised that while games embodied many of these features, this was not meant as an invitation to teachers to turn classroom activities into games (Gee 2013). Integrating elements of gaming culture into science lessons can potentially enhance students' learning experience by addressing their interests, motivations, and diverse learning needs (Sung and Hwang 2013). This is relevant to our research, which focuses on how students used their game culture to access and engage with the content of science lesson on classification using characters from videogames featuring Sonic the Hedgehog.

Existing studies confirm that adaptive teaching can lead to more effective and engaging science lessons, as students are challenged at an appropriate level and receive support tailored to their specific learning needs (Pane et al. 2017). By incorporating a variety of instructional strategies found in videogames, such as differentiated instruction and flexible grouping, teachers can create a more inclusive and responsive learning environment that caters to the diverse needs and abilities of their students (Tomlinson 2014). Furthermore, personalised learning experiences can foster a sense of autonomy in students, as they are empowered to take ownership of their learning (Patall, Cooper, and Robinson 2008).

In the National Curriculum (DfE 2014), a common theme throughout is the encouragement of schools to develop a curriculum that is inclusive and acknowledges the varied backgrounds, cultures, and experiences of students. Recognising game culture as a form of cultural wealth aligns with this ethos, as it values students' lived experiences and incorporates their interests into the learning process. Given the imperative to consider students' backgrounds as prescribed by the National Curriculum (DFE 2014), it is important to recognise that these backgrounds encompass a wide range of cultural experiences, including game culture. Indeed, game culture has become an integral part of the mainstream culture (Gee 2013), due to its influence on young people's lives which is undeniable and profound. Therefore, in the same way that education strive to acknowledge and incorporate various cultural aspects into curriculum materials and course content, students' game culture deserves similar consideration and space in education. For example, the National Curriculum introduction (DfE 2014) often includes language about fostering pupils' understanding and appreciation for their own and different cultures. By extension, considering game culture as part of the mainstream culture falls well within this ethos.

Acknowledging game culture as a significant component of students' cultural wealth (Yosso 2005) not only acknowledges their experiences but also provides a relatable and familiar context that can enhance students' engagement and learning outcomes. Integrating elements of game culture into the curriculum supports educators to offer a more inclusive and representative educational experience that mirrors the diverse interests of their students. This approach aligns with

the broader educational goal (OECD 2023) of creating a curriculum that resonates with all students, thereby fostering a more engaging and meaningful learning environment. Incorporating elements of gaming culture into the curriculum can be seen as a way to recognise and utilise students' cultural wealth, making education more inclusive and relevant to their lives.

Game culture and education: the benefits

Incorporating Yosso's (2005) theory of cultural wealth into the educational benefits of game culture highlights how students' cultural experiences can enrich the learning environment. The concept of game culture refers to a blend of actions, attitudes, and implicit rules that all video gamers accept and enjoy (Carr and Pelletier 2009). That is, there is a shared appreciation within the group of the value of video games for the mutual experiences provided through engagement. Video games have the potential to draw young people together across the boundaries of diverse social class, gender and ethnic identities (REDACTED). Through engaging in game culture, children have the space to develop 'cognition i.e. problem solving and its meaning' alongside what it can tell us about 'life in a world that is increasingly globalised and networked' (Steinkuehler 2006, 101).

In terms of popularity, game culture has swept across the global north and south over the past two decades with children and young people increasingly engaged in a variety of massive multiplayer online games (MMOGs). The exponential increase in engagement with online gaming amongst young people has drawn criticism from parents, teachers and school leaders trying to manage the demands of formal education and the draw of MMOGs. However, Pearce (2006, 23) invites us to challenge and to 'question the assumption that games and play are unproductive'. She argues that video game play 'has its own productive character, which can also be seen as a form of cultural production and perhaps could be defined as a form of folk art' (Pearce 2006, 24). Viewing game culture through the lens of cultural wealth (Yosso 2005) allows us to see it as a valuable asset that students bring to their educational experiences. Paraskeva, Mysirlaki, and Papagianni (2010, 503) confirm that a balance is needed to ensure that educational games 'negotiate the intriguing conundrum of being interesting enough to engage students, without being addictive and thus detrimental to academic performance'. Viewed from these perspectives, game culture cannot be immediately overlooked purely as a leisure pursuit, rather, as a productive means of engaging in the digital world that has the potential to create a shared experience and become a culture of its own.

Furthermore, incorporating game culture into the classroom is a promising opportunity to improve pupil engagement and academic achievements. Gaming's universality as a cultural medium enables it to surpass conventional barriers in the classroom, creating an inclusive setting that recognises and accommodates varied learning methods (REDACTED). For example, the competitive and cooperative nature embedded in numerous gaming experiences aligns with educational objectives that aim to promote teamwork, resilience, and goal-setting (Christopoulos and Mystakidis 2023). Leveraging these aspects of cultural wealth (Yosso 2005) helps educators to create learning experiences that are not only instructive but also memorable for students, thereby enhancing their ability to remember and apply knowledge.

Additionally, game culture has the capacity to serve as a connection between students' personal life experiences including their interests and academic objectives. By incorporating components of game culture into the curriculum, educators can use the motivational aspects of gaming to cultivate a profound and long-lasting commitment to learning (Khasawneh, Khasawneh, and Khasawneh 2024). This innovative strategy also disrupts the conventional classroom, promoting a learner-centred approach where students' interests and passions drive their educational path.

Considering these factors, game culture is not only a part of contemporary digital age but also a valuable asset for educational advancement and innovation. The ability of game culture to bring people together, motivate them, and educate reflects the foundation of twenty-first century learning

(Moseikina, Toktamysov, and Danshina 2022). Thus, the intersection of game culture and education is a dynamic and developing practice that reflects the ever-evolving landscape of knowledge, technology, and culture (Richardson, Hjorth, and Davies 2021) which provides an effective strategy for a more inclusive, and captivating educational experience for all students.

Game culture and education: the limitations

While the potential benefits of incorporating game culture into education are significant, it is important to acknowledge the broader concerns that have been raised in the literature. Critics of gamification and the integration of game culture in education often mention issues such as gender disparities, the digital divide, addiction, excessive time consumption, and exposure to violence.

A key finding in existing research points to gender differences in terms of engagement, game preferences, character choices and time spent on gaming (Paraskeva, Mysirlaki, and Papagianni 2010). As Gray and Leonard (2018, 104) argue 'male game players are exposed to hypersexualised and powerless representations of women, their attitudes to gender become more conventional and their dominance in gaming culture is reinforced'. This research contends that from dominant stereotypes within the industry itself to the dehumanising representations often found within game space, gender inequalities are an area that require further challenge to ensure a more inclusive game culture for future generations.

Another important factor to consider when incorporating gaming culture into education is the digital divide, which presents difficulties in terms of accessibility and equality. Gaming enjoys widespread popularity, yet unequal access to technology (Scholes et al. 2024) could limit the efficacy of game culture-based learning methods among various socio-economic groups. This study recognises the significance of fostering inclusive educational strategies that use the potential of game culture in a manner that is accessible and fair to all students, irrespective of their background or available resources.

Research has shown that prolonged exposure to video games can lead to addictive behaviours in some individuals, which could negatively impact their academic performance and social interactions (Yılmaz, Yel, and Griffiths 2018). The time-consuming nature of gaming is another concern, as students might prioritise gaming over their studies, leading to limited time spent on academic tasks (Wolters and Brady 2021). Additionally, the immersive and often fast-paced nature of video games can result in distractions that detract from the focus required for learning, particularly in a classroom setting (Pasqualotto, 2023).

Another significant concern is the content of some video games, which may include violent themes. There is ongoing debate about the impact of violent video games on children's behaviour, with some studies suggesting that exposure to such content may lead to increased aggression (Anderson et al. 2010; Kühn, 2019). This raises important questions about the suitability of integrating game culture into educational environments, especially when the type and content of the games is not carefully selected.

In light of these concerns, it is important to approach the integration of game culture in education with caution. The findings of this study, which highlight the positive impacts of game culture on student engagement and learning, should be understood within the broader context of these potential drawbacks. Having outlined the background and key concepts that inform this study, we now outline the research that forms the basis of this paper.

The research

To understand the engagement potential of the distinct pedagogy of Checkpoint's prepared lesson materials for Key Stage 2 Science, and to evaluate feedback on any perceived enhanced classroom learning that takes place, we carried out empirical research between January and July 2023 in the London Boroughs of Hillingdon and Hammersmith and Fulham.

Theoretical framework

This study draws on Yosso's (2005) theory of cultural wealth to understand how game culture can be leveraged to enhance engagement and learning outcomes in the Key Stage 2 science curriculum. The concept of cultural wealth was developed by sociologist Gloria Anzaldúa in the 1980s as to recognise the strengths and assets of marginalised students (Anzaldúa 1987). Anzaldúa argued that students' cultural wealth should be recognised and valued in education, rather than being seen as a hindrance to learning (Anzaldúa 1987). Students' cultural wealth refers to the various forms of cultural knowledge, experiences, and skills that students bring to the classroom (Anzaldúa 1987). This includes their social, cultural, and linguistic backgrounds, as well as their family, community histories, and personal experiences. These resources can often be overlooked or undervalued in mainstream education (Anzaldúa 1987), leading to seeing students' cultural backgrounds and experiences as deficiencies or obstacles to learning, rather than assets or sources of strength.

Yosso (2005) explicitly expanded on Anzaldúa's (1987) ideas to challenge the negative perception of students' cultural wealth in education by identifying, recognisisng and valuing the cultural assets that students from disadvantaged backgrounds bring to their education. Yosso's (2005) theory specifically outlines various forms of cultural wealth such as aspirational, linguistic, familial, social, navigational, and resistant capital. Therefore, while Anzaldúa's pioneering work laid the foundation and inspired many scholars, the detailed development and application of the theory of cultural wealth in the context of mainstream education are often attributed to Yosso (2005).

Game culture, which includes the shared experiences, language, and social experiences inherent in playing videogames (Carr and Pelletier 2009), aligns well with Yosso's (2005) theory. As previously explained, for many students, gaming is a significant aspect of their lives and has become an important form of cultural wealth. The goals and achievements pursued in games build aspirations, while the unique communication methods used within gaming communities enhance linguistic skills. The social connections and teamwork developed through multiplayer games contribute to social skills, and the ability to navigate virtual worlds reflects and strengthens navigational skills. Moreover, many games encourage players to think critically and question norms, which aligns with the idea of resistant capital.

Integrating game culture into the Key Stage 2 science curriculum presents an opportunity to connect more deeply students with their learning environment by recognising and utilising the cultural wealth they bring from their gaming experiences, hence their game culture. Thus, recognising and integrating elements of game culture in education not only acknowledges the cultural experiences students bring to the classroom but also enhances the learning environment by making it more engaging and inclusive (Holmes and Gee 2016).

Methods

The study employed a qualitative methodology and methods that included qualitative interviews with the teachers after they had delivered the prepared lesson and questionnaires completed by the children also immediately following the lesson. The interviews were a useful method to understand teacher's experiences of delivering the lesson. They enabled us to gather the teachers 'experiences and interpretations of particular experiences' thus allowing for 'additional insights and enriching the research through the generation of qualitative data' (Winwood 2019, 12).

The quantitative questionnaire administered to students, by the class teacher, immediately after the Key Stage 2 science lesson was designed to capture their perceptions and experience of the lesson. The questionnaire included open-ended questions that asked students to reflect on various aspects of the lesson, such as what they liked most about the teaching, the activities, and the new knowledge or skills they gained. Additionally, students were asked to choose statements that best reflected their views on how the use of video game content impacted their learning, confidence, and engagement.

They were also given the opportunity, through the questionnaire, to identify specific skills they developed during the lesson, such as creativity, teamwork, listening, determination,

problem-solving, risk-taking, and analysis. Students were asked to indicate the skills they believed they developed. The responses were gathered to determine how frequently each skill was reported among the students. This analysis allowed us to evaluate the impact of the lesson on skill development from the perspective of students themselves, with the results presented in both the text and Figure 1 to highlight the distribution and significance of the skills gained.

The data were collected in two stages in four primary schools as follows:

Stage 1: five qualitative interviews with classroom teachers in four schools directly after they had delivered the Key Stage 2 science lesson on classification. Four of the teachers were female, one was male and they are all from differing ethnic backgrounds and at varying stages in their teaching careers.

Stage 2: questionnaires with children participating in the lesson in each of the four schools. Students were asked straight after the lesson to reflect on what they liked and what they found interesting (Table 1).

Ethics

Participation in the research was entirely voluntary and the informed consent of all participants was sought prior to the interviews. Those who took part in the research were assured that their comments would be treated in confidence and any quotes used would be anonymised. The research complies with the ethical protocols set out by the British Education Research Association (BERA) (2018) revised ethical guidelines; the BSA (2017) ethical guidelines; and Brunel University London's ethical guidelines (Table 2).

The findings are presented below and organised around the teachers' experiences and then the students' experiences.

Findings from teachers

Improved engagement

All of the teachers cited the positive aspects of the learning material, in particular in terms of improved engagement and focus through the duration of the lesson:

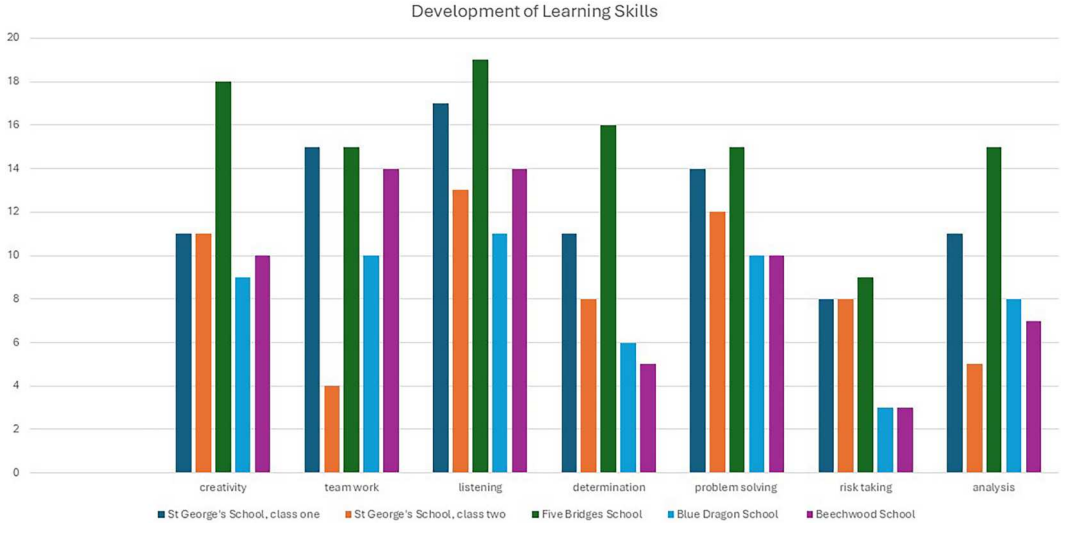

Figure 1. Development of student learning skills.

Table 1. Schools' information (at the time of data collection).

	St Georges School	Five bridges School	Blue Dragon School	Beechwood School
Type of school	Academy sponsor-led	Academy sponsor-led	Academy sponsor-led	Maintained
Ofsted Rating	Good	Good	Outstanding	Good
Number of students	359	832	260	215
EAL Students	The proportion of pupils from minority ethnic groups and who speak English as an additional language is above national average.	The proportion of pupils from minority ethnic groups and who speak English as an additional language is well above national average.	The proportion of pupils from minority ethnic groups and who speak English as an additional language is well above national average.	The proportion of pupils from minority ethnic groups and who speak English as an additional language is above national average.
PP Students	The proportion of pupils eligible for the pupil premium funding is above the national average.	The proportion of pupils eligible for the pupil premium funding is well above average.	The proportion of pupils eligible for the pupil premium funding is lower than average.	The proportion of pupils eligible for the pupil premium funding is well above average.
SEN Students	The proportion of pupils who have special educational needs and/or disabilities is lower than the national average.	The proportion of pupils who have special educational needs and/or disabilities is average.	The proportion of pupils who have special educational needs and/or disabilities is average.	The proportion of pupils who have special educational needs and/or disabilities is above the national average.
Schools' performance	The school meets the government's floor standard.	The school meets the government's floor standards.	The school meets the government's floor standards.	The school meets the government's floor standards.

Table 2. Overview of teachers' professional experience.

Teacher name	School name	Teaching experience	Enjoyment of teaching	Challenges of teaching
Mrs Chaudry	St Georges School 1	23 years	'I learned a lot. They are in fact encyclopaedic'	'Paperwork is one of the challenges that I would say is major'
Mr Kaur	St Georges School 1	2 years	'Relationships with the children and the parents'	'The different needs that each child and parent has'
Mrs Tollit	Five bridges school 2	7 years	'When children actually understand the learning'	'It's attitude towards learning that they have, them not having aspirations'
Mrs Jamieson	Blue Dragon school 3	5 years	'That moment when it clicks in their head'	'Admin, it's the admin outside of teaching at the moment'
Mrs Davies	Beechwood School 4	11 years	'Working with the children, and helping them to get new knowledge'	'Massive challenges with funding and finances. Parents are challenging, as well'

Definitely, when we started to talk about the character straightaway, they were engaged from the start, they loved it. They loved the fact that it's something that is in everyday life, especially the boys, they realise, okay, yes, that's different (Mr Kaur, St Georges).

It grabbed their attention, which was amazing. I think teamwork, they worked really well, the communication with them was really well, and they were all focused. Yeah.

In the afternoon lessons, especially in the afternoon (Mrs Chaudry, St Georges).

I've got my autistic child there, he was engaged throughout the lesson, he wants to know, he was talking, he was asking questions and asking for more ideas. So I really like that. Yeah, I think the engagement was there. It really was highlighted (Mrs Jamieson, Blue Dragon).

They definitely enjoyed it because it was the Sonic characters. Definitely (Mrs Davies, Beechwood).

The stuff with the characters, they loved that! Yeah. And I think that what they're talking about is those unique characteristics, which I think that was really helpful (Mrs Tollit, Five Bridges).

Reference in the learning materials to the Sonic characters was cited as a key feature in the improved engagement experienced by the students. Existing research suggests that the immersive and engaging nature of games has been shown to positively influence children's cognitive processes, leading to enhanced learning experiences (Kiili 2005; Shaffer 2006). Drawing on Yosso's (2005) theory of cultural wealth, we recognise that students' engagement with game culture represents a valuable form of aspirational and/or social capital. While the use of actual games in the classroom has attracted some mixed attention, researchers emphasise the importance of recognising and understanding the various features of gaming culture that can be effectively incorporated into the learning process (Kapp 2012). As our study shows, by focusing on the underlying principles and mechanism that make games engaging, such as the characters, game mechanics and play styles – learning through play, teachers can utilise learning resources that promote critical thinking, problem-solving, collaboration and motivation and, adaptive and personalised learning (Gee 2007; Squire 2008), thus leveraging students' cultural wealth (Yosso 2005) to positive effect; without necessarily relying on the use of videogames themselves (Barab, Gresalfi, and Ingram-Goble 2009; Prensky 2001).

Research has also shown that gaming culture can improve children's cognitive skills such as problem-solving and critical thinking (Adachi and Willoughby 2013; Wouters et al. 2013). Videogames often require players to strategise, analyse complex situations, and adapt to changing circumstances, which can promote the development of higher-order thinking skills (Granic, Lobel, and Engels 2014) which can be applied to classroom learning as transferable skills. Our data confirms that drawing on students' gaming culture created a space for collaborative and social learning (Steinkuehler and Duncan 2008), which can be viewed as a form of cultural wealth within Yosso's framework (2005). The data from our teacher interviews highlights that incorporating these aspects into educational settings can foster cooperation, communication, and teamwork among students, ultimately enhancing their social skills and collaborative problem-solving abilities (Sung and Hwang 2013). Our findings resonate with those from a recent study conducted by Hewett, Zeng, and Pletcher (2020) who found that videogames 'help students learn to problem-solve, improve their research skills, be resourceful, multitask, and develop their social skills through teamwork' (Hewett, Zeng, and Pletcher 2020, 361) which contributes to their educational learning and represent forms of cultural wealth (Yosso 2005).

Potential areas for further development

The aim of this research was to better understand areas that would benefit from further development. Supporting and meeting the needs of students with SEND was identified by two teachers based in the same school, as follows:

> Maybe Special Needs SEN needs, need to be incorporated into the lesson plan. How am I going to challenge certain kids in the classroom? I said, we're very fortunate in my class that everyone can get on. But if I have certain needs specifically my last year's one, how am I going to cater to those? (Mrs Kaur, St Georges).

> So, some children require extra scaffolding than the others, because everybody was doing the similar thing. That is where, you know, the focus might have lacked, because I have special education needs. So, I have to target to their level. We usually adapt the resources to match their level so not everybody works at a level of year five, you have ups and downs. So, to adjust the lesson according to them (Mrs Chaudry, St Georges).

These findings suggest some further refinement of the material to ensure differentiation across ability levels would enhance the inclusivity of the lesson for all learners. Indeed, videogames often adapt to the ability of the player, offering personalised learning experiences that challenge and engage learners at the appropriate level of difficulty (Sitzmann 2011). Incorporating such differentiated or adaptive learning approaches inspired by game culture, could enable teachers to tailor instructions to meet students' individual needs, thus leveraging their cultural wealth, leading to a more engaging learning experience for all (Pane et al. 2017).

Overall experience

We asked our teachers if they would recommend Checkpoint's learning materials to their Senior Leadership Team (SLTs) for purchase and all five teachers responded positively:

> Definitely. It was something that we can use as a basis, and then we can adapt it to each need of various classroom. So, it would be something we recommend (Mr Kaur, St Georges).

> Yes absolutely, absolutely … We can adapt the material, but you know when you have to basic structure, it's just adapting. So, something like that, we would love to have it (Mrs Chaudry, St Georges).

> Yes, definitely yes because it hooks them in. It's straight in there. As soon as they came in, they saw the three characters and they were like Oh wow! (Mrs Jamieson, Blue Dragon).

> Yes, absolutely yeah. Yes. I think the children really enjoyed it (Mrs Davies, Beechwood).

> Yes, I would. Like I said, I would just need to go back and have a look at … we always, we have the national curriculum, but we always kind of want to extend their learning (Mrs Tollit, Five Bridges).

Many videogames offer adaptive learning experiences, adjusting the level of difficulty based on the player's performance. Our findings lead us to contend that teachers can adopt a similar approach in the classroom by using formative assessments and adaptive teaching to tailor the activity according to individual students' needs, ability, and progress (Sitzmann 2011). To ensure the continuing effectiveness of drawing on student's game culture, teachers must regularly assess students' understanding of science concepts which can be done through quizzes, discussions, and observations, teachers can identify areas where individual students may require additional support (Black and Wiliam 2009) to adapt the teaching and learning to the students' ability.

Findings from students

Students were asked to complete a questionnaire based on their experience of the Checkpoint lesson.

The following table (Table 3) summarises their responses to the statements noted in the first column of the table.

The provided data presents a thorough summary of student feedback from five classes in four schools, encompassing the effects of a particular lesson on improving learning, boosting confidence, and increasing engagement. The total number of pupils in all classes was 102, which is a significant sample size for analysis.

92.8% of the students said that the session improved their learning experience. The high percentage suggests that the lesson's content and delivery were well received, suggesting that the instructional approach effectively improved understanding and memory of the subject matter by

Table 3. Summary of student responses.

	St Georges School, class one	St Georges School, class two	Five Bridges school	Blue Dragon school	Beechwood School	Totals
Number of students in class	23	20	25	13[1]	21	**102 students**
Number of students agreed the lesson helped them learn better	21	18	23	12	17	**92.8% agreed**
Number of students agreed the content made them more confident	20	16	20	8	17	**82.6% agreed**
Number of students agreed they were engaged in the learning	22	15	22	11	16	**87.7% agreed**

leveraging elements of students' cultural wealth (Yosso 2005). The consistent positive comments from all schools emphasise the widespread appeal and efficacy of the lesson.

Furthermore, a significant majority of 82.6% of students indicated a rise in confidence after the lesson. This significant majority indicates that the lesson has the ability to not only provide knowledge but also to provide students the power to succeed in school, which is a crucial feature of recognising and utilising their cultural wealth (Yosso 2005). Having confidence in one's ability to study is essential for promoting active engagement and creating a supportive environment in the classroom (Munna and Kalam 2021). The lesson's ability to enhance student confidence in different school environments further demonstrates its flexibility and applicability to diverse groups of students' cohorts.

Student engagement, a crucial determinant of good learning outcomes, was also scored highly, with 87.7% of participants reporting their active involvement in the learning process. The lesson's ability to catch students' attention effectively is shown by the observed high levels of engagement, which is vital for keeping student interested and motivated. Lessons that are engaging are more likely to lead to a better understanding and long-term retention of material (Dickinson et al., 2011). This suggests that the teaching methods used were effective in creating a learning experience that was both fun and instructional, leveraging students' cultural wealth (Yosso 2005) to create a more meaningful and engaging learning environment.

To summarise, the data analysis indicates that the lesson was well-received and had a good impact on various measures of educational achievement, such as improved learning, higher confidence, and enhanced engagement. The results of this study provide evidence that incorporating aspects of game culture into educational materials can positively influence students' academic experiences by leveraging their cultural wealth. The data emphasises the potential of these innovative techniques to make a substantial contribution to educational practices. This justifies the need for additional investigation and incorporation into broader curricular designs in order to meet the changing requirements and interests of students.

Furthermore, our positive findings from the students suggest that drawing on students' game culture in science lessons by incorporating elements not explored but including points, badges, and challenges can motivate students and encourage engagement (Dicheva et al. 2015). These game mechanics provide a sense of achievement and recognition, fostering intrinsic motivation and promoting a positive learning experience (Hamari, Koivisto, and Sarsa 2014). The positive engagement and increased sense of confidence reported by the participants suggest that their motivation was stimulated through participating in the lesson that recognised and utilised their cultural wealth.

As previously explained in the Research section, students were asked to identify the skills they developed, such as creativity, teamwork, listening, determination, problem-solving, risk-taking, and analysis. The table below highlights the distribution of key skills students gained from the lesson, grouped by individual skills as they appeared in the questionnaire:

The chart confirms the range of skills gained through participation in the lesson, with creativity (59), listening (74) and problem-solving (61) scoring highest. There is some differentiation at the school level with Five Bridges School scoring the highest in all skill areas. The bar chart illustrates the progress of students' learning skills in a Key Stage 2 science lesson that integrated game culture. It provides insights into the success of this teaching method.

The presence of high levels of creativity, specifically observed in St George's School, class one, and Five Bridges School, indicates that the incorporation of game culture aspects, such as Sonic the Hedgehog, may have facilitated a supportive environment for creative thinking. This phenomenon may be attributed to the intrinsic characteristics of games, which frequently promote exploration and innovative problem-solving (Adachi and Willoughby 2013; Wouters et al. 2013). Students may have been motivated by the vibrant characters and storylines in their gaming experiences, which are integral to their cultural wealth (Yosso 2005), enabling them to approach scientific subjects in new and innovative ways. This demonstrates that leveraging students' cultural wealth, in particular game culture, can indeed create a more engaging and relevant learning environment.

The prominent display of teamwork abilities at Five Bridges School may be attributed to the collaborative attitude commonly observed in online gaming situations. This suggests that the lesson may have effectively incorporated elements of gaming that necessitate players to collaborate in order to accomplish shared objectives (Granic, Lobel, and Engels 2014), thereby leveraging students' cultural wealth (Yosso 2005) to enhance their learning experience.

Listening skills seem to be consistently developed throughout all classes and schools, with minor variances. This suggests that the lesson's design was successful in capturing students' attention and encouraging them to actively listen. This may have been achieved through the use of interactive features or game-like instructions found in the lessons that required students to closely follow in order to achieve the learning objectives.

The level of determination has significantly improved, particularly in class two at St George's School. The lesson incorporated challenges resembling those found in video games. This could have motivated pupils to persist in completing tasks, thus strengthening their resilience to achieve (Christopoulos and Mystakidis 2023). This attribute is of utmost importance in the field of science education, as pupils frequently come across difficult tasks that require persistent effort to understand.

The problem-solving ability has a comparable increase to creativity, particularly within the two aforementioned schools. Integrating game culture into KS2 science lessons could have offered pupils authentic scenarios to practice and improve their problem-solving skills, which are essential in gaming (Hewett 2022).

The tendency for risk-taking, which is particularly pronounced in Blue Dragon School, may be attributed to the game culture's promotion of experimentation (Paul 2018). The lesson's pedagogical approach may have facilitated greater opportunities for open-ended inquiry and offered situations in which pupils could formulate and test hypotheses, gaining knowledge via the process of trial and error, similar to the experimentation with various methods in games.

The Five Bridges School demonstrated the highest level of development in the crucial analytical skill required for scientific enquiry. It can be inferred that the science lesson, which was based on game culture, thereby leveraging students' cultural wealth (Yosso 2005), effectively incorporated components such as logical problems that necessitate analytical skills, so mirroring the strategic nature of gaming (Granic, Lobel, and Engels 2014).

To summarise, the analysis of the bar chart on the integration of gaming culture into KS2 science lessons suggests that game culture-based learning can make a substantial contribution to the acquisition of several abilities that are essential for scientific education and education in general. The success observed in all four schools demonstrates the effectiveness of game culture as an educational strategy, able to improve both subject knowledge and fundamental skills that support scientific literacy and inquiry.

To better understand these perceptions of skills gained, the questionnaire also asked students to note 'what they found interesting about the lesson'. A sample of responses representative of the cohort in each school is as follows:

I loved the animals (St Georges School).
I cannot choose because it was interesting throughout the whole lesson (St Georges School).
When we had to sort animals in classification keys (St Georges School).
How to analyse (Five Bridges School).
The classification and scientific names of the animals (Five Bridges School).
Discovering the scientific names (Five Bridges School).
The characters of a videogame (Five Bridges School).
I learned many new words (Blue Dragon School).
Listening, teamwork (Blue Dragon School).
How they used videogame characters in the lesson to teach me about animals (Blue Dragon School).
A classification sheet (Beechwood School).
Using videogame content (Beechwood School).
That Knuckles as an echidna (Beechwood School).

In response to the question 'what was the most useful thing you learnt today' the following sample of responses representative of the cohort in each school is as follows:

The most useful thing I learnt was how to make my own classification (St Georges School).
The most useful thing I learnt was the data table because I never knew how to use it (St Georges School).
The classification key was useful to be honest because you know how to sort and group (St Georges School).
How to classify animals (Five Bridges School).
I could classify plants or animals for science (Five Bridges School).
Learning about habitats (Five Bridges School).
I might use it if I become a scientist (Blue Dragon School).
We could explore different animals which had invertebrates and vertebrates (Blue Dragon School).
The differences of different characters – classification (Beechwood School).
Say what type of animals were from the sonic movie (Beechwood School).
How to sort things out into groups (Beechwood School).

The responses to these two questions suggest that incorporating gaming culture elements in the classroom can lead to a more enriching learning experience for students, transforming the way they engage with and understand scientific concepts. Teachers can potentially foster a deeper connection between students and the subject matter when leveraging their cultural wealth (Yosso) and bringing the excitement and challenges of videogames into the learning process, ultimately promoting a lasting interest in science education.

Conclusion

Our findings suggest that game culture might be a key element of students' cultural wealth (Yosso 2005) and that it has appeal to almost all students. Incorporating elements of game culture into primary education, specifically Key Stage 2 science lessons has the potential to enhance student engagement, motivation, and learning outcomes. Tapping into the interests and passions of students, teachers can create more captivating and meaningful learning experiences that resonate with their students' lived experiences. In this exploration, we discovered that when students encounter familiar elements from their gaming experiences within the classroom, their enthusiasm for learning visibly increases. This alignment between students' recreational interests and academic content, viewed through the lens of cultural wealth (Yosso 2005), presents a compelling case for the deeper integration of game culture into educational strategies. The overwhelmingly positive feedback from both students and teachers on the utilisation of Checkpoint Magazine's videogaming-inspired lesson materials highlights the transformative potential of this approach. Such materials not only make learning more relatable and engaging but also facilitate a stronger connection between students and the aim of the curriculum.

Teachers highlighted the need to adapt the resources for SEN and economically disadvantaged, but no concern was explicitly raised for any other characteristic. Teachers can create more engaging and inclusive learning environments by understanding and leveraging key aspects of students' cultural wealth (Yosso 2005), namely gaming culture which includes quest-based learning, collaboration, adaptive teaching, and feedback. These gaming-inspired strategies can not only spark students' curiosity and excitement but also help them develop further the essential skills acquired through playing videogames, such as critical thinking, problem-solving, and teamwork, all of which contribute to their cultural wealth.

This study illuminates the broad spectrum of benefits that game culture, an integral aspect of students' cultural wealth, can bring to the classroom. By integrating game culture elements into the curriculum, educators can leverage the motivational power of games to foster a more inclusive and dynamic learning environment. The positive outcomes observed in this study advocate for an adjustment of traditional teaching methodologies, suggesting a paradigm shift towards a more interactive and student-centred model of education.

To take the work forward, the key focus will be to better understand how drawing on students' game culture, not just in science lessons but across the curriculum, has the capacity to

transect students diverse cultural, social and economic backgrounds to create more inclusive classroom environments. The journey ahead calls for an expansive exploration into how game culture as an aspect of cultural wealth (Yosso 2005), can be systematically integrated in educational practices the same way other types of culture are. By drawing on this relatively untapped knowledge, we want to understand the benefits to the whole school community. Thus, any future research should continue to explore the long-term effects of incorporating gaming culture elements into primary education across the socio-economic and cultural spectrum, as well as identifying best practices and potential challenges associated with their implementation. The ultimate goal remains clear: to leverage the universal appeal of gaming, which has become an integral part of students' cultural wealth, to unlock new dimensions of learning and discovery for all students everywhere.

Note

1. Half the class were out on activities.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Brunel University London.

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