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Teachers' perceptions of implementing Digital Game-Based Learning in the classroom: A convergent mixed method study

La percezione degli insegnanti sull'implementazione in aula dell'Apprendimento Basato su Giochi Digitali: uno studio con metodo misto convergente

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ABSTRACT Research on Digital Game-Based learning (DGBL) indicated it is effective in inducing student motivation and learning outcomes. Teachers as gatekeepers of technology should maneuver DGBL as pedagogical approach to engage students. In this convergent mixed method study, the researcher surveyed 116 pre-service, internship, and in-service teachers about their attitudes, self-efficacy, teaching philosophy, and perceived barriers toward the implementation of DGBL. Qualitative and quantitative data were collected and corroborated. Results showed majority of teachers gravitated toward Edutainment Games and Educational Applications based on pre-existing familiarity, comfortableness, and ease of use. Findings revealed misalignment between teachers' endorsed teaching philosophy and their preferred game genre for use in instruction. The implication is that teachers during internship and post-induction should become educated in digital games and corresponding learning theory inherent in its design, so they can leverage teaching philosophy, knowledge and strategies to instruct in tandem with a pedagogically sound and thoughtfully chosen game.

KEYWORDS Digital Game-Based Learning (DGBL); Perceptions; Teacher Preparation; Teaching Philosophy; Mixed Methods.

SOMMARIO La ricerca sull'apprendimento basato sui giochi digitali (DGBL) ha dimostrato la sua efficacia nell'indurre motivazione e risultati di apprendimento negli studenti. Gli insegnanti, in quanto custodi della tecnologia, dovrebbero utilizzare il DGBL come approccio pedagogico per coinvolgere gli studenti. In questo studio effettuato con metodo misto convergente, sono stati intervistati 116 insegnanti in pre-servizio, in tirocinio e in servizio, in merito ai loro atteggiamenti, all'autoefficacia, alla loro filosofia di insegnamento e alle barriere percepite nell'implementare il DGBL. Sono stati così raccolti e validati dati qualitativi e quantitativi. I risultati mostrano che la maggior parte degli insegnanti è orientata verso giochi di edutainment e applicazioni educative basate su una loro familiarità preesistente, sulla comodità e sulla facilità d'uso. I risultati rivelano un

disallineamento tra la filosofia di insegnamento adottata e il genere di gioco scelto per l'insegnamento. Ciò che se ne evince è che gli insegnanti durante e dopo il tirocinio dovrebbero ricevere una formazione sull'uso dei giochi digitali e sulle teorie dell'apprendimento sottostanti la loro progettazione, in modo da poter sfruttare la filosofia di insegnamento, le conoscenze e le strategie per insegnare in tandem con un gioco pedagogicamente valido e scelto con cura.

PAROLE CHIAVE Apprendimento Basato su Giochi Digitali (DGBL); Percezioni; Preparazione degli Insegnanti; Filosofia di Insegnamento; Metodi Misti.

1. Introduction

The 2018 Pew Research Center's study on 743 teens found that 84% of teens had access to digital game console and 90% played video games on a computer, tablet, console, or smartphone at home (Andersen & Jiang, 2018, p.9). The Entertainment Software Association (ESA) estimated that 214.4 million Americans played video games, with about 70% of children under the age of 18 playing games regularly (ESA, 2020). The ever-expanding game industry, increasing penetration rate of mobile technologies such as tablets and smartphones, and up and coming generations of digital game natives pose important questions and implications for teachers, practitioners, and teacher educators. Game research to date provided empirical evidence on games' effectiveness in inducing learner motivation, engagement, and learning outcome in both formal and informal settings (Barab, Gresalfi, & 2009; Connolly, Stansfield, & Hainey, 2011; Easterling, 2021; Gee, 2007; Van Eck, 2015). Two rationales support the use of DGBL. First, the thinking patterns of learners today have changed considering that they are native speakers and users of the languages of digital multi-media. Second, young people are experiencing innovative forms of computer and video game play and the continuing experience and exposure to these new forms of entertainment has an impact on their perceptions, cognitive abilities, and preference for learning (Prensky, 2007; Susi, Johannesson, & Backlund, 2007). Ultimately, DGBL is about leveraging the mechanisms and effects of digital games to motivate and engage learners for learning.

Despite the evidence and recommendations provided by the research community, does our teaching force acknowledge the utility of digital games in the classroom? Are teachers ready to teach and incorporate digital games into instruction? If we were to anticipate affirmative answers to the first and second question, are teacher educators taking note of the educational potential of digital games and deliberately act on preparing our future teachers to teach using digital games?

Meredith (2016) conducted a literature review on Digital Game-Based learning (DGBL) in K-12 teacher professional development and identified a gap in the literature, stating game-based learning in K-12 teachers' professional development as sparse. Teacher preparation and professional development should provide teachers with the tools to evaluate digital games' compatibility and suitability for use in classrooms (An, 2018). Research investigating pre-service and in-service teacher attitudes towards using digital games in the classroom showed that despite teachers' interest, teacher preparation has not done much to prepare teachers in using digital games in formal learning contexts (Hayes & Ohrnberger, 2013; Hsu & Chiou, 2011; Millstone, 2012; Takeuchi & Vaala,

2014). A dearth exists in the literature regarding a lack of educator training during teacher preparation and in-service professional development related to the use of DGBL (An, 2018; Denham, 2019; Groff, 2018; Stieler-Hunt & Jones, 2019). Takeuchi and Vaala's (2014) study on 694 American teachers in grades K-8 found 74% of respondents used digital games in their classrooms but only 8% learned about educational digital game usage during teacher preparation, and 17% learned about DGBL in in-service professional development. Findings pinpointed to the lack of incentivized preparation on using digital games during teacher preparation and in-service professional development.

Moreover, many studies have focused on teachers' attitudes towards DGBL. Kaimara, Fokides, Oikonomou, and Deliyannis (2021) examined 170 pre-service teachers' perceptions of the barriers to DGBL implementation and found via online survey that the major perceived obstacle is the inefficient allocation of available financial resources. Vogt (2018) conducted a qualitative study with eight purposively selected middle school teachers who use DGBL. Findings indicated these teachers use DGBL to engage students in content, support skill building, promote teamwork and feedback. Factors that positively influenced adoption included teachers' own gaming experience and positive perception of using games to support lesson planning and classroom management. Negative perceptions were technical difficulties, lack of self-efficacy, time constraints, and the need for back-up plans. Gao, Li and Sun (2020) conducted a systematic review of mobile DGBL in STEM education and concluded teachers are concerned that the use of a mobile phone could disturb student learning or cause problems in classroom management.

From a practice-based perspective, Huizenga, Ten Dam, Voogt, and Admiraal (2017) interviewed 43 game-using secondary education teachers and found 41 teachers mentioned game-based learning to be effective in inducing student engagement, 38 teachers mentioned cognitive learning outcomes in formal teaching, whereas 17 teachers mentioned motivational effects via learning with games. Investigating best practices using games in teaching adds valuable insights and evidence to the usefulness and feasibility of game-based learning. Uluay and Dogan (2020) studied 18 pre-service teachers' usage of Kodu Game Lab in teaching science concepts and found the Kodu-using treatment group have more positive opinions toward DGBL compared with the control group.

1.1. Purpose of study and research questions.

This study built upon findings from prior research in teachers' attitudes toward using digital games and extended the scope by examining potential relationships among factors such as teachers' attitudes, self-efficacy, teaching philosophy, and perceived barriers, which might facilitate or impede with teachers' adoption of DGBL in K-12 schools.

The term "digital games" used in this study refers to video games played digitally on a technological device such as home gaming console, handheld gaming device, tablet computer, cell phone or smart phone, and home computer.

Four research questions were formulated to guide this study.

1) What are teachers' attitudes toward implementing DGBL in the classroom?
2) What are teachers' perceived levels of self-efficacy on integrating DGBL?

3) What is the relationship between teachers' chosen game genre for DGBL and teaching philosophy?

4) What are teachers' perceived barriers toward using DGBL in the classroom?

2. Methods

Mixed methods is a research methodology in which "*a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration*" (Johnson, Onwuegbuzie, & Turner, 2007; p.123). To obtain a complete understanding of teachers' attitudes and perceptions of using DGBL, the study used a convergent mixed methods research design with the priority on the quantitative strand (see Figure 1). To corroborate the quantitative results, we collected qualitative data with the purpose of cross-validating multiple sources of findings within a single study (Collins, Onwuegbuzie, & Sutton, 2006; Creswell & Clark, 2017; Greene, Caracelli, & Graham, 1989).

3. Data collection and analysis

3.1. Sample and sampling

Participants of this study were 116 undergraduate and graduate students enrolled in educational technology courses in a large Midwestern university in the United States of America, including pre-service teachers (44%), student teachers in their internship year (20%), and in-service teachers (36%) in K-12 school settings in the US.

Survey was sent to a convenient sample of approximately 1,000 teachers with a response rate of 11% (116 fully completed responses). Among the 116 survey respondents, 85% (N=99) were female and 15% (N=17) were male. A combined 81.9% of respondents were between the age range of 18 to 26, with 69.8% of them preferred or were already teaching in K-6 settings.

3.2. Instrument

An online survey containing 33 five-point Likert scale items with qualitative probes and open-ended questions was administered via *Survey Monkey*, an online survey hosting site. The survey included four dimensions and items were adapted from existing scales:

1) 11 items about pre-teachers' attitudes toward using digital games in a classroom (Gibson, Halverson, & Riedel, 2007; Hsu & Chiou, 2011; Lambert, Gong, & Cuper, 2008; Millstone, 2012);
2) 9 items about perceived self-efficacy on the implementation of DGBL (Chatham, 2007; Egenfeldt-Nielsen, 2005);

3) 2 items about challenges and barriers to the adoption of DGBL in classroom settings (Baek, 2008; Becker, 2007; Kerbitchi, Kappers, Hirumi, & Henry, 2009; Rice, 2007), and
4) 4 items about teaching philosophy (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Five demographic items and two follow-up items were also included.

The Cronbach's alpha reliability of the four dimensions was averaged at 0.82.

3.3. Data analysis.

Quantitative data were analyzed in the Statistical Package for Social Sciences (SPSS 22) using descriptive statistics, Pearson bivariate correlations and exploratory factor analysis. Descriptive statistics was run for teachers' attitudes and self-efficacy in four game genres. Correlation analysis was performed to evaluate how teachers' teaching philosophy associated with their chosen genre of educational digital games to be used for DGBL in the classroom. Exploratory factor analysis was performed to examine the latent structures underlying the perceived barriers toward using DGBL. Qualitative data were coded using content analysis approaches guided by Krippendoff (2004). Pre-planned codes included for instance, "*fitting into content area and learning objectives*" (26 mentions), "*teacher demonstration and guidance*" (8 mentions), "*supplemental to whole group instruction or as a reward*" (11 mentions), and "*outcome assessment and meeting common core state standards*" (27 mentions). After data analysis, quantitative and qualitative results were juxtaposed and integrated for interpretation.

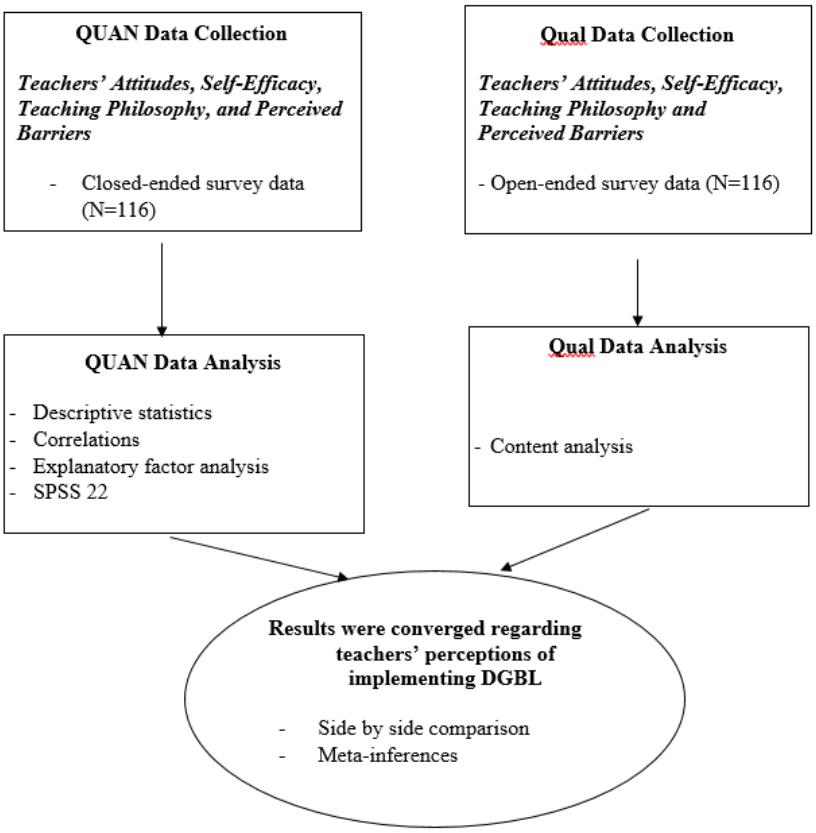

Figure 1. Methods of the study.

4. Findings

4.1. Attitudes toward using digital games in the classroom

Survey respondents held an overall positive attitude toward using digital games as tools for instruction (M=4.11, SD=0.87). A combined 77.6% of respondents (90 out of 116) expressed comfortableness in using digital games to supplement classroom instruction. Coincidentally a combined 77.6% of respondents (90 out of 116) chose "likely" or "very likely" in terms of likelihood of incorporating digital game-based learning. Consistency was found between respondents' favourable attitudes with their perceived likelihood of utilizing DGBL in the classroom.

Qualitative findings supported the above positive results, as participants indicated digital games "*learn and engage with life*", facilitative for practicing "*decision-making*", "*critical thinking*", and fantasizing "*alternate universes*". In specific, educational digital games were perceived as having a "*tie-in with subject area matter*". Many responses noted the extra practices afforded by the use of educational digital games in traditional subject areas of literacy, mathematics, and science, and they also provide a venue through which non-conventional skills such as creativity, problem-solving and motor skills can be honed in. Moreover, these games met the "*need for teaching young learners in ways that appealed to them*". Multiple responses mentioned that nowadays educational digital games are an integral part of kids' lives and these games are good at "*tricking students into learning*" and helping "*kids engaging in learning without realizing that they are*".

4.2. Self-efficacy on implementing DGBL

The researcher identified four genres of educational digital games based on review of literature on the historical development of educational games and contemporary learning theories (Wu, 2018; Flynn, Bacon, & Dastbaz, 2010; Games & Squire, 2011). Descriptions and screenshots of game play of the four game genres were provided to respondents to explicate what these genres entailed.

The four game genres include Edutainment and Educational Applications which highlight learning more than entertainment through rote learning and repeated practice; Serious games emphasize learning the hidden curriculum through gameplay and they promote learning in healthcare, corporate training, advertisement, civics, and politics; Educational game design tools are entry level game design platforms where players learn programming concepts and block-code; Simulation games and massive multiplayer online role-playing games (MMORPG) require players to cooperate and use strategic thinking, resource allocation, and role-play to make in-game progress.

The results indicated that regardless of participants' groups, they all ranked atop from the most favoured Edutainment Games and Educational Applications, to Serious Games, then Educational Game Design Tools, and lastly Simulation Games and MMORPGs (massive multiplayer online role playing games) (see Table 1).

Genre by Teaching Status	*M* Pre / Int / Ins	*SD* Pre / Int / Ins	Ranking
Edutainment & Educational Apps	4.0 / 3.8 / 4.1	.95 / .78 / .79	Unanimous 1st
Serious Games	3.8 / 3.6 / 3.9	.79 / .83 / .83	Unanimous 2nd
Educational Game Design Tools	3.4 / 3.1 / 3.3	1.0 / .81 / 1.19	Unanimous 3rd
Simulation Games & MMORPGs	3.1 / 2.6 / 2.9	.99 / 1.0 / 1.33	Unanimous 4th

Note. Pre = Pre-service, Int = Intern, Ins = In-service. Mean score ranging from 1 to 5.

Table 1. Mean, standard deviation, and ranking for the four game genres.

A combined 81% (94 out of 116) believed they were capable of using digital games to deliver educational contents in teaching and this showed their general optimism and belief in their self-efficacy to use DGBL. An ensuing item asked about their actual experience of using DGBL. Intriguingly 66.4% (77 out of 116) chose "no (experience in using games in teaching)" and this was counterintuitive to their optimism. In other words, even though 81% of respondents expressed self-efficacy in using DGBL but only 33.6% (39 out of 116) of respondents had actual experience using DGBL for educational purposes at the point of taking the survey.

Among the 33 Liker-scale survey items, 14 items included a text box for participants to expound opinions. In terms of the number of respondents choosing each of the four game genres to practice DGBL, the result was found to be the same as the order of preference ranking gathered from the four items completed earlier in the survey. The game genre Edutainment and Educational Applications received 69 mentions over the other three genres combined (38 mentions). In terms of ranking order, the same was found with Serious Games coming in at second with nineteen mentions, Educational Game Design at third with twelve mentions, and Simulation and MMORPGs with seven mentions. In sum, when it came to respondents' ranked preference of game genre for implementing DGBL, the results garnered from four items on game genre and an open-ended item were congruent.

4.3. Teaching philosophy

Four survey items asked about the four strands of contemporary teaching philosophies/learning theories – behaviourism, cognitive constructivism, social constructivism, and constructionism. Each teaching philosophy was accompanied by three statements to examine respondents' alignment or belief in teaching practices. In the attempt to test if the total of 12 sub-items were valid measures of respondents' teaching beliefs, bivariate correlation analysis was conducted. The result showed that the three sub-items in each of the four philosophies were significantly correlated with moderate to high coefficients ranging from .76 to .96

($p < .01$, two-tailed). The Cronbach's alpha of each measure of the four philosophies was as high as .90 (see Table 2). Among the four philosophies, teachers resonated the least with the teaching beliefs of behaviourism, whereas the other three teaching philosophies received relatively equal and favourable acknowledgment.

Teaching Philosophy	M	SD	N of Items	Cronbach's Alpha
Behaviourism	2.73	1.17	3	.98
Cognitive Constructivism	4.14	.62	3	.93
Social Constructivism	4.06	.60	3	.94
Constructionism	4.17	.60	3	.94

Note. Items were rated on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree, with a higher score indicating agreement with statements reflective of these teaching philosophies.

Table 2. Mean Score on Teaching Philosophy.

To investigate if there was alignment between the four types of teaching philosophies and the four identified game genres, a correlation analysis was performed. The following four findings emerged:

1) Behaviourism was negatively correlated with Educational Game Design Tools with statistical significance ($r = -.30, p < .01$).

This finding was relevant since the central learning tenet of behaviourism, stimulus and response (knowledge input and output in the form of observable behaviour), was at odds with the learning objectives such as creativity and artifact creation promoted by the exploratory and design-oriented activities involved in educational game design.

2) Cognitive Constructivism was positively correlated with Edutainment Games and Educational Applications ($r = .23, p < .05$), Serious Games ($r = .21, p < .05$), and Educational Game Design Tools ($r = .25, p < .01$) with statistical significance.

This finding was congruent with the previously stated notion that the four game genres are not mutually exclusive in terms of the learning objectives/opportunities they are designed to afford. For instance, even though Edutainment Games tend to be designed to promote learning as defined by behaviourism, these games can still be leveraged in ways to promote cognitive learning when a teacher employs pedagogical practices in line with cognitive constructivism by emphasizing the information taken in by an individual learner through schemata activation and cognitive processing.

3) Social Constructivism was positively correlated with Edutainment Games and Educational Applications ($r = .21$, $p < .05$), Serious Games ($r = .22$, $p < .05$), and Educational Game Design Tools ($r = .23$, $p < .05$) with statistical significance.

This finding seemed out of place considering that Edutainment Games and Serious Games were designed to promote individual learning processes and outcomes devoid the impact of social surroundings and participation.

4) Constructionism was positively correlated with Simulation Games & MMORPGs ($r = .19$, $p < .05$), and Educational Game Design Tools ($r = .32$, $p < .01$) with statistical significance.

4.4. Perceived barriers to the integration of DGBL

Exploratory factor analysis was performed to examine the latent structure underlying the 18 sub-items representing external barriers in implementing DGBL in one survey item. A parsimonious set of five components was extracted with 68% cumulative variance explained, including misalignment between DGBL and standardized curriculum, administrative and parental negative perceptions, lack of technology support and preparation in teacher preparation and professional support, short class periods, and low quality of educational digital games. For instance, a majority of respondents were first and foremost concerned about the budget of purchasing educational digital games, including "*cost of purchasing games*" (53.4%), "*inadequate computer or technology support to run digital games in the classroom*" (53.4%), and "not enough time to use digital game-based learning in short class periods" (50%). Some teachers also indicated that playing digital games might bring adverse effects to students, "*playing video games may have negative influences on my students*" (40.5%), "technology is distraction" (37.1%), "*low quality in graphics or audio effects in educational digital games*" (35.3%), and "*digital game-based learning cannot meet desired learning objectives*" (35.3%).

Qualitative analysis confirmed the above external barriers and they were misalignment between DGBL and standardized curriculum, administrative and parental negative perceptions, lack of technology support and preparation in teacher preparation and professional support, short class periods, and low quality of educational digital games.

4.5. Corroboration of quantitative results in qualitative responses

The analyses of respondents' qualitative responses corroborated the results of the quantitative analyses. These two data sources offered corroborated insights on respondents' perceptions of the value of DGBL converged on two emphases.

1) *Teachers' lopsided preference for using Edutainment Games and Educational Applications and lack of familiarity with the other three genres of educational digital games*: both the results of

quantitative and qualitative data analysis pointed to the notion that teachers heavily favoured Edutainment and Educational Applications over the other three genres.

2) *Misalignment between teachers' preference of Edutainment Games and Educational Applications and their endorsement in non-behaviouristic teaching philosophy*: the rule of thumb is that Edutainment Games and Educational Applications are designed following learning principles of behaviourism because they focus on rote learning. While majority of teachers indicated preference for using this genre of games, it would have made sense that they endorse behaviourism as the teaching philosophy they resonated with. Instead, behaviourism received a low mean score of 2.73 as these teachers gravitated substantially more toward constructionism (M = 4.17), social constructivism (M = 4.06), and cognitive constructivism (M = 4.14).

See below Table 3 for a joint display table of the corroborated results.

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Corroborated Results	Qualitative Data	Quantitative Data
Teachers' lopsided preference for using Edutainment Games and Educational Applications and lack of familiarity with the other three genres of educational digital games.	Teachers all favoured edutainment and educational applications on a personal level and pedagogical level. In the content analysis, edutainment and educational applications were most frequently mentioned (69 times). Participants gave varied justification on their preference for using such genre of games, such as *"familiarity and comfortableness", "fitting into content area", "promoting positive learning", "engaging", "easy set-up", "appealing to and motivating for special education students", "easily used as supplemental materials/rewards for brain-break"*, etc. • *"I would work on cognitive ability and social skills within special education because I believe this (game) can help to bring both aspects in."* • *"The game provides motivation and student interest."* • *"I feel more comfortable in using the tools (games) to help me teach a standard than having the tool be the lesson itself."*	Edutainment and educational applications had the highest means among the four game genres (M=4.0 for pre-service teachers, M=3.8 for interns, M=4.1 for in-service teachers). Edutainment and educational applications was positively correlated with teachers' teaching philosophy (r=.23, p<.05) In the responses to the item, *"I believe I am capable of using digital games to deliver educational contents in my teaching"*, 62.9% of all participants chose "agree" with "strongly agree" coming in second at 18.1%.
Misalignment between teachers' preference of Edutainment Games and Educational Applications and their endorsement in non-behaviouristic teaching philosophy.	Majority of teachers indicated preference for using edutainment games and educational applications that were designed following learning principles of behaviourism with a focus on inducing learning in the form of stimulus and response. • *"Use the game as a partner/independent practice after a mini lesson."* • *"Learning objectives would be to maintain measurable checkpoints and continuous challenges rather than having them just practice what is comfortable."* • *"I would pick a game that scaffolds what they have already learned."* • *"The game should give immediate feedback of correct or incorrect responses/answers."*	Behaviourism (M=2.73, SD=1.17) resulted the lowest mean among all types of teaching philosophy. Behaviourism was negatively correlated with educational game design tools (r=-.30, p<.01).

Table 3. A joint display table of the corroborated results.

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5. Discussion and conclusion

The misalignment between the chosen game genre and teaching philosophy pointed to two observations. First, teachers may not have been cognizant of the behaviouristic learning principles infused in the design of Edutainment Games and Educational Applications. Their favourable attitudes toward adopting this genre of games arose mainly from familiarity, comfortableness, and the ease of set-up. Second, considering the discrepancy between mean scores, the teachers apparently felt more in line with the learning principles of constructionism, cognitive constructivism and social constructivism, but not as prominently in behaviourism. The fact that the teachers favoured Edutainment Games and Educational Applications yet the teaching philosophy they endorsed was not compatible with the chosen genre of educational games may lead to a misalignment between teaching materials and pedagogical strategy, hence rendering DGBL less effective. From teachers' standpoint, finding suitable games to use for the skills needed to be taught is of critical importance. To achieve this, teachers need to find resources and become educated in the genres of educational digital games and the corresponding learning theories inherent in its design, so that they can better leverage their teaching philosophy, knowledge and skills to teach in tandem with a compatible genre of educational digital game. A combination of personal and pedagogical factors led to their preference. On a personal level, teachers may already have established prior experience, familiarity and comfortableness with Edutainment games and Educational Applications. On a pedagogical level, these short-form games and applications are ideal for the attention span of younger age students (majority of the survey respondents self-identified as K-6 teachers) and they are in general simple to set up. More importantly, Edutainment games and Educational Applications provide accompanying lesson plans for teachers. Thus these games serve as convenient, expedient and intuitive fit for delivering educational content in classrooms.

This study provides contribution to the literature in studying the use and inculcation of DGBL in teacher education programs (Franklin & Annetta, 2011) and the attitudinal survey served as tool and foundation on which to bridge theory to practice in teachers' pedagogical usage of educational digital games in a classroom setting. Continuing research in the use of DGBL is important because DGBL supports students' growing interests, constructs new areas of technological and knowledge base, and sustains student motivation to learn (Barab et al., 2009; Caperton, 2010; Papastergiou, 2009; Rankin, McNeal, Shute, & Gooc, 2008; Richter & Dawley, 2010). Despite a growing number of studies on using educational digital games to support student learning in K-12 subject content areas (Charsky & Mims, 2008; Connolly et al., 2011; Gros, 2007; Ritzhaupt, Higgins, & Allred, 2010; 2011; Squire, 2005), there is lack of evidence demonstrating DGBL is effective and compatible with formal learning contexts in most schools and districts.

Adding to the issue of incompatibility, the variety of game genres, different methods for integrating games into instruction, and poor quality of many educational games complicate the adoption of DGBL in classrooms (Gee, 2007; Tobias & Fletcher, 2011; Young et al., 2012). The diversity of educational games, the different ways of incorporating games into instruction, and the complexity of measuring game-based learning add to

the challenge of using digital games for teachers (Molina-Carmona & Llorens-Largo, 2020; Ren, 2019), requiring them to have "*more than a superficial understanding of game elements to make informed decisions about their use*" (Hayes & Ohrnberger, 2013, p.155). On one hand, we need more empirical studies documenting the processes and pedagogies of incorporating digital games into K-12 curricula (Van Eck, 2015). On the other, the field of study in DGBL needs a guiding framework with which we can reference in tackling problems arising from the integration of DGBL in the classroom.

The manner in which teachers navigate to understanding different genres of educational digital games, the embedded learning principles and the design implications can potentially influence their choice, pedagogy, and implementation of DGBL in a classroom. Sandford, Uicsak, Facer and Rudd (2006) called for the differentiation between types of learning opportunities afforded to teachers b different genres of games and stated that the differentiation would aid the process of coming to a fuller understanding of the potential of using digital games in education (p.3). Among many others, a typology of educational digital games might serve to assist teachers in understanding the pedagogical implications of adopting the four genres of games and how their teaching philosophy may factor in depending on their chosen game genre (Wu, 2018).

Emerging technologies such as virtual reality, augmented reality, and mixed reality markets are expected to increase and so are hardware and software usage. Extended reality (XR) games deliver deeply immersive experiences for learners by placing them within rich simulated environments (Madden et al., 2020) and such technologies had found a stronghold in corporate setting and military training, and it is safe to assume that they are, if not sooner, set to impact education where true immersion and heightened engagement can be realized for the benefits of student learning and teaching.

Findings of this study provide teachers and teacher educators with insights on effectively implementing DGBL, one such consideration being thoughtfully align teacher's teaching philosophy with a chosen game genre for use in classroom instruction. Many studies found the lack of training during teacher preparation and professional development hinders teachers' willingness, comfort, and confidence in the use of DGBL (Easterling, 2021; Meredith, 2016; Stieler-Hunt & Jones, 2019). There should be shared responsibility in teacher preparation programs where teacher educators impart knowledge about DGBL to pre-service teachers and in in-service professional development through which teachers can develop confidence and skills in using DGBL. When teachers received training associated with implementation of DGBL, their comfort and confidence increase, the game-based lesson would be carried out more effectively, and student learning would improve (An, 2018; Stieler-Hunt & Jones, 2019; Takeuchi & Vaala, 2014). Another solution lies in teachers themselves actively seeking to improve pedagogical practices by keeping up to date with resources and information about using emerging technologies for teaching and learning. It is imperative for teachers to equip themselves with a malleable mindset, rather than a fixed skill set, when it comes to navigating through the constantly changing landscape of educational technology.

5.1. Limitations

Several limitations should be considered in interpreting the findings of this study. First of all, the subjects under study were by no means fully representative of the teaching force considering that the respondents were limited to a pre-determined pool of teachers from a large Midwestern university in the US. Secondly, this study was exploratory in that the attitudinal survey was piloted to gauge 116 teachers' perceptions toward DGBL and the survey has not been extensively tested beyond the confines of the current study. Thirdly, the usage of one survey item to gauge teaching philosophy presented threats to validity and reliability. Fourthly, the collected data were self-reports that were subjective and may reflect response biases.

5.2. Implications for Future Research

One future direction for research is to investigate whether misalignment between teachers' choice of game genre and their teaching philosophy would induce adverse effects on using DGBL for instruction. While extant research does not address the relationship between teaching philosophy and game genre, the importance for teachers to understand the varying design and learning principles embedded in the four genres of educational digital games cannot be over-emphasized. Teachers need to be cognizant of their choices of technology tools and how their choices subsequently weigh in on their approach in the set-up, instructional practices, delivery of subject area contents, and outcome assessment.

Another research direction is to emulate large-scale studies (Millstone, 2012) by augmenting the sample size to a national level where the researcher-developed survey can be validated. In a similar vein, Easterling (2021) conducted a quantitative study surveying pre-service and in-service teachers (N=345) enrolled in a large Midwestern University in the US about their perceptions of benefits and barriers to the implementation of DGBL. Findings pointed to the lack of teacher training aligned with the integration of digital games into the classroom, despite the majority of responding teachers perceiving DGBL to be useful as supplemental activities that are motivating and could provide instantaneous feedback to learners. The study also concluded with recommendations for school administrators that there should be professional development offerings aligned to DGBL and on-site technology support personnel to provide support in teachers' planning for the use of DGBL in classrooms.

Well-received is that the responsibility of teachers is to design and deliver learning experiences that captivate and engage learners. One of these designed learning experiences may entail creativity and creativity on the part of teachers during instruction would in turn inspire creativity in students' endeavour to learn contents and produce evidence, prowess, and artifacts of learning. DGBL represents such a venue of pedagogical practice that requires persistence on creative teaching and purposeful play on the part of learners. After all, learning is and should be fun, motivating and fulfilling when a teacher has the capacity to leverage DGBL and engage learners via creative, meaningful, and purposeful play.

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