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Original Article

Simple but Effective: Using Reflections to Improve Pre-service Teachers' Utility Value to Teach with Game-Design

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Abstract

In this quasi-experimental study, we examined the effect of a self-reflection activity on the utility value of pre-service teachers in teaching game design. A pretest-posttest design was used to determine any differences associated with the intervention. 129 pre-service teachers from different majors participated in the study. The participants developed educational games using the MS Kodu game engine within a seven-week implementation process. The participants were randomly assigned to control and experimental groups before the intervention and engaged in specific interventions based on their group assignment. The control group students wrote summaries about game design activities, while the experimental group students wrote self-reflections about game design activities. The results indicated that the interventions influenced changes in the utility value of pre-service teachers: the utility value of the experimental group increased, while the utility value of the control group decreased. In addition, linguistic analyses indicated that students in the experimental group used more cognitive processing, affect, tentative language, and future focus than students in the control group. Gender differences in favour of female participants' utility-value perceptions were also observed following the game design process. This study provides empirical evidence of the effectiveness of self-reflection on utility value perceptions in teaching with game design.

Keywords: game design, motivation, utility-value, teacher education, linguistic analysis, gender differences

Introduction

Game design activities have gained increasing attention in formal educational settings for their effectiveness in teaching and reinforcing various cognitive abilities (Akcaoglu & Koehler, 2014; Akcaoglu & Kale, 2016; Baytak & Land, 2011; Hava et al., 2020; Ke, 2014; Navarrate, 2013; Robertson, 2012). These activities foster critical thinking, problem-solving, and digital literacy skills in learners (Hava & Cakir, 2017). Furthermore, research suggests that designing games leads to higher engagement and deeper learning compared to merely playing games (Vos et al., 2011).

Underlying the potential of game design in education is its inherently multidisciplinary nature. The process typically requires skills such as programming, graphic design, and narrative development (Prayaga & Coffey, 2008). Fortunately, recent advancements in game development platforms—such as Scratch and MS Kodu—have lowered the barrier to entry, making it easier for students with limited technical backgrounds to participate (Allsop, 2016; Li, 2018). Since its release in 2009, MS Kodu has become especially popular among young learners, while platforms like Unity 3D, GameMaker, and Stencyl also play a role in broadening access to game development.

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Despite these advances, several obstacles still hinder the widespread adoption of game design in educational contexts. Common challenges include the need for programming knowledge, time constraints within school curricula, and the costs associated with creating lab environments (Hava & Cakir, 2017). A particularly pressing issue is the lack of technical proficiency among K12 teachers (Ownston et al., 2019). This challenge aligns with the broader literature on technology integration, which emphasizes the critical role of teacher beliefs and competencies in effectively using technology in classrooms (Ertmer et al., 2012).

Given these challenges, it becomes essential to prepare future teachers to confidently and effectively incorporate game design into their teaching practices. Game design not only benefits K–12 learners but also offers valuable learning opportunities for pre-service teachers (Akcaoglu & Kale, 2016). Embedding game design activities in teacher education can help these future educators develop an understanding of digital learning tools and environments (Li, 2018). As Kafai et al. (1998) noted, designing games can serve as a powerful form of professional development. However, successful implementation goes beyond skill acquisition; it also depends on teachers' self-efficacy and beliefs in the relevance of such tools to their teaching (Ertmer, 1999; Ertmer et al., 1999).

The link between beliefs, motivation, and learning aligns with broader findings in educational psychology. Students' career and course choices are influenced not only by their performance but also by how useful they perceive a subject to be (Bathgate & Schunn, 2017). This perception, known as utility value, reflects the extent to which a task is seen as relevant for achieving personal or professional goals (Durik et al., 2015). When students find academic tasks personally meaningful, they are more likely to invest effort and achieve success (Brisson et al., 2017; Canning & Harackiewicz, 2015; Wigfield & Gladstone, 2019).

Enhancing utility value has shown positive impacts on motivation, engagement, and performance across various disciplines (Curry et al., 2020). As such, it serves as a motivational bridge between learners' goals and educational content (Durik et al., 2018). Notably, simple interventions—such as reflective writing exercises—have been found to increase students' perceptions of utility value by prompting them to consider how a task relates to their lives or future careers (Hulleman & Barron, 2017).

While utility value interventions have been widely studied in educational psychology, their application within the fields of educational technology and teacher education—especially in relation to game design—remains limited and underexplored (Kale & Akcaoglu, 2018). This presents a critical gap, given the increasing emphasis on preparing future educators to integrate digital tools and foster 21st-century skills in their classrooms. Game design, as both a creative and technical practice, offers a unique opportunity not only to enhance digital literacy but also to serve as a motivational tool for pre-service teachers. However, little is known about how these future educators perceive the value of game design for their professional development, or how interventions such as reflective writing can influence their motivation to adopt such practices. Addressing this gap, the present study investigates the impact of self-reflection activities on pre-service teachers' motivation to integrate game design into their future pedagogical practices. By doing so, this research contributes to a deeper understanding of how motivational constructs can be leveraged to support meaningful technology integration in teacher education programs.

Theoretical Framework

Game Design and Learning

Design, especially game design, is a complex process that requires intentional efforts to combine different pieces of knowledge and information in order to create a final product or solution (Ke & Im, 2014). Since games are interactive and intricate systems that respond to user choices, the design process is inherently iterative and layered (An, 2016). Because of the higher-order thinking involved, an increasing number of educators are using game design to engage students in technology and

programming concepts. Through game design, students go through a metacognitive process with the goal of creating both entertaining and functional games (Clark & Sheridan, 2010). Kafai and Burke (2015) suggest that game design gives students insights into the long-term benefits of computing and digital design. Additionally, it provides a conducive learning environment for the development of higher-order cognitive functions and problem-solving skills (Akcaoglu, & Kale, 2016; Yang & Chang, 2013), while also fostering creativity, digital literacy, and algorithmic thinking (An, 2016). The growing body of research in this field supports the effectiveness of game design in enhancing programming (Carbonaro et al., 2010; Denner et al., 2012), problem-solving (Akcaoglu & Koehler, 2014; Hwang et al., 2014), and creative thinking skills (Eow et al., 2010; Navarrete, 2013).

Game Design in Teacher Education

Although young people show a strong interest in games, this enthusiasm has not been fully leveraged in teacher education programs. Existing studies provide foundational insights but reveal important limitations. For instance, Li et al. (2013) found that game design courses can positively shape pre-service teachers' attitudes and skills for using digital games in education. Similarly, Sancar-Tokmak (2015) reported that game design activities enhanced pre-service teachers' technological, pedagogical, and content knowledge. Additional studies (e.g., Akcaoglu & Kale, 2016; Yukselturk & Altiok, 2017) highlighted increased self-efficacy and technical skills through programming and design tasks. However, while these studies focused on skills and attitudes, they largely overlooked the motivational processes that drive pre-service teachers to integrate game design into their future teaching. Few have examined how self-reflective activities can strengthen the perceived value of game design in teacher preparation. The current study addresses this gap by investigating how self-reflection influences pre-service teachers' motivation to adopt game design as a pedagogical tool.

Utility Value and Utility Value Interventions

Motivation is a theoretical concept used to explain various aspects of behaviour, including its initiation, direction, intensity, persistence, and quality (Brophy, 2010; Maehr & Meyer, 1997). It influences how long we persevere with certain tasks and, ultimately, our success in them (Wigfield & Eccles, 2000, 2004). In the context of motivation, utility value refers to an individual's perception of how relevant and useful a task is for their future career or life (Hulleman & Harackiewicz, 2009).

Utility value is understood as an individual's belief in the importance of a task and its relevance to other areas of their life (Akcaoglu et al., 2018; Hulleman et al., 2010). Specifically, interventions aimed at enhancing utility value are crucial for increasing student engagement in learning environments (Canning & Harackiewicz, 2015). These interventions help students establish personal connections to the content (Canning, Priniski, & Harackiewicz, 2019). Canning and Harackiewicz (2015) observed that such utility-value interventions are particularly effective for students who typically underperform in subjects. Therefore, students should focus on finding personal relevance in course content rather than simply summarizing it (Daniels & Goegan, 2019).

One strategy for influencing students' perceptions of the value of their education is through the implementation of simple reflection tasks (Lazowski & Hulleman, 2016). For example, Hulleman and Harackiewicz (2009) found that such tasks were effective in helping students with low self-efficacy to recognize the significance of school subjects, such as science, for their future lives. Consequently, these students experienced a notable improvement in their GPAs, with an increase of nearly one grade point. In fact, a meta-analysis conducted by Lazowski and Hulleman indicated that interventions aimed at enhancing the utility value of education yielded a moderate effect size (Average d = 0.39). The incorporation of self-reflection activities enables students to identify the relevance of their academic tasks to their personal and professional lives, thereby influencing their academic performance, interest in the subject matter, and perceptions of its value (Prinski et al., 2019).

Canning et al. (2018) conducted a study that demonstrated the effectiveness of UV writing interventions in enhancing task engagement and academic performance in introductory courses. The

researchers further suggested that these interventions may have the potential to encourage students to pursue STEM courses and specialize in STEM fields. Similarly, Duffin et al. (2016) also found that utility-value interventions led to an increase in students' perceived utility-value for chemistry content and bolstered their intention to pursue a career in chemistry.

When combined with self-efficacy beliefs—defined as one's confidence in successfully completing a specific task—utility value beliefs become strong predictors of academic achievement (Prinski et al., 2019). In a focused study on the impact of such interventions on pre-service teachers, Kale and Akcaoglu (2018) utilized utility value reflections to increase technology use and interest among these teachers. Their research demonstrated that pre-service teachers who contemplated the future relevance of educational technology in their teaching experienced increased interest levels after the intervention, regardless of their initial interest.

Gender Differences in STEM and Computer Science Domains

A significant issue in the fields of STEM and computer science (CS), both in academia and the workforce, is the notable disparity between males and females in terms of their participation and career choices (Cheryan et al., 2017; Google Inc. & Gallup Inc., 2016; 2017; Lishinski & Yadav, 2019). For instance, Programme for International Student Assessment (PISA) conducted by the OECD in 2015 revealed that male students had higher levels of science self-efficacy and greater interest in science subjects compared to their female counterparts (Mostafa, 2019). Similarly, a recent study conducted in Turkey found that male students exhibited a higher interest in pursuing careers in STEM fields (Ünlü & Dökme, 2020).

One of the contributing factors to this gender disparity is students' attitudes and perceptions towards computer science, as well as their understanding of success in this field (Stoilescu & Egodawatte, 2010). Bonner and Dorneich (2016) argued that providing female students with STEM learning experiences, particularly from an early age, can positively impact their likelihood of pursuing careers in STEM fields. Conversely, McGuire, Jefferys, and Rutland (2020) highlighted that, in the UK, despite early exposure to computer science for all children, few female students choose to take national computer science exams. A similar trend is observed in the US, where the number of female students enrolled in CS programs is significantly lower than their male counterparts (Guzdial, 2019).

Amid growing global concerns about economic competitiveness, increasing female participation in computer science (CS) has emerged as a pressing priority. To address the gender gap, educators and researchers have launched targeted initiatives—such as Girls Who Code and Girl Scouts technology programs—that aim to both introduce girls to CS and foster their sustained motivation in the field. Denner et al. (2012) suggest that students may be encouraged to pursue CS careers through two complementary pathways: cultivating interest and enthusiasm, and introducing fundamental computational concepts. In this context, enhancing female students' experiences with computers and boosting their computer self-efficacy are expected to positively influence their long-term engagement in CS (Ioannis & Maria, 2019). These findings are directly relevant to the current study, which explores motivational factors—such as utility value and self-reflection—in shaping pre-service teachers' intentions to use game design as a pedagogical tool. Given that pre-service teachers will play a key role in either reinforcing or reducing gender gaps in technology education, understanding how to increase their motivation and self-efficacy is crucial for supporting more inclusive and engaging CS learning environments.

The Present Study

Considering that game design represents an advanced form of technology integration in teaching, understanding how to enhance the effectiveness of such integration in pre-service courses is crucial. Therefore, the purpose of this study was to examine the effect of self-reflection activities on pre-service

teachers' perceptions of utility value related to incorporating game design in their future instructional practices.

Our research questions regarding utility value are as follows:

- Does the self-reflection activity impact pre-service teachers' utility value to teach with game design?
- What are the linguistic features that explain the intervention effects?
- Is there any utility value change by gender?

To the best of our knowledge, no existing study has examined the impact of self-reflection activities on the perceptions of pre-service teachers regarding the usefulness of game design in educational settings. This study aims to connect the fields of educational psychology and educational technology by demonstrating how interventions from the former can be applied to the latter. Additionally, our research utilizes computational text analysis methods, which serve two purposes: verifying the authenticity of our students' writings and uncovering the linguistic mechanisms that contribute to the effectiveness of the writing activity. This study is significant because it provides empirical evidence for the effectiveness of self-reflection in shaping perceptions of the usefulness of teaching with game design.

Methodology

In this quasi-experimental study, we investigated the effects of a self-reflection activity on pre-service teachers' utility value toward game design. We chose this study design because it allows us to reveal the cause-and-effect relationship between the intervention and motivation outcomes. During the research, freshmen pre-service teachers from different majors were randomly assigned as either the experimental or control group within their classrooms based on their order in the class list (odd/even) before the intervention.

Participants and Context

The study sample consisted of 129 first-year pre-service teachers enrolled in a variety of majors at a mid-sized public university in Turkey. Participants ranged in age from 17 to 33 years, with a mean age of 19.62 years (SD = 2.11). This group was selected through convenience sampling, as it provided a readily accessible population of pre-service teachers early in their educational training. The breakdown of participants by gender and major can be found in Table 1. While the use of convenience sampling may limit the generalizability of the findings, it is a common approach in educational research when studying specific populations, particularly at the early stages of teacher training.

Table 1.
The profile of the participants

	Variable	**n**	**%**
Gender	Female	33	25.6
	Male	96	74.4
Major	English Teaching	31	24.0
	Preschool Teaching	35	27.1
	Counselling Education	25	19.4
	Turkish Teaching	16	12.4

Procedures

The current study was conducted as a part of a three-credit, mandatory, Information Technology course at the university level. The course was designed to introduce the pre-service teachers to general concepts in information technologies and to increase their computer literacy. Due to the COVID-19 pandemic, the course was offered fully online. Moodle, a learning management system, was used for file sharing and assignment submissions, and Google Meet for live sessions. The primary researcher actively participated in the study as the instructor responsible for overseeing the application process.

In the context of this study, students utilized Microsoft Kodu for game development. This platform offers multiple advantages, including visual appeal and the elimination of the need for coding skills. Additionally, it is freely available, supports 3D environments, is suitable for children, and employs a user-friendly visual programming tool that doesn't require extensive technical knowledge (Microsoft, 2021).

Before the study began, an orientation was held to introduce students to game development tools such as Scratch, Stencyl, and Game Maker. The session also covered basic elements of digital games and steps in the game development process, such as making a prototype and evaluation.

During the semester, all participants engaged in the same teaching activities, regardless of their study conditions. In addition to regular asynchronous learning, there were one-hour live sessions for three weeks, which all students attended and completed the assigned tasks. The course unfolded as follows:

- During the first three weeks, students were introduced to the basic features and functions of MS Kodu.
- Activity sheets detailing specific tasks like objectives, characters, and sensors were distributed to the students, who then developed these components and posted screenshots in a forum.
- In subsequent weeks, each student developed a single educational game, choosing from various game types like shooter, platformer, quiz, or race, and completed the projects individually.
- In the fourth week, students chose an educational game topic and drafted a game scenario within a week.
- In the fifth week, they created either a paper prototype or a graphical representation of their game world.
- In the sixth week, the game designs were developed using MS Kodu.
- In the seventh week, students had a family member evaluate their games with a provided evaluation form, followed by revisions based on the feedback.

Detailed information about the implementation process is available in Table 2.

Table 2
Details of the study process

Week	Topics	Activities

1	• Introduction activities
	  ○ What is a digital game?
	  ○ Components of a game
	  ○ Game development tools
	  ○ Game development process (Analysis, Design/Development, Evaluation)
	• Installation of MS Kodu
		• Hello rover!
		• Let's shoot!

	• Language settings • Configuration settings • Game environment/Adding an object/changing object settings • Saving game • Exporting game • Implementation of Kodu objects to move on a path • Implementation of eating an apple	
2	• Landscape editing (square brush, round brush, etc.) • Adding label—adding music • Camera settings • Cut/Paste line of verse • Making score • Switching pages • Count-down	• Build a maze game
3	• Implementation of rover object grab/release • Speech dialog • Chronometer • Two-player games	• Let's pick the coins!

4	• Systematic game development process
	  • Analysis stage
	  • Design stage I
		Free design
		• Determining the game topic and target group and
		• Filling the game design template (writing a game scenario, defining game rules and characters in the game)

5	• Design stage II	• Making the paper prototype or drawing the game world
6	• Development stage	• Developing game designs with Kodu
7	• Evaluation stage	• Making the game evaluate using the evaluation form, and revising the game according to feedback

Figure 1. A screenshot from a student's game about water creatures

Intervention

The intervention occurred in Weeks 2, 5, and 7. During these weeks, the students completed a distinct set of experimental tasks asynchronously in addition to their regular instruction (refer to Table 3 for details). The students in the control group only wrote summaries of the game-design activities they participated in. On the other hand, the students in the experimental group were instructed to engage in activities aimed at enhancing their understanding of the relevance of the game design skills to their future teaching. To this aim, the students in the experimental group were prompted to reflect on the relevance of these skills each week (see Table 3 for the specific self-reflection prompts used in the intervention). In the study, the application process was implemented identically for both the experimental and control groups of students. The only difference in the intervention was observed in that students in the experimental group wrote reflection reports, while students in the control group created course summaries.

Table 3.

Self-reflection prompts used in the intervention

Weeks	Self-reflection prompts
2	Your task here is to tell us about your favourite game(s) you play in your spare time. If you haven't played before, you can play one of the web games. While doing this, it is important to pay attention to the following points: • You can choose one or more (up to 3) games (but choose at least one game) • Tell me why you like these games. • Tell us what makes these games special for you. While writing this paragraph, you can give short examples from the game. For example, if there is an important story in the game, you can mention it, or at least outline the story. Take care to write as much detail as possible about this game or

	games so that someone who has not played the game before can easily understand whether the game will be fun when they read your paragraph.
5	Demonstrate the importance of the lesson by explaining how game design skills could be useful for your school or real life. You can also talk about how you use your system analysis, debugging, and decision-making skills during game design activities and how these skills can be useful to you in real life.
7	Write a short paragraph considering the stages in the game development process (analysis, design, development, evaluation) of this course. When writing the paragraph, consider one or more of the following game design activities you did during the game design. • When you do research about the target audience, take into account the characteristics of the target audience and shape the game design accordingly. • When you write a game script and make a paper prototype or draw a game world during the design process. • When you revise the game according to the feedback you received from peers and self-evaluation.

Table 4
Reflection samples

Reflection with Relevance	Reflection without Relevance
It is an undeniable fact that playing games has an important part in the lives of people and has become a regular activity as well as watching TV series/movies. People have a lot of fun while playing games. It would be wrong not to integrate games into education, especially when many students' interest, I designed a game that allows teenagers begin learning English from games. This is where game design skills get involved in my teaching life. I am planning to become an English teacher. Vocabulary is one of the basic subjects in EFL education that I have to teach my students. The importance of vocabulary is so high not to be ignored in foreign language education. To make this teaching process become more fun, more practical, and easier is to integrate vocabulary into a game. Therefore, in the future, I would like to teach vocabulary to my students through a game that I designed. This is the contribution of game design skills to my teaching life. I can use these skills in my child's development when I become a parent. By designing suitable games for his age and cognitive level, I can teach him/her many things very easily and effectively. Coding games may contribute directly to my life.	In my MS Kodu game, I created geometric shapes on a flat background, made each a different colour, and wrote numbers on them. With this game, students will gain both the ability to distinguish colours and four processing skills. To increase students' interest, I designed a game that allows students to earn 10 points for each activity. The students who complete 50 points will be successful in the game.

Fidelity and Participant Flow

Implementation fidelity refers to the extent to which an intervention is implemented as intended (Carroll et al., 2007). Maintaining fidelity is crucial for making accurate and consistent comparisons (Moncher & Prinz, 1991). Therefore, prior to data analysis, we reviewed three types of assignments completed by the participants: self-reflections and lesson summaries. Initially, we examined the students' self-reflections and excluded those that merely provided a summary without indicating their significance. Below is an example of a removed reflection and a reflection that establishes relevance for comparison.

After conducting fidelity checks, we adjusted the total number of participants. Initially, the study included 129 participants, including those in the control group. However, we had to exclude twelve participants from the data analysis because they did not complete the required reflections and summaries related to game design. Therefore, the final participant count, including the control group, is 117. You can see the sequence of participant flow in Figure 2.

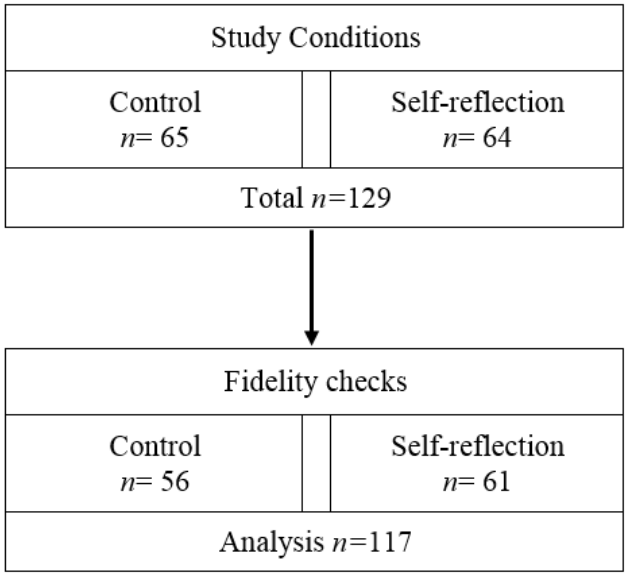

Figure 2. Participant flow chart

Data Collection and Instruments

Data were gathered through a utility value in the game design scale, as well as through participants' self-reflections and summaries. A pre-survey was administered prior to the commencement of the game design course, and a post-survey was collected following the conclusion of Week 7.

The utility value in game design scale used in this study consisted of six items adapted from the utility value scale developed by Hulleman et al. (2010). The original scale was in English, and the items were translated into Turkish by a bilingual researcher fluent in both languages. A back-translation procedure was employed to ensure the accuracy and clarity of the translation, in which the Turkish version was translated back into English by a second bilingual researcher. Discrepancies between the original and back-translated versions were resolved through discussion and refinement. The scale employed a seven-point Likert-type response format, ranging from (1) strongly disagree to (7) strongly agree. The items were customized to reflect the specific context of game design in education, with examples such as, "Using game design in class is relevant to my future teaching." The reliability of the scale was assessed using Cronbach's alpha, which yielded a coefficient of .90, indicating high internal consistency. The full list of items in the utility value in game design scale can be found in the appendix.

The qualitative data of the study comprised the self-reflections and summaries of the control and experimental group students. The self-reflection prompts are provided in detail in Table 3. The data were collected through assignment submissions in the learning management system.

Data Analysis

Quantitative data obtained from the study were analysed using JASP 0.14.1 statistical software (JASP Team, 2020). All statistical analyses used a significance level of .05. The data were analysed with an independent samples t-test due to the normal distribution of the data.

In this study, we employed the Linguistic Inquiry and Word Count (LIWC) software for linguistic analyses. Initially, all summaries and self-reflections, originally in Turkish, were translated into English using both human translators and machine translation tools like Google Translate. LIWC, a tool widely recognized in social science research for content analysis of high-reflective texts (Akcaoglu et al., 2023; Akcaoglu, 2018; Dudău & Sava, 2021), facilitates the examination of emotional, cognitive, structural, and process components in oral and written speech (Pennebaker, 2014).

Developed by Pennebaker and Francis (1996), LIWC has evolved significantly, enhancing its capacity to analyse a broad spectrum of linguistic elements. Its operational functionality involves analysing word frequencies in a text file, and categorising them into predefined groups reflecting social, psychological, and speech dimensions. For instance, words indicative of a positive tone were categorized accordingly, based on LIWC's extensive dictionary, in which each word is linked to one or more categories derived from psychological theories (Dudău & Sava, 2021).

Our analysis capitalized on LIWC's robustness in identifying meaningful word usage patterns. It quantified usage of first- or second-person pronouns and other functional words, associating them with psychological categories such as self-focus, cognitive complexity, and goal effort. Crucially, LIWC's methodology accommodates the complexities of overlapping categories. In the cognitive processes category, words can simultaneously relate to insight, tentativeness, certainty, and differentiation, highlighting LIWC's nuanced approach to text analysis (Dudău & Sava, 2021).

To illustrate, LIWC adeptly categorizes statements containing both cognitive processing and emotional expression elements by evaluating their predominant linguistic features. This fine-grained analysis is pivotal in our study, especially in examining the impact of self-reflection on utility value. By dissecting self-reflective statements through their emotional and cognitive word choices, LIWC contributed significantly to our understanding of how these aspects interplay to enhance the utility value of experiences. Moreover, the choice of LIWC is justified by its historical reliability and validity in automated text analysis (Boyd, 2017). We tailored LIWC to our specific context, ensuring accuracy and relevance. This customization underscores LIWC's flexibility and effectiveness in diverse linguistic and cultural contexts.

In sum, the use of LIWC in our study not only strengthens our methodological approach but also aligns with similar successful applications in the field (Kahn et al., 2018). While acknowledging LIWC's limitations in capturing subtleties of idiomatic expressions and cultural linguistics, we complemented its analysis with human interpretation where necessary, thereby enhancing the overall robustness and reliability of our linguistic analysis.

Results

Impact of Self-reflection on Utility Value

To address our initial research question, we first calculated a change score by subtracting the pretest scores from the post-test scores. We then conducted an independent samples t-test to examine the change in utility value for both the experimental and control groups after the intervention. The findings indicated a significant difference between the two groups in terms of utility value change post-intervention, $t(115) = 2.65$, $p = .009$. These significant t-test results confirmed a divergence between the groups in their level of utility value after engaging in reflections on game design activities. The mean utility value for the

experimental group (M = .11, SD = 1.4) showed an increase, while the control group (M = -.57, SD = 1.4) exhibited a decrease post-intervention. The effect size for the change in utility value was calculated as .49, suggesting a medium to large effect size (Cohen, 1988). This indicates that the self-reflection activity had a moderate impact on pre-service teachers' willingness to teach with game design in comparison to simply summarizing course content.

Table 5
Descriptive statistics of pre-service teachers' utility value by intervention type

		Pre-Utility Value		Post-Utility Value	
Group	N	Mean	SD	Mean	SD
Control	56	4.56	1.48	3.99	1.43
Experimental	61	4.34	1.37	4.45	1.51

As presented in Table 5, the pretest scores were approximately four on a six-point Likert scale, indicating that both the control and experimental groups initially held similar positive perceptions of utility value. However, after the intervention, the control group's utility value perceptions noticeably declined, while those of the experimental group modestly increased. Descriptive statistics highlight that the experimental group demonstrated a higher level of utility value perceptions in comparison to the control group, as depicted in Figure 3.

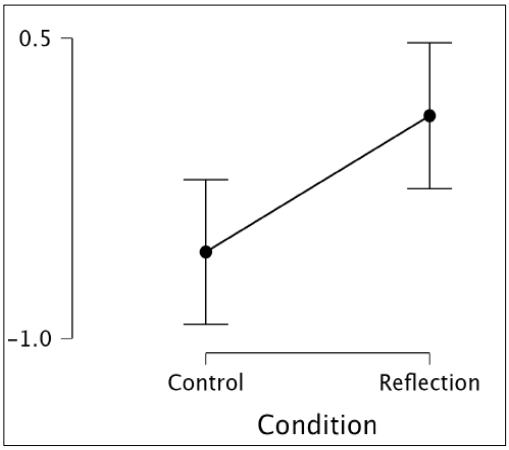

Figure 3. Utility value changes after the intervention

Linguistic Features Explain Intervention Effects

Using the LIWC tool, an independent samples test was conducted to examine the disparities in reflections and summaries between the control and experimental groups. The results of the analysis indicated that the experimental group displayed significantly higher usage in cognitive processing, $t(142) = 5.4$, $p < .001$; affect, $t(124) = 10.13$, $p < .001$; tentative language, $t(124) = 3.3$, $p < .001$; and future focus $t(124) = 7.787$, $p < .001$, compared to the control group. These findings suggest that there is a statistically significant distinction in cognitive processing, affect, tentative language, and future focus between the two groups. Effect sizes for these differences ranged from medium to high, with respective values of $d = .96$ for cognitive processing, $d = 1.81$ for affect, $d = .59$ for tentative language, and $d = 1.4$ for future focus.

Is there any utility value change by gender?

The results of the independent samples t-test analysis on utility value change by gender are presented in Table 6.

Table 6

The independent samples t-test result for the utility-value change by gender

Group	N	M	SD	df	t	p	Cohen's d
Male	31	-0. 914	1.58	115	-3.33	0.001	-0.698
Female	86	0.039	1.28				

As seen in Table 6, a significant difference was found between male and female participants' utility value change [t(115) =-3.33, p =0.001, p<0.05]. The mean of the female participants' utility value increased while the mean of the male participants' utility value decreased after the game design process.

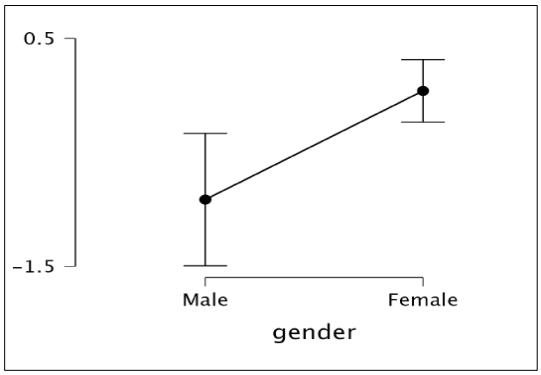

Figure 4. Utility value change by gender

These findings indicated that gender had an impact on pre-service teachers' utility value perceptions, and the effect was different depending on the type of intervention. As presented in Table 7, the pretest scores were around 4 on a 7-Likert scale, indicating that female and male participants had close positive utility value perceptions. But, after the game design process, male participants' perceptions of utility value declined sharply, while utility value perceptions of female participants increased slightly (see Figure 4). As indicated by the descriptive, the female participants showed a higher degree of utility value perceptions than the male participants.

Table 7

Descriptive of pre-service teachers' utility value by gender

		Pre Utility Value		Post Utility Value	
Gender	n	Mean	SD	Mean	SD
Female	86	4.41	1.39	4.45	1.38
Male	31	4.54	1.44	3.62	1.62

Discussions

This study aimed to investigate the influence of self-reflection activities on the perceived utility value of pre-service teachers regarding teaching with game design. The results support our hypothesis, demonstrating that self-reflection activities effectively increased perceptions of utility value. Participants who engaged in self-reflection reported higher levels of perceived utility value than those who summarized the content and activities of the game design course.

Our findings align with existing literature suggesting that self-reflections on utility value enhance participants' engagement and interest in tasks. For example, Duffin et al. (2016) found that interventions targeting utility value increased students' perceived utility value in chemistry and influenced their career choices. Similarly, Kale and Akcaoglu (2018) indicated that pre-service teachers who reflected on the future utility of educational technology exhibited higher levels of interest. Students who made connections between game design and future teaching found more utility in these tasks. This outcome can be attributed to their enhanced understanding of the benefits of game design for their personal and professional development. As mentioned earlier, the literature suggests that self-reflection activities can strengthen students' perceptions of utility value. While our study focuses on immediate intervention effects, recent research suggests that these activities could have long-term benefits.

Previous studies on utility value have utilized linguistic analysis in addition to qualitative human coding (Hetch, 2019; Harackiewicz, 2015; Akcaoglu et al., 2018). This approach serves two purposes: ensuring intervention fidelity and providing insights into underlying mechanisms. For instance, Hecth et al. (2019) used linguistic analysis to assess students' personal focus and engagement, which approximated self-relevance. The increasing availability of computational text analysis tools can provide an additional source of data and help corroborate qualitative findings. Given the rapid analysis capabilities of these tools, they could be employed in educational settings to monitor students' writings for specific linguistic features that align with pedagogical goals.

In our study, linguistic features such as cognitive processing, affect, tentativeness, and future focus were more prevalent in the self-reflections of the experimental group. These features likely indicate the mechanisms driving the effectiveness of the self-reflection activity. Our results are consistent with similar studies; for example, Hecht et al. (2019) found a greater personal focus in utility value reflections, which positively affected other motivational factors. Similarly, Akcaoglu et al. (2018) reported increased cognitive processing in students' writings when they focused on creating personal connections.

The findings of this study revealed notable differences in the utility value perceptions between male and female participants following the game design process. Specifically, female participants experienced an improvement in their utility value perceptions, whereas male participants saw a sharp decrease. This discrepancy may stem from gender-related disparities in expectations towards the game design software and process. It is plausible that the game design activities failed to meet the expectations of male participants. This finding could be attributed to tool features within the game design program (MS Kodu) and potential shortcomings in the implementation process, as highlighted by Akcaoglu and Green (2019). For instance, the inability to incorporate external objects into the game worlds and the presence of fixed sensors/actions in MS Kodu software may have contributed to this outcome. In a related study, Hava et al. (2020b) discovered that gifted students expressed dissatisfaction with the limited characters available in MS Kodu, asserting that the software was insufficient for developing advanced games. The high expectations among participants may have led to disappointment and subsequently lower perceived value. Additionally, it is plausible that students with more gaming experience were particularly disappointed with the game design software. This group may have included a larger proportion of males than females.

The findings of this study not only contribute to our understanding of how self-reflection activities influence the perceived utility value of game design, but also hold significant implications for pedagogy,

particularly for pre-service teachers. As future educators, pre-service teachers will be tasked with integrating innovative teaching methods, such as game design, into their classrooms. The increase in perceived utility value observed in the experimental group suggests that self-reflection activities can help pre-service teachers recognize the relevance of game design to their teaching practice, fostering a deeper appreciation of its potential to enhance student engagement and learning outcomes.

Self-reflection activities encourage teachers to connect new teaching tools—such as game design—with their own teaching philosophy and future classroom applications. By engaging in these activities, pre-service teachers can develop a more nuanced understanding of the value of game-based learning, which is increasingly recognized as an effective approach in today's digital age. This process may also increase their self-efficacy, motivating them to integrate game design into their future pedagogical practices with greater confidence and enthusiasm.

Furthermore, considering the growing emphasis on technology integration in education, the ability to critically assess the utility of educational tools like game design will be invaluable for pre-service teachers. As our findings suggest, students who engage in self-reflection activities related to the utility value of game design are better positioned to understand how such tools can be used to meet educational goals, making them more likely to embrace and apply these tools in their own teaching contexts.

Limitations and Future Research

Several limitations in the current study should be acknowledged, as they set the stage for future academic exploration. Firstly, the game design activities were conducted exclusively online, which inherently restricts the depth of student-teacher interactions compared to traditional face-to-face instruction. This virtual setting may have hindered effective scaffolding, particularly during the developmental stages of game design activities. Furthermore, certain pedagogical activities that are feasible in face-to-face settings, such as peer game evaluations, were absent. Despite these constraints, our course and targeted interventions demonstrated effectiveness in enhancing the utility value for pre-service teachers in game design. In the future, research could investigate hybrid instructional formats that combine online and face-to-face elements to optimize scaffolding and promote peer interaction opportunities.

Despite the random assignment of participants to the groups, there exists an imbalance in the number of male and female participants. The male participants (n=31) in this study were significantly outnumbered by the female participants (n=86). Nevertheless, this disparity is representative of the teacher education programs in the study's context, where the majority of students are female. Consequently, this serves as an accurate reflection of the quasi-experimental nature of the research. However, it is important to acknowledge that there are distinct differences between male and female students, and future research should delve into the reasons behind the divergent perceptions of utility value in game design activities. In order to thoroughly examine the gender gap, qualitative methods could be employed in future studies to compare pair and individual programming.

Second, the lack of feedback on students' self-reflections represents a methodological limitation. Future studies could incorporate real-time or asynchronous feedback mechanisms within utility value interventions to assess their impact on student outcomes. Examining the nature, timing, and source of feedback could provide nuanced insights into how to maximize the effectiveness of utility value interventions.

Third, the study's limited sample size and reliance on only two data collection instruments limit the generalizability of our findings. Future research could expand the sample size and incorporate a variety of data collection methods, such as qualitative interviews, observational data, or longitudinal tracking. These methodological diversifications would address the existing limitations and provide a more comprehensive understanding of the interplay between utility value and technology integration. Additionally, exploring the differential impact of utility value interventions across diverse demographic

groups or educational contexts could offer a broader view, thus expanding the scope and applicability of our findings.

Conclusions and Implications

Utility value has been correlated with numerous positive educational outcomes, such as motivation and beliefs about abilities across different disciplines (Bathgate & Schunn, 2017; Curry et al., 2020). Perceived utility value serves as an effective mechanism for aligning student goals with subject matter (Durik et al., 2018). Moreover, utility value acts as a mediator between beliefs about efficacy and the integration of technology (Cheng et al., 2020). For teachers to incorporate information technologies into their classroom practices, it is crucial for them to recognize the value of these technologies (Akcaoglu et al., 2018). The perception of utility value in technology use within the classroom plays a key role in shaping teachers' intention to integrate technology (Nelson & Hawk, 2020). Therefore, interventions targeted at teacher candidates who acknowledge the significance and value of technological applications are recommended for promoting technology integration (Kale & Akcaoglu, 2018).

Our study demonstrates that game design activities are beneficial from both motivational and cognitive perspectives, serving as effective tools for introducing students to computer science and coding. We discovered that simple instructional interventions, such as encouraging reflections on utility value, can assist students in recognizing relevance and making connections. Technology integration is not just a matter of skill and knowledge; it also requires teachers to perceive the application as relevant for their students. We argue that technology courses for pre-service teachers can incorporate the activities outlined in this paper.

The game design activities implemented were designed to provide pre-service teachers with learning opportunities in design-based learning environments, while also prompting reflections on future pedagogical integration. Beyond the immediate tasks of game design, our focus extended to the incorporation of theory-based practices within this technologically enhanced context. Our goal was to examine how motivational aspects in pre-service teachers could be enhanced to facilitate the inclusion of game design in future instructional settings. In utility value interventions, exposing students to examples of utility value writings relevant to the subject can create a resonance between the content and the learners themselves, thus providing supportive scaffolding (Canning, Priniski, & Harackiewicz, 2019). Peer-generated utility value writing could potentially offer students an additional level of personal connection.

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