

# Digital Badges for Motivating Introductory Programmers: Qualitative Findings from Focus Groups

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**Abstract**—This Research Full Paper presents the qualitative findings from a study that implemented digital badges in a university-level programming course. Motivation has been shown to play a key role in programming performance. Increasingly, gamification is being used to facilitate student learning of concepts and skills in programming. Our study examined the impact of digital badges on the intrinsic motivation levels of introductory programmers and the badge design features leading to motivational effects. We collected data over two academic sessions in 2015 using a badge system design implemented in the Moodle learning management platform. This paper focuses on the qualitative findings from three focus group sessions and personal interviews which explored student understanding of their badge experiences. Focus group results indicated that badges were positively received and motivating. Student recommendations included physical badges to highlight achievements, and competitive badges for added motivation. The results suggest that students' social interactions play a role in how badges are perceived. This study should be of interest to badge designers and educational stakeholders using or contemplating badge systems. In particular, it may be of significance to stakeholders involved in computing education as it seeks to contribute to ongoing research efforts in the introductory programming domain.

**Keywords**— *Introductory programming, digital badges, badge design, motivation, qualitative*

## I. INTRODUCTION

Challenges continue to abound with the learning of introductory programming [1], [2]. Motivation has been shown to play a key role in learner performance in this field [3], [4], [5]. Factors contributing to low motivation to learn to program may be due to a myriad of reasons such as low interest in a unit, difficulties in learning a particular task, and a lack of technical or problem-solving skills [6], the type of major [1], or the programming subject itself [5]. There is growing use of digital badges in education to engage and motivate students [7], [8], [9]. With its roots in gamification, which uses game-like features in non-gaming contexts [10], digital badges are increasingly being used to facilitate student learning of

concepts and skills. How badges are designed and implemented, and what motivational effects they have in different contexts [7] remain to be seen. Studies are also needed which examine the effect of individual game elements on outcomes such as motivation [11].

In programming, gamification research efforts have focused on improving programming skills, engaging students and teaching core programming concepts [9], [12], [13]. Insights into understanding aspects of the relationship between gamification and motivation, especially in different contexts, can prove useful for future badge evaluations [7], [14], as success in one educational context does not guarantee similar results in another [11]. While there are increasing studies on the educational impact of badges, more extensive analysis of badge experiment results is needed to understand, among other things, student behavior with the use of badges [15]. Reference [16] suggest that gamification impacts students with differing motivations in different ways and recommends qualitative approaches to further understanding how these interventions should be designed. Student perceptions of their own participation, or lack thereof, in the gamification effort using badges can shed contextual light on its motivational effects. This is consistent with [17] who posit that qualitative investigations of gamification implementations are needed to understand student perceptions of gamification elements that can lead to successful outcomes.

Using a badge system implemented in the Moodle learning management platform, our research work sought to determine the impact of digital badges on the intrinsic motivation levels of introductory programmers and the badge design features that lead to motivational effects. We collected data from two experiments over two academic sessions in 2015, including focus group interviews, Moodle log data and an adapted version of the intrinsic motivation inventory [18], a multidimensional instrument used to assess participants' subjective experience while performing a given activity. Our study reported mixed findings, resulting in slightly negative quantitative intrinsic motivation results, but the focus group sessions and open-ended survey items on badges indicated that

badges were positively received. The design of the first badge experiment and initial results of the first experimental study, including the first focus group findings are provided in [19].

In this paper, we present a detailed analysis of the qualitative results of both badge experiment studies and further contribute to the ongoing discussion on badges and their motivational effects on students within the domain of introductory programming. Through further exploration of students' self-report of being motivated by badges, we aim to uncover how programming students perceive the motivational nature of badges and their specific design features.

## II. RELATED WORK

Research has shown a positive relationship between high-performing students in programming and high levels of intrinsic motivation [2], [6], hence promoting intrinsic motivation to learn [20] is often desired. Intrinsically motivated students tend to be persistent, apply information to new contexts and adopt a measured approach towards programming problems [6]. Reference [20] suggest that a programming learning environment outside the classroom lacks the necessary scaffolding for novice programmers but there is potential to influence this environment to improve learning. Complementing formal learning with informal learning and gamification may be an effective strategy [21].

Gamification is increasingly being used in technical higher education to motivate and engage students [22], [23]. In a systematic review on gamification in education, [11] revealed that a large number of gamification studies are in the area of Computer Science/Information Technology (CS/IT), but it was inconclusive whether these subjects were more suitable for gamification. The authors speculate that the ease with which CS/IT instructors are able to experiment with gamification in their courses could be a reason for this result.

The impact of gamification on motivation has been the subject of much debate over the past few years. On the one hand, various studies indicate that gamification has a positive impact on learning outcomes [12]. In a study with undergraduate students learning C programming, [9] revealed positive effects on knowledge acquisition and cognitive engagement, with the collection of badges deemed to be the gamification element most successful in fostering engagement. Studies have reported positive motivational effects [24], increased engagement [23], increased participation [22],[25], increased confidence [26], high student satisfaction [22] and personal empowerment, where users are allowed to feel in control of their own learning [27], as positive elements associated with using digital badges. In [13], an authoring tool was developed to help novice programmers test their programming knowledge and skills of Java programs; points, leaderboards and customized gamification settings are included in this tool which the authors expect will reinforce student knowledge and be motivating. Reference [17] used a variety of gamification elements in their study but specifically for the badges element, some participants either did not see or had no interest in them while others felt positive towards them. It was suggested that the positive feelings were due to the fun and

confidence booster associated with the messages and icons, and the self-assessment the badges facilitated.

Conversely, the use of digital badges, as a gamification element, is seen by some researchers as an extrinsic motivational activity which has the potential to decrease student motivation [28], in particular, if too much focus is placed on them [29]. Extrinsic motivators used to promote student learning has been considered to negatively affect student motivation [3]. Educators should therefore be aware that what and how students learn may be influenced by their level of intrinsic motivation even when there are extrinsic influences [30]. Reference [31] suggest research to determine whether badges will provide additional motivation. Other views are mixed; for example, one study [32] revealed that participants considered the use of badges to motivate learners as both an opportunity, example for gaining recognition and value from external audiences, and as a challenge, for example, by decreasing students' intrinsic motivation to learn. Reference [33] found that while game design elements significantly increased performance, they did not appear to affect intrinsic motivation, and should not be used solely for sustaining user engagement in the long term.

There is caution regarding the use of rewards for motivating programming students; rather, it has been suggested that other techniques should be considered to foster intrinsic motivation [3]. Sustaining motivation, however, continues to be an educational challenge [11] and students' intrinsic motivation to learn can shift in either direction from low to high [6]. Reference [5] suggests that instructors should devise ways to motivate and engage students and avoid the assumption that students are motivated to learn programming. Motivating and engaging students can lead to higher levels of sustained interest and better learning of instructional content [30]. Despite this, there is consensus in the literature that exploring various aspects of gamification and its individual design elements across different contexts, such as learner groups, learning environments and badge types, is necessary to examine its educational benefits [7], [11], [33].

## III. METHODOLOGY

Our study sought to determine the impact of digital badges on the intrinsic motivation levels of introductory programmers and the design features that lead to motivational effects. We collected data from two experiments over two academic sessions in 2015 using a badge system design implemented in the Moodle learning management platform. A pre- and post-test intrinsic motivation survey, Moodle log activity data and focus groups were among the data captured in the studies. This paper focuses on the qualitative findings from the focus group sessions and interviews conducted in both experiments to gain valuable insights into student reports of being motivated by badges amid slightly negative quantitative results.

The participants included students pursuing the Programming 1 course offered in the first year of an undergraduate Computing programme. In the first badge experiment, 71 students participated in the study, while for the second badge experiment, there were 280 participants. The number of students in both studies is typical of the registrants

in the academic sessions in which the course is offered. The challenges associated with learning introductory programming, as described above, were not immune from this course. Past experience revealed challenges with class attendance, lack of sufficient practice, particularly outside of classroom sessions and an aversion to drawing flowcharts. Badges were created accordingly and implemented in the Moodle open source learning management system. In a first release of the course, 27 badges were available for achievement, with 2 additional badges were included in the second release of the course.

Badges were presented in three main categories - attendance, participation and flowcharts. In each category, a series of badges including at least one starting badge and a master badge for that category were included. For example, in the Attendance category, a Course Newcomer badge was awarded for attending the first lecture while a Course Ambassador badge was awarded for perfect attendance of all 13 lecture, tutorial and lab sessions. The Participation category include badges such as Little Adventurer awarded to those who viewed general course resources in the learning management system and a Super Adventurer badge for exploring supplemental resources. The Challenger and Super Challenger badges were awarded to those who credibly attempted at least one or all 5 programming challenges respectively. Two badges in this category were also created to encourage reflection of learning - a Reflective Programmer badge awarded for submitting a post to an online forum and a Shining Star badge obtained for the submission of at least 2 online posts that were highly rated by their peers. Other activities included self-test quizzes. The Flowchart category included a Flowchart Novice badge for viewing resources about flowcharts and passing a brief flowchart quiz, and a Flowchart Expert badge for obtaining the other three badges in the category. A fourth category, reflected overall course badges for cumulative achievements in the other categories, for example, the Programming 1 Rookie, Advanced, Pro and Master badges. Students were notified of badges in the lecture sessions and via a document uploaded in Moodle which described the various badges and their earning criteria. The lecture sessions were also used to solicit direct feedback from students who had recently earned badges. In the second iteration, two badges were added, the Avid Adventurer and Enthusiastic Reader badges as we found that students were finding it difficult to obtain the master (Super) badges for the Reader and Adventurer badge types.

Three focus group sessions were conducted to explore student understanding of their badge experiences. The first focus group session related to the first badge experiment was conducted with four of 15 invited students, while individual interviews were conducted with three of the students who were not able to make it to the session. The second and third focus group sessions were conducted with the second badge experiment. The second session consisted of 8 students considered to be high achievers and the third consisted of 9 students of mixed achievement levels. In total, qualitative feedback was obtained from 24 students. The responses to semi-structured interviews were recorded and transcribed. General questions were asked on how students found the badge experience, the extent to which badges shaped their behaviour and their recommendations on the future use of badges. The

content was analyzed in order to yield the main ideas occurring in their responses. This was particularly useful in relation to their recommendations, which covered a wide variety of themes. For example, the Peer Interaction theme arose due to references on peer rating in one of the Moodle forums, how students were made aware of badges, and their interest in sharing their achievements and viewing peer badges.

The next section outlines the cumulative qualitative findings from these sessions.

#### IV. FINDINGS AND DISCUSSIONS

The research questions being addressed were how badges affected the intrinsic motivation of introductory programming students and what were the specific design features of badges that had an impact on students' intrinsic motivation. In this paper, detailed qualitative results from two badge experiment studies are provided and discussed according to current literature. Qualitative student perspectives on gamification elements can reveal how learning is impacted [17]. In our case, the qualitative results provided us with insightful feedback on the use of badges for motivating students.

In the focus group sessions and interviews, students considered badges to be "motivating", "a good incentive" and "useful". Another expressed the view that "even though I didn't get that much badges, when I got a badge, I felt like I accomplished something and felt all good inside". Generally, student motivation differed per individual evidenced from statements such as "badges made you feel like you accomplished something", "I think I could have gotten some more badges maybe if there were some more rewards attached to them, perhaps percentage grades" and "it didn't appeal to me, my motivation doesn't come like that...I just have intrinsic motivation so it doesn't have to be external ...". Another variation of the motivation effect was expressed through the statement "if I did more things to earn badges, I would have been more motivated". One student was neutral, indicating that he received the badge "by default". Views were mixed, however, on whether badges should be used for grading but it was clear that students felt that any assigned grade should constitute only a small percentage of the course. In our view, badges used for grading would further fuel the debate on the use of rewards for fostering motivation to learn.

Students also found the earning of badges by their peers motivating. In the first experiment, the Moodle system did not facilitate the viewing of badges by their peers, however there were some students who shared their badge achievement with others or discussed badges within informal groups. One student expressed the view that if badges were made public then it would motivate the achievement of other badges. It was also suggested that students should be encouraged to speak openly about their badges in other sessions, as this could be a motivator for others, especially as stated by one student put it, "nobody in my group spoke about badges". Other students expressed having increased interactions in informal groups, with one sharing that asking peers about how many badges they achieved initiated friendships in the group. One student confessed becoming interested in badges only after seeing others getting badges. Another admitted to thinking that "I

have to get that badge too” after seeing her peer participate in a badge forum. Students’ descriptions of their badge achievements in the lecture sessions appeared to encourage others as reflected in one student’s comment: “she’s a motivation when you mentioned her in class”. While students agreed that badge achievements should be shared amongst their peers, most were not interested in sharing them to external networks, consistent with the literature [27]. Only two students wanted to achieve more badges to “show off”. This raises the issue of who the audience is, and how receptive they are towards badges. If badges are designed for motivation, then sharing badges outside of a course context may not be meaningful for the students and the external audience. Hence the specific purpose for which badges are designed could indicate how likely they are to be shared externally.

Concerns about badges leading to decreased motivation to learn also arose in different ways. In speaking about the attendance badges, one student reflected, “when I started not to get the badges, it was demotivating”. While concerns that badges may decrease intrinsic motivation for an already motivated student should not be ignored [28],[31], one “already motivated” student acknowledged that badges recognized his hard work but expressed “don’t think I can be motivated more”. The theme of competition arose in student responses. Their opinions differed on whether badges led to competition amongst peers. Some students indicated they worked to earn badges to brag or outdo their peers. A few students felt that including competitive badges would motivate them to earn more badges. Their suggestions on future badges include displaying the top badge achiever for each month, or overall, using a dashboard and being able to challenge peers for their badges. They also recommended an option to enrol in a ranking system so as to not de-motivate peers uninterested in competing. Besides competitive badges for added motivation, students also recommended physical badges to highlight their achievements.

We also received feedback based on the categories of badges - attendance, participation, flowchart and course badges - used in our studies. Some students reported that attendance badges motivated them to attend classes. In [23], high lecture attendance was reported as a result of the reward scheme implemented. In the high achievement group, students deemed that badges would be more rewarding if only some students could earn them. They were not interested in, for example, attendance badges which could be earned by everyone, but instead preferred badges requiring effort in their achievement. Given that course attendance was not compulsory, it may mean that other measures are needed to encourage students to attend classes. Deliberate placement of badges at various sections throughout the period of the course could help to motivate persistence with the course and engagement [15]. The reasons, however, for non-attendance would need to be explored since ineffective content, inconsistent or poor content delivery or even personal activities such as job conflicts or sorting out school-related administrative issues could be contributing causes. Providing badges for high levels of engagement with the content, whether off-line or on-line, rather than for high levels of attendance, may be more a meaningful motivation strategy.

Various activities were available for the participation badges. The main challenge reported with their achievement was that of time management. Consistent with [26], students were willing to participate in badge-related activities but were consumed with course workload, in some instances pursuing up to 6 concurrent courses. Some were also employed and were challenged with both school and work responsibilities.

Regarding awareness of badges, some students expressed being unaware of the document in Moodle describing badges, while others indicated that they saw the document. According to one student, she went onto Moodle to “... download what you need to download and get back off”. Some students also reported receiving badge notifications via email but did not know what was done to earn them. One student stated he merely clicked on the course resources and received the badge notification, without intentionally trying to achieve the badge, consistent with a student’s earlier statement that badges were earned “by default”. Also, not all badges were available for achievement at the start of the course. Some, for example, those associated with quizzes and other types of participation activities, were shown in the system at a later time. One student suggested having all the badges available at the start of the course. Disseminating knowledge about available badges and badge activities at the start of the semester [26] may give them the choice and freedom to participate in those activities that they find challenging and motivating.

Reference [15] recommends social badges to represent tasks such as voting or commenting to motivate usage of a badge system. In our case, very few students submitted a post in the Reflection forum which would have earned them a Reflective Programmer badge if a student posted a reflection. If the reflective post was rated highly by other students, a Shining Star badge could be also achieved by that student. Despite completing the reflection, no other student rated the posts made. The feedback from one of the students who submitted a reflection post was that “nobody rated me, there was no way to get that badge”. When probed, she surmised that the good rapport in the classroom environment would not have led to a poor rating but her peers may have been unaware of the requirement to post. As [15] suggest, making students more aware of these activities could encourage greater interaction. For the same student, badge activities provided motivation to explore the Moodle environment: “it allowed me to actually explore Moodle itself a bit more...every time I went onto Moodle, I would look around to see what is new and what I’m able to do now to get a badge”. Another student expressed in similar terms that going on the system and seeing evidence of a badge achievement would lead him to consider “what else I can do”. One report about the flowchart badges was that they were appealing “because I don’t like flowcharts”.

Badges were considered to be visually appealing with the symbols representative of their intent, though one student found them “just okay”, while another suggested “make them look pretty and more colourful”. Though aesthetics were included in studies mainly for badge descriptions, the use of colour, symbols, icons and other visual elements, could potentially impact whether some students choose to interact with the badge system.

Similar to the view of [6] that motivation to learn can shift in either direction, our experience shows that interest in badges can also increase or decrease throughout the period of exposure. For example, one student initially “did not see the point of badges” but as email notifications of badge achievements came in, she became more interested in them. Also, students could start off being interested in badges but course workload could affect whether they continue.

The increasing number of studies of gamification with badges at the tertiary level suggests that the effect of rewards transcend educational levels. One student admitted to initially thinking that badges was a “primary school thing”, making reference to the reward tokens typically given to children in their early levels of education but later took a keen interest in earning them. Another student remarked that the badges “brought me back to my childhood days in Cub Scouts” but notwithstanding was still very enthusiastic about earning badges. Most students expressed a desire for badges to be implemented in their subsequent programming courses.

As described in the theoretical framework, successful programming students tend to have high levels of intrinsic motivation to learn evident in their persistence and application of information to new contexts [6],[20]. Providing a learning environment outside the classroom to complement formal with informal learning and gamification has the potential to improve their success [20], [21]. In our study, we attempted to provide this environment by placing learning activities within the Moodle environment which students could access in their own time. The qualitative findings from our studies have provided us with insights into how introductory programming students perceive the impact of badges on intrinsic motivation. Altogether the qualitative feedback from the 24 introductory programming students across the two experimental studies, though relatively small, provides a good indication of their perceptions of badges within the Moodle environment. Table I provides a summative view of the themes arising from student feedback on badges as well as examples of statements related to these themes.

TABLE I. STUDENT QUOTES FROM FOCUS GROUP AND INTERVIEWS

Feedback Theme	Examples of Focus Group Remarks
Motivation	‘badges showed that you were accomplishing something’ ‘...already motivated, don’t think I can be motivated more’
Demotivation	‘when I started not to get the badges, it was de-motivating’
Peer Interaction	‘nobody in my group spoke about badges’ ‘nobody rated me, there was no way to get that badge’
System Interaction	‘every time I went onto Moodle, I would look around to see what is new and what I’m able to do now to get a badge’
Value	‘...want badges that everyone won’t earn’
Competition	“I just want to beat everybody”
Grading	‘I think I could have gotten some more badges maybe if there were some more rewards attached to them, perhaps percentage grades’

Feedback Theme	Examples of Focus Group Remarks
Achievement	‘positive reinforcement’ ‘I thought they were very useful’ ‘I was pleased with those I got’
Notifications	‘what was nice was going onto Moodle and getting messages that you had badges’ ‘criteria should be on the badge’
Timing	‘badges came just in time’ ‘liked the timing of the challenges’
Sharing on Social Media	“people will think you are a nerd” ‘they wouldn’t be able to appreciate it’
Physical Badges	‘I would put on a badge pin’

Students generally found their badges, and those of their peers, to be motivating. Few students reported that they were already motivated and did not want to participate in badge activities or that badges decreased their intrinsic motivation to learn. The debate on badges as extrinsic awards which has the potential to decrease intrinsic motivation is valid. The literature suggests that badges, competition and social comparisons via leaderboards could potentially harm motivation [28]. Students’ reported willingness to engage in competitive activities to earn and display their badges indicate, however, that this form of motivation may not be harmful to all students. If achievement is perceived based on the number of badges received, this could raise concern as reflected by one student who wondered whether someone who received the same number of badges “if he’s as good as you”. The students themselves acknowledge that ranking systems could de-motivate some persons and suggested providing an option to enrol. Traditional games incorporate many options such as timed/not timed, scoring/no scoring, levels etc. to suit the motivational requirements of players. Incorporating these options into badge systems where students could choose how they engage with the individual elements may be an effective way to deal with students’ varied learning goals.

Applying a one size does not fit all approach and designing customized game experiences for a diverse group [34] could help to address the issue of decreased motivation, as participants could be given options similar to those mentioned above. In our case, and others, where badge implementations are typically done for a course, this may require significant technical effort for the design of such a system. Research is, however, necessary to investigate how participant’s eagerness and choice of engagement could impact motivation [33]. It is important to highlight that the type of badges earned, rather than the number earned, may be more useful to educators and designers. Allowing students to choose the badges that they are interested in may be more motivating than giving them a list for which all badges are to be acquired to indicate achievement. Also, badges that involve easy exercises may not motivate students to master certain concepts hence careful design of the badge system is required [15].

Our results also show that attendance badges were not highly valued. Students were not keen on sharing their badges via social media or other networks, preferring instead to keep their achievements within their programming social context [27]. One student stated “people will think I am a nerd”. It

appears that despite information on how to earn badges being disseminated in documented and in verbal form, more details should be provided on what actions result in earning a badge to reduce any potential negative motivational effects [7]. Knowledge of how to view the badges of their peers will also need to be shared if the social aspects of badge systems are to be encouraged, particularly if ranking systems are not explicitly set up. Social interactions where students with interest in badges can share their achievements in an ongoing manner, whether through online or offline forums, could be motivating.

## V. CONCLUSION

Gamification and other technology enhanced interventions may lead to increased motivational effects but will vary according to user preferences, interest, culture, personality and other factors [25],[34]. Further work is needed to examine the motivational nature of badges and the specific design features to determine their motivational effects. This study should be of interest to badge designers and educational stakeholders involved in computing education as it seeks to contribute to ongoing research efforts in the challenging domain of introductory programming.

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