

# Investigating the Effectiveness of Personalized Gamification in Enhancing Student Intrinsic Motivation: an Experimental Study in Real Context

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**Abstract.** *Gamification in education has been used to increase student engagement. However, there are concerns about potential negative effects, such as decreased intrinsic motivation and performance. To address these limitations, personalized gamification has emerged as a research focus. It aims to tailor game elements to individual preferences, but its effectiveness compared to a standardized approach is still uncertain. One aspect of personalization that has been underexplored is the visual appearance of game elements. To explore that aspect, we conducted a 4-week experimental study to evaluate gamification personalized through visual appearance in a real lesson context. We focused on the Acknowledgment game element, which is the most used in the literature, and compared students' learning experiences based on personalized and non-personalized badges. The study presents evidence of the effectiveness of personalizing gamification's visual appearance in real educational settings, unlike past research that is focused on changing the game elements available. Thus, we reveal the potential of personalizing game elements' looks to enhance learning experiences.*

## 1. Introduction

Gamification incorporates game elements and mechanics into non-game contexts with the aim to enhance engagement and motivation [Koivisto and Hamari 2019]. In the field of education, gamification has gained significant attention as a promising approach to enrich the teaching and learning process, and empirical evidence has shown positive outcomes, such as increased student motivation, engagement, and knowledge retention [Sailer and Homner 2020]. However, it is important to acknowledge potential negative outcomes, such as decreased intrinsic motivation and performance loss [Toda et al. 2018].

In that regard, the literature often criticizes gamified environments because they are the same for all users, the one-size-fits-all approach, while research demonstrates different people are motivated by distinct game elements [Bovermann and Bastiaens 2020]. Such evidence motivated research on personalized gamification, which aims to acknowledge people's differences by providing them with a gamification design aligned to their

preferences [Rodrigues et al. 2020]. Most often, this is accomplished by changing the game elements available in the gamified environment depending on one's preferences, as found in the literature review by [Hallifax et al. 2019]. However, empirical evidence remains unclear on whether and how such personalization compares to the standard, one-size-fits-all approach (e.g., [Rodrigues et al. 2023, Lopez and Tucker 2021]).

Unlike the most common approach, the same literature found that there is limited research on personalizing how the game elements look [Hallifax et al. 2019]. That is, making game elements aligned to one's preferences by changing how it looks, instead of changing the game element itself. Recent research supports the potential for that approach as, for instance, [Rodrigues et al. 2022] found indication that students felt more intrinsically motivated after receiving badges from a brand they like (i.e., Pokémon), in contrast to generic badges (i.e., Trophies). Similarly, [Linehan and Kirman 2017] provide a compelling argument that the visual Pokémon layer in Pokémon Go<sup>1</sup> plays a key role in its success compared to its very similar counterpart, Ingress. To the best of our knowledge, however, previous studies have not experimentally compared the one-size-fits-all approach and gamification personalized by changing the game element's look in the context of real lessons.

Thus, this paper starts to tackle that gap with an 4-week experimental study conducted in the context of real lessons. Particularly, this study is focused on the Acknowledgment game element (i.e., badges) [Toda et al. 2019] as i) it is one of the most used in the literature [Koivisto and Hamari 2019] and ii) to isolate the change on its looking [Landers et al. 2018]. Based on that, we compared the one-size-fits-all approach, implemented as non-personalized badges, to personalized gamification, implemented as badges with pictures relevant to the users. In contrast, past research on personalized gamification is limited to changing the game elements available, instead of their looking [Mora et al. 2018, Lopez and Tucker 2021, Rodrigues et al. 2023]. Therefore, this paper expands the literature by investigating an underexplored way to personalize gamification, providing empirical evidence on how this alternative compares to the one-size-fits-all approach in the context of real lessons.

## 2. Literature Review

The literature offers several tools, such as frameworks and processes, to support gamifying learning environments [Mora et al. 2015, Knutas et al. 2019]. Whereas most of those highlights the importance of considering users' characteristics in defining the gamification design, most gamified environments act and look the same for all users: the one-size-fits-all approach [Orji et al. 2018, Tondello et al. 2017]. Following increasing evidence that different people have distinct preferences, researchers started exploring the personalization of gamification as a way to overcome the shortcomings of the one-size-fits-all approach [Klock et al. 2020].

Nevertheless, empirical evidence on how personalized and one-size-fits-all gamification is unclear. [Mora et al. 2018] personalized gamification to students' Hexad user types and found nonsignificant differences in terms of motivational outcomes. In contrast, [Hajarian et al. 2019] used log data to personalize gamification and, in the context of social networks, found positive effects on usage data. [Lopez and Tucker 2021] also

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<sup>1</sup><https://pokemongolive.com/>

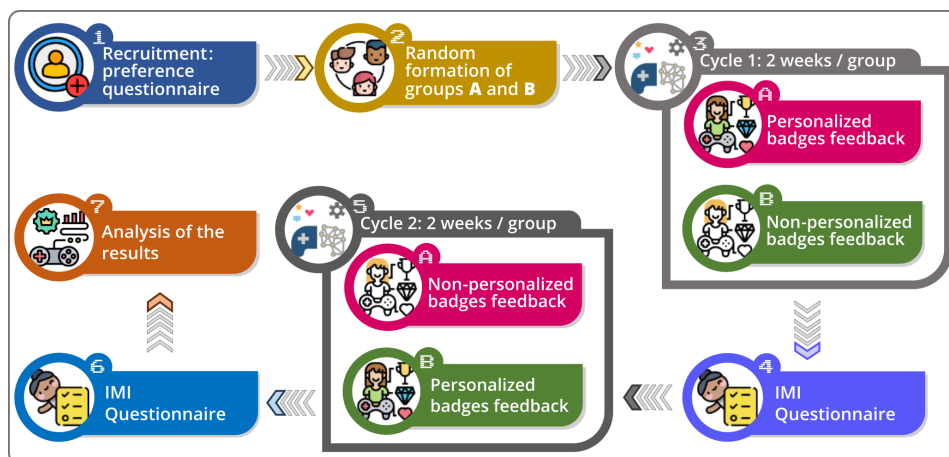
found positive results, but in the context of exercise, after personalizing gamification to users' Hexad types. In the educational domain, [Rodrigues et al. 2021a] found promising results, in terms of student motivation, from using a multidimensional approach to personalizing gamification based on user and contextual characteristics. However, a subsequent study yielded nonsignificant results after the same intervention was evaluated in another sample [Rodrigues et al. 2023]. Importantly, all of those studies personalize gamification by changing the game elements available in the gamified environment.

**Table 1. Related works comparison**

Ref.	Personalization Changes	Domain	Outcome
[Mora et al. 2018]	Game elements	Education	Nonsignificant
[Hajarian et al. 2019]	Game elements	Soc. Network	Positive
[Lopez and Tucker 2021]	Game elements	Exercise	Positive
[Rodrigues et al. 2021a]	Game elements	Education	Positive
[Rodrigues et al. 2023]	Game elements	Education	Nonsignificant
This	Appearance	Education	<i>To be discussed</i>

Table 1 summarizes our related works. On the one hand, research outside the educational domain suggests personalized gamification outperforms the one-size-fits-all approach [Hajarian et al. 2019, Lopez and Tucker 2021]. On the other hand, studies within the educational domain have yielded both positive [Rodrigues et al. 2021a] and nonsignificant outcomes [Mora et al. 2018]. Notably, regardless of the domain, all studies are limited to personalizing gamification by changing the game elements available. In contrast, the literature indicates that ensuring one's interest in the game element's visual is likely to enhance their experience [Rodrigues et al. 2022, Linehan and Kirman 2017, Chou 2019]. Thus, this paper expands the literature by investigating the personalization of gamification by changing the game element's look and comparing it to the one-size-fits-all approach to generate evidence on how this personalization alternative affects learning experiences.

### 3. Method



**Figure 1. Experiment overview.**

This study was driven by the following Research Question (RQ): **is it possible to enhance motivation during the learning process by using personalized acknowledgments in feedback?** In the intention of answering the RQ, an experiment was designed to analyze personalized gamification in a real context. For this, a class of 40 students was randomly divided into groups A and B of the same size for insertion of a counterbalancing [Brant-Ribeiro and Cattelan 2019]. The counterbalancing was employed to eliminate order effects [Wohlin et al. 2012]. Thus, group A first received the personalized acknowledgment game element and subsequently the non-personalized acknowledgment. With group B the process was reversed from that performed with group A. Figure 1<sup>2</sup> shows an overview of this method.

The research participants were students from a technical education program taking an introductory programming course. The content covered the basic concepts of algorithms and programming logic. The experiment was part of the course as a pedagogical strategy to seek greater motivation in the first few weeks. The students were between 14 and 16 years old. As a recruitment strategy (bullet 1 in Figure 1), the initial step involved requesting voluntary participation in a preferences questionnaire. In addition to the experiment, the questionnaire was administered to learn a little more about the class. Regarding preferences, the following topics were considered: i) musical groups; ii) anime; iii) movies; iv) games; and v) books. For each topic, students could answer up to three items. In the end, students could indicate, among the topics, which one they enjoyed interacting with/consuming the most. In this stage, out of the 40 students, 38 submitted responses regarding their preferences. Groups A and B were kept the same size (bullet 2 in Figure 1).

Following this, the Virtual Learning Environment (VLE) was organized to support the experiment. After the week's content, students were challenged to complete a daily activity. The activity was directly related to the content taught in the classroom. Both groups received the same daily activities and feedback on the activity the following day, just before starting a new task. The experiment lasted for four weeks, divided into two cycles (two weeks per cycle) to implement the counterbalancing. Five activities were proposed per week. Students had the option to submit their activities daily and receive feedback along with an acknowledgment. Alternatively, they could choose to accumulate their activities and submit them the day before the following week without receiving any acknowledgment. Thus, each cycle included ten activities, and the four weeks in total comprised twenty activities.

The insertion of gamification in the experiment occurred from the first activity proposed to the students. By providing feedback on the exercise completed by the student, according to their preference questionnaire and group, they would receive a virtual medal (referred to as a badge hereafter), which is an implementation of the acknowledgment game element [Toda et al. 2019]. In the first cycle (bullet 3 in Figure 1), Group A students received personalized badges (Figure 2(b)). In this case, the badge could be, for example, a character from a movie or a game. As mentioned earlier, in addition to listing the names of movies, series, and others, students could also indicate their order of preference. Thus, if a student indicated that games and movies were their preferred activities, the badges related to the chosen games and movies had higher priority. We were careful to provide

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<sup>2</sup>This model was designed using images from Flaticon.com.

unique and individual badges for each activity.

Due to the creation of distinct badges for each feedback, the reward received by the student did not always align with their preferred activities. However, all badges were produced based on the responses provided in the preference questionnaire. For example, a student might have indicated a particular TV series as their favorite, even if it was not among their preferred activities. Nevertheless, a badge featuring that series could be produced at some point. In contrast, for Group B during the first cycle, the same emoji badge was sent to all students (Figure 2(a)). Figure 2 provides a comparison of the badges. Note that the badge was provided to any student who completed an activity within the deadline. The reason for this approach is that, for this research, the objective was to analyze intrinsic motivation through the personalized acknowledgment game element. Furthermore, the customization of badges was closely linked to the student's group affiliation.



**Figure 2. Badges examples used as acknowledgment game element.**

After two weeks of activities, the students were invited to respond to a questionnaire to assess their intrinsic motivation concerning the pedagogical practice (bullet 4 in Figure 1). For this research, we utilized the items that assess “Interest/enjoyment” from the Intrinsic Motivation Inventory (IMI) following the methodology proposed in [Deci and Ryan 2011]. These items were selected because they evaluate the individual's intrinsic motivation, which is strongly related to learning gains [Hanus and Fox 2015, Rodrigues et al. 2021b]. Considering that our sample consisted of Brazilian students, we used the Brazilian Portuguese translated version [Pedro 2016]. Each student was asked to respond to seven items on a seven-point Likert scale. In order to explore additional variables in investigating the impact of using preferences for the acknowledgment game element, students who felt comfortable were also invited to provide an open-ended response regarding their impressions of the pedagogical practice. Comments related to motivation in completing the activities and/or comments specifically about the badges were manually classified as positive or negative. Answers concerning other topics (e.g., the activity's difficulty level) were not considered, as they fall outside our experiment's goal.

Once the IMI questionnaire was completed, the reversal process took place. Students from Group A started receiving non-personalized badges, while students from

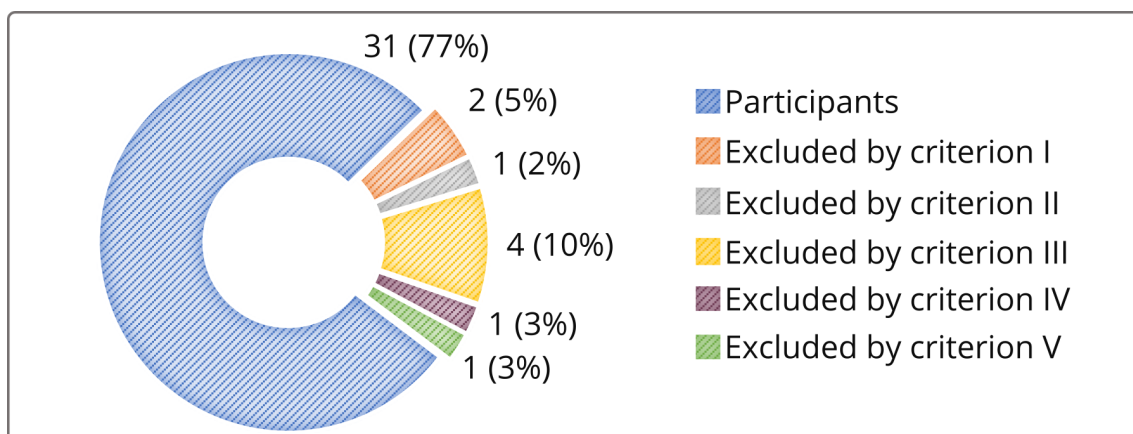
Group B received personalized badges (bullet 5 in Figure 1). The activity process was repeated for another two weeks. At the end of these two weeks, students were invited again to respond to the IMI questionnaire and a similar open-ended question as in the previous stage (bullet 6 in Figure 1).

At the conclusion of the four-week period, we had both quantitative and qualitative data pertaining to motivation in relation to the gamified activity. Table 2 presents the exclusion criteria adopted for this research. Regarding criterion V, it is justifiable because there are some reverse-coded items (i.e., that are completely opposite to each other), which does not allow individuals who are responding carefully to maintain the same extreme value for both (see [Pedro 2016]).

**Table 2. Exclusion Criteria of the Analyzed Sample.**

Criteria	Description
I	Failure to complete the preference questionnaire
II	Failure to complete Part 1 of the IMI questionnaire
III	Failure to complete Part 2 of the IMI questionnaire
IV	Failure to complete any activities in one of the cycles
V	Responding to all items in the IMI with maximum or minimum ratings

In Figure 3, we present the total number of participants in the experiment, as well as the exclusion criteria rates. Despite being part of the methodology of the classes, the experiment still had voluntary participation in all stages. Out of the 40 participants initially invited to the experiments, over  $\frac{3}{4}$  (31 students) participated in all stages, enabling the analysis of results based on this total.



**Figure 3. Total number of participants in the experiment.**

We conducted the data analysis using the results of the questionnaire. Regarding student intrinsic motivation, we calculated it based on the mean of its seven items, after reverse-coding item five, as recommended in the literature [Pedro 2016, Deci and Ryan 2011], for the groups with and without personalization. Specifically, for the first part, we calculated the mean for Group A and Group B. The same process was repeated for the second part. Based on that, we used a paired t-test to test for differences

in intrinsic motivation (dependent variable) depending on the badge design (independent variable: personalized or non-personalized) students received. In this analysis, we adopted the 95% confidence level as recommended in the literature [Wohlin et al. 2012].

Regarding the students' comments about the badges, whether personalized or not, we performed a content analysis on open-ended responses [Blandford et al. 2016]. Based on a manual classification, the students' responses related to motivation were classified as positive or negative, depending on the content of the message. For example, the message *"Very interesting. The reward aspect motivates me to complete the activities on time"* was classified as a positive message. On the other hand, the message *"I don't like the emojis"* was classified as negative. This classification was conducted by an experienced researcher who was familiar with the study participants to increase the results' validity. Table 3 shows some examples. Then, we compared if the number of positive/negative comments differed depending on whether students were commenting about personalized or non-personalized badges. For this, we used the Chi-squared test, also with a 95% confidence level, as suggested in the literature [Wohlin et al. 2012]. The following section presents an analysis of the results.

**Table 3. Examples of comments translated into English.**

Positive Comments	Negative Comments
"Great, now I earn badges with characters!"	"...badges only with emojis (my case) is very uninteresting and demotivating..."
"My experience has been enjoyable"	"I would like to change my badges because I'm not liking them :)"
"...when I started receiving different badges, I felt more motivated to do the activities..."	"I don't care much about the badges, but I would like to receive cooler ones..."
"Interesting, especially the fact that I earn badges..."	"Most of my badges were emojis, I would like to receive cooler badges"

#### 4. Results

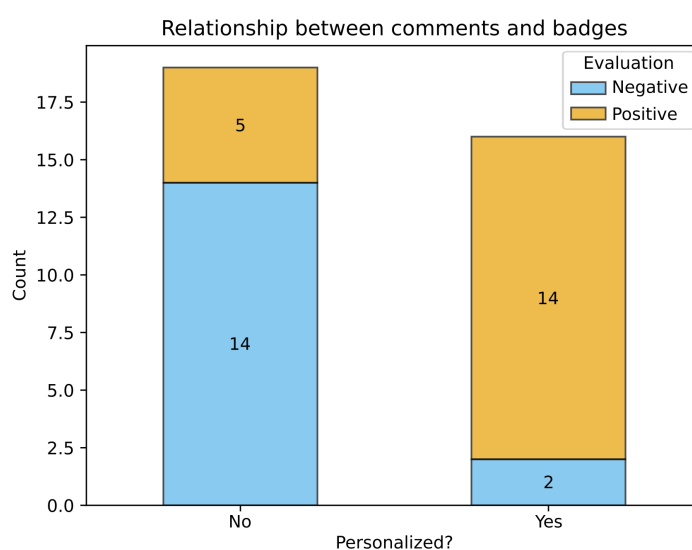
The results of this research were divided into quantitative and qualitative analyses. The quantitative results are shown in Table 4, which demonstrates that the overall score with personalization was slightly higher, although the result without personalization still showed a positive average. Nevertheless, this difference is statistically non-significant at the 95% confidence level ( $t = 1.356$ ; degrees of freedom -  $df = 30$ ;  $p = 0.185$ ; Confidence interval -  $CI = [-0.154, 0.762]$ ) when comparing the intrinsic motivation from receiving personalized badges to that from receiving non-personalized ones. Hence, there is no evidence to reject the null hypothesis that student intrinsic motivation differs depending on whether they received personalized or non-personalized badges. Table 4 also presents the standard deviation (S.D.).

On the other hand, our qualitative findings are somewhat contradictory to the quantitative results. As shown in Figure 4, 14 out of 16 (87.50%) students' comments regarding personalized badges were positive. Conversely, 14 out of 19 (73.68%) comments regarding non-personalized badges were negative (see Table 3 for sample comments). This difference is statistically significant at the 95% confidence level (X-squared

**Table 4. Quantitative analysis of intrinsic motivation with and without personalization.**

	Group A		Group B		Overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Personalized	4,80	1,54	5,04	1,45	4,92	1,50
Non-personalized	4,31	1,34	4,93	1,42	4,61	1,41

= 10.753; df = 1; p = 0.001). Thereby, there is evidence that students' perceptions regarding personalized badges were more positive than those concerning non-personalized badges.



**Figure 4. Comparative graph of comments based on personalization.**

## 5. Discussion

This section i) summarizes and interprets our findings, ii) discusses our study's contributions and implications to research and practice, and iii) presents recommendations for future research based on our experiment's limitations.

### 5.1. Findings' Summary

In summary, our findings are twofold. Quantitatively, the results of the experiment showed a higher average in the assessment of intrinsic motivation with personalized badges compared to non-personalized badges. Although the average was higher, the difference did not reach statistical significance. Qualitatively, however, the results revealed that participants perceived the personalized badges more positively than the non-personalized ones, and this difference was statistically significant.

Based on that context, it is evident that the use of personalized badges led students to make more positive comments about the pedagogical practice of awarding personalized badges compared to the non-personalized approach. Consequently, it is notable that, although there was no statistically significant difference in intrinsic motivation, the use of



personalized badges resulted in more positive learning experiences. Therefore, upon analyzing the open-ended question and considering students' reports, it was noted that the act of receiving a badge already brought about a positive engagement, and the expectation of eventually receiving a personalized badge made them enjoy the activities even when they did not receive personalization. Thus, by completing quantitative results with qualitative insights, it seems that the personalization approach improved students' learning experiences, despite finding a non-significant difference in intrinsic motivation, which might be attributed to, for instance, the sample size (see Section 5.3).

## **5.2. Contribution and Implications**

Overall, our findings expand the literature with empirical evidence from an underexplored approach to personalization. Whereas most research on personalized gamification concerns changing the game elements available [Hallifax et al. 2019], prior studies have mostly found inconclusive results when comparing this approach to the standard, one-size-fits-all gamification [Rodrigues et al. 2023, Mora et al. 2018]. Differently, this study explored personalizing the game elements' appearance. Although previous studies have argued towards that idea's potential [Rodrigues et al. 2022, Linehan and Kirman 2017, Chou 2019], to our best knowledge, past research on the personalization of gamification applied to education has not compared this method to the one-size-fits-all approach. Therefore, this paper contributes to the literature by shedding light on how personalizing gamification through the game element's appearance affects learning experiences.

Overall, our findings corroborate the literature by showing that the use of gamification in education still holds great potential for further research and exploration [Sailer and Homner 2020, Bai et al. 2020, Huang et al. 2020]. Based on our results, considering a real environment and a classroom setting, it is evident that the personalization approach we implemented was able to improve students' learning experiences. Thereby, our findings suggest to practitioners that personalizing badges' appearance is likely to enhance their gamified learning environments. Nevertheless, we did not find statistically significant differences in terms of student intrinsic motivation. Therefore, research in this field should also move increasingly towards new discoveries regarding the personalization of the game elements' appearance, taking into account students' preferences. As motivation is a crucial factor in fostering learning [Deci and Ryan 2011, Vansteenkiste et al. 2009], including elements that make the learning journey more comfortable and individualized can be one prominent contribution to the Educational Technology field. Table 5 summarizes the study's main takeaways.

## **5.3. Limitations and Future Research**

Although the comparative result measuring intrinsic motivation did not show statistical significance in our research, the qualitative analysis revealed positive outcomes regarding personalization. This finding motivates the use and continuation of investigations involving personalized gamification in the field of education. Particularly, this issue is interesting because our sample size ( $n = 31$ ) might have prevented us from finding such a statistical significance for intrinsic motivation. Importantly, despite the modest size, 31 participants are similar to related work (see 2). Moreover, having conducted our experiment in a real setting provides a valuable trade-off compared to exploring a larger sample in a laboratory setting [Wohlin et al. 2012].

**Table 5. Summary of Takeaways**

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Intrinsic motivation was higher for personalized badges, compared to standard ones, but the difference was nonsignificant
Personalized badges were associated with more positive comments than standard ones
Personalized badges enhanced the learning experiences, probably based on a construct different than intrinsic motivation
Our results expand the literature with evidence on the potential of personalizing badges' visuals to improve learning experiences
Further research on personalization of game elements' appearance is recommended to further understand its potential.

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Furthermore, a limitation observed during the research process was related to the administration of questionnaires to assess intrinsic motivation. Despite emphasizing that the focus was on evaluating the Acknowledgment game element, some students found it challenging to isolate the activity itself within the questionnaire format. Another limitation identified was the manual generation of personalized badges according to each student's preferences, which imposed a considerable time burden. Not all instructors may have the availability to invest such time in this task due to their existing workload.

As future work, we hope to explore other ways of measuring the impact of personalized gamification in education, such as: i) instant analysis upon receiving the personalized elements; ii) level of interaction in the virtual environment with and without personalization; iii) motivation for timely submission of activities based on personalization; iv) performance in the discipline with and without personalization. Additionally, with the advancement of Generative Artificial Intelligence, we aim to develop a model that assists in the automatic generation of personalized images, taking into account the student's preferences through continuous interactions.

## **6. Final Remarks**

In this research, we aimed to explore new perspectives on the Acknowledgment game element in the context of gamification in education. Whereas past research has explored the personalization of gamification based on changing the game elements available, our study explored changing the game elements' appearance. Despite the latter has been discussed as a valuable approach to improving student learning experience, to our best knowledge, previous studies have not compared it to one-size-fits-all gamification in real contexts. Therefore, we conducted a 4-week experiment in a real environment where we provided personalized and non-personalized badges as acknowledgments for the timely completion of activities. From our research, we obtained several positive comments regarding the pedagogical practice of personalized badges, as well as negative comments regarding non-personalized badges. Our work advances the field of personalizing game elements in the context of gamification in Educational Informatics. Our results also suggest that this and other game elements can be analyzed through an interface that incorporates affective elements for students engaged in the learning process.

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