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Received: 29 March 2022 | Revised: 29 June 2022 | Accepted: 15 August 2022

DOI: 10.1002/cae.22564

RESEARCH ARTICLE

WILEY

Hackathons as extracurricular activities: Unraveling the motivational orientation behind student participation

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Abstract

The education sector is constantly progressing its competency paradigm by establishing a nexus between practical, theoretical, and technical dimensions of teaching and learning. In the modern age of education, hackathons are becoming increasingly prominent in providing an optimal academic environment that connects classroom learnings to real-life scenarios. This study explored the motivational orientation behind student participation in hackathons through the framework provided by self-determination theory. Specifically, it investigated the role of intrinsic and extrinsic motivations in encouraging initial and continuous hackathon participation. The partial least squares-structural equation modeling method was used to analyze data collected from 437 students in 12 countries. According to the findings, although intrinsic motivation influences participation intention, extrinsic motivation drives continuance participation. When intrinsic and extrinsic motivational constructs were analyzed individually, it was found that continuance participation demands both motivational orientations. Comparisons of demographic characteristics indicate that older students with more extensive educational experience may have higher intentions to participate and continue participating in these events. This study offers insights into how the education sector can increase hackathon participation by tapping on students' motivational orientation. From a methodological point of view, it is apparent to recommend the promotion of hackathons as a core extracurricular activity at a school level, and more indispensably, as pedagogy at a classroom level. In a world where students are encouraged to fail early, fast, and often, participating in hackathons is a tactical preparation for eventual success.

KEYWORDS

extracurricular activity, extrinsic motivation, hackathon, intrinsic motivation, self-determination theory

1 | INTRODUCTION

An extracurricular activity (henceforth abbreviated as ECA) is a critical segment of the education landscape. Depicted as an adjunct to the primary curricula, the appreciation of its vital role stems from the positive relationships between activity participation (i.e., school-based ECAs engaged in by students) and cognitive, psychological, and social outcomes [15,23,69]. In particular, several studies suggest that ECA participation is

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associated with a stronger sense of school belonging [36], better character development [65], more social and human capital [19], superior academic performance [9], a higher likelihood of attending college [53], and increased employability chances [71]. ECA examples include running for student government, competing in athletics, joining academic organizations, and participating in hackathons. Among the forenamed instances, hackathon participation is the most recent addition to the growing inventory of ECAs.

Hackathon (a portmanteau of "*hack*" and "*marathon*") is an intensive, time-bound event where participants in multidisciplinary teams collaborate and develop innovative solutions to real-world problems. In their book, Kohne and Wehmeier [39] narrated the origin of hackathons as pure software development meetings for developers to create software on their respective platforms. Since then, it has evolved into several forms, and various organizations host hackathons for different reasons: technology companies to promote their products, governments to build technologies for social good, institutions to accelerate scientific discoveries, and schools to empower their students [28,42,43,77]. As it originated outside academia, research is still scarce on hosting hackathons within the education field. In addition, most studies concentrated on engineering, computer science, and allied disciplines where innovation is a core mechanism of development. For instance, Porras et al. [59] concluded from a decade of events in software engineering education that hackathons fulfill the needs of students (e.g., acquire hard and soft skills), capstone projects (e.g., foster collaborative work), and society (e.g., solve real problems). These needs are collectively exhibited in a recent study by Pakpour et al. [56], which examined hackathon events to highlight the important role of computer scientists and engineers in controlling disease outbreaks. In emulating a real-life workplace and challenges, students perceived the hackathon environment to be more authentic than university classes [77].

Despite the potential of hackathons for educational transformation, why students intend to or continuously participate remains unexplored. Understanding this phenomenon will help devise appropriate institutional schemes necessary to encourage more hackathon participation. Building on this study gap, the purpose of this study was to examine the motivational orientation behind student participation in hackathons. Although not in the context of hackathons but ECAs, researchers such as Dang and Nguyen Viet [16] and Liu [46] launched similar investigations grounded in various theories. However, there is still a lack of understanding on whether student participation is likewise driven by motivational factors. Saeed and Zyngier [63] framed motivation as a prerequisite of student engagement not only in learning but also in the processes (e.g., any activity to achieve sound academic outcomes) by which it is acquired. More importantly, motivation is among the most powerful determinants of students' success or failure in school [35]. Thus, this study employed the framework provided by self-determination theory (SDT) to explore the role of intrinsic and extrinsic motivations in encouraging hackathon participation. The succeeding parts of the study discuss the theoretical underpinning, research model and hypotheses development, methodology, discussion of the findings, and the implications, recommendations, and conclusion.

2 | BACKGROUND

2.1 | Life outside the classroom

The world is constantly evolving, and it has been increasingly recognized that formal education alone is insufficient [72]. For students to thrive in the digital age, the school climate must be supportive of activities that promote exposure to realities and are conducive to experimenting with disruptive ideas. Following the notion of "*whole-person education*" (i.e., a school experience is not limited to academic undertaking), students should be exhorted to explore life beyond the classroom walls and acquire skills not directly taught in the traditional curriculum [38,49]. Lipscomb [45] asserted that many of the character-building skills needed in the workplace are attainable through ECAs. This assertion is further corroborated by employers who underscore ECAs as instrumental in exemplifying skills and competencies transferable to the workplace [69]. Thus, schools are constantly looking for new ECAs not only to upgrade their education models but also to help their students succeed academically and developmentally.

2.2 | Hackathons as ECA

With hackathons primitively intended for and attended by software developers, it is unsurprising that most prior studies have focused on events organized by governments, nonprofits, and corporations rather than those by and for education institutions [77]. Much like design thinking methodologies [60], hackathons have made their way into education to encourage curiosity

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and innovation beyond the classroom and into the world [67,78]. In addition to design thinking, hackathons pose similarities with cooperative learning, project-based learning, and inquiry-based learning when viewed as a pedagogy. Kohne and Wehmeier [39] provided a detailed account of hackathons as a campus event of a university. In their book, they posited the importance of paying close attention to students and their backgrounds, such as age, education, seniority, and motivation. Contrary to its origin, a hackathon yields promising results when groups are made up of students with different disciplines and backgrounds. In principle, any motivated, creative, and idealistic students (rather than solely coding connoisseurs or engineers) are welcome to participate, although it still largely depends on the event objectives and its expected results (e.g., prototype or working products). Thus, the context of a hackathon in this study is not limited to coding-based events. Regardless of their characteristics, it is still unknown what motivates students to participate in hackathons. Although there is a study that identified what motivates ECA participation [16], motivating factors were not given priority.

2.3 | The self-determination theory

The SDT is one of the core psychological theories on motivation [17]. It describes the innate psychological needs of people to thrive, such as *autonomy* or the need to feel in control of one's behavior; *competence* or the need to gain mastery; and *relatedness* or the need to experience a sense of belonging. The nature of hackathons reflects these needs by allowing students to work together (relatedness), have creative freedom in solving problems without faculty supervision (autonomy), and build their skills in the process (competence). In educational research, motivation is a prerequisite and necessary element for student engagement in learning and activities (e.g., ECAs) that can lead to improved academic outcomes [63,75]. Initially, motivation was regarded as a single concept, but SDT differentiates individual motivation into two types: *intrinsic* and *extrinsic*. In essence, the main difference between intrinsic and extrinsic motivation is that the former involves engaging in an activity for the sake of doing it (e.g., satisfaction) while the latter involves external rewards (e.g., tangible incentives). The implications of both these motivation types in education have been profound [62,80], which is why it is important to determine whether hackathon participation is driven by these factors.

3 | RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

Within the field of educational research, there is a scarcity of studies on hackathons as a form of ECA despite their growing popularity. The only available systematic reviews on the hackathon domain have primarily focused on the connection between the event outcomes and design aspects [50], and how to organize it online [34]. Thus, to supplement the lack of hackathon studies, the research model of the present investigation borrowed theories, frameworks, and concepts from the ECA domain.

Previous research on ECA participation used various theoretical lenses to form and embody their analyses. Cortellazzo et al. [14] adopted experiential learning theory [40] to empirically disentangle the connection between ECAs (cultural activities, sport, volunteering, experience abroad) and emotional and social competencies. Griffiths et al. [29] conducted a similar study but grounded the investigation on self-efficacy theory [5] and self-concepts of student self-efficacy. Both studies have successfully established a positive relationship between ECA participation and student educational success. Shaffer [64] posited that participation in an ECA is also a predictor of student motivation. However, while ECAs influence student motivation, what motivates students to participate in ECAs remains unclear. Conversely, Dang and Nguyen Viet [16] looked at the antecedents by combining the theories of planned behavior [1] and signaling [66]. This study used demographic, information quality, capability, and motivation (i.e., attitude and subjective norm) factors to determine what influences students to participate in ECAs. While these prior works indicate transferable similarities between ECAs and hackathons, there is still a lack of understanding on whether student participation is likewise driven by intrinsic or extrinsic motivations. Thus, instead of replicating the studies in the hackathon context using the same theories, the present study selected the SDT approach to focus on the motivational factors.

SDT research commenced with an emphasis on intrinsic motivation—a prototypical manifestation of active human tendencies. Deci and Ryan [17] posited that intrinsically motivated people freely engage in an activity for the inherent satisfaction and pleasure derived from the process. By doing so, they experience enjoyment and interest and feel self-determining and competent [62]. For instance, when intrinsically motivated students participate in hackathons, they do so not because of the potential rewards (e.g., prize money) but because they are interested in the events. This established association of intrinsic motivation

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with the mood of pleasure institutes a personal long-lasting commitment thereby permitting an adequate performance [7]. As intrinsic needs, self-determination and competence inevitably lead people in endless cycles of pursuing and conquering challenges (e.g., hackathons). Accordingly, the following hypotheses are proposed:

H1. Intrinsic motivations are positively associated with participation intention in hackathons.
H2. Intrinsic motivations are positively associated with continuance participation in hackathons.

Often contrasted with intrinsic motivation is the behavior of undertaking activities for reasons separate from the activity itself (i.e., extrinsic motivation). According to Deci and Ryan [17], a person who is extrinsically motivated is generally focused on the expected results. Thus, when extrinsically motivated students participate in hackathons, they do so because they are aiming for external awards, such as improving their reputation to find a better job in the future. The study of Lepper et al. [44] in traditional education contexts has shown that intrinsic and extrinsic motivation can and do coexist. This prospect indicates that students may seek out activities that they find inherently pleasurable while simultaneously paying attention to their extrinsic consequences. Thus, the following hypotheses are likewise proposed:

H3. Extrinsic motivations are positively associated with participation intention in hackathons.
H4. Extrinsic motivations are positively associated with continuance participation in hackathons.

In this study, the dependent variables (i.e., participation intention and continuance participation) aim to distinguish the factors affecting hackathon participation between students with and without experience. The research model is presented in Figure 1.

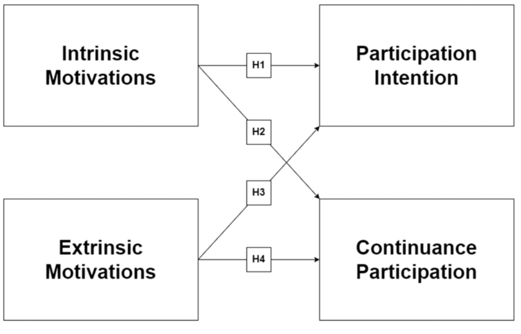

FIGURE 1 Research model

4 | METHODOLOGY

4.1 | Measurement development

Drawing from the existing literature, the constructs were formulated based on the concepts and findings presented in studies related to ECAs, hackathons, motivation, and educational research in general. As shown in Table 1, the constructs selected to measure intrinsic motivations were *practical experience* [52], *social connection* [2], *vocational skills* [45], and *challenge demand* [44]. Meanwhile, the constructs selected to measure extrinsic motivations were *competition prize* [68], *additional credit* [30], *career opportunities* [71], and *personal reputation* [73]. The items per each construct were either extracted from or formulated based on the forenamed literature. All items were measured on a five-point Likert scale with anchors from "*strongly disagree*" (1) to "*strongly agree*" (5). After formulating the initial questionnaire, its characteristics (e.g., format, completeness, and readability) were scrutinized using the expert judgment approach. The questionnaire was then revised accordingly. Before data collection, the revised questionnaire was subjected to a pilot test with 50 students at a large university to ensure its reliability and validity. The Cronbach's alpha was computed for each construct, and the results show all values were above the cutoff point ($\alpha > .7$), which indicates an internally consistent questionnaire.

4.2 | Procedure and sample

The final validated questionnaire was disseminated online via academic (e.g., learning management system) and social media channels (e.g., Facebook, Reddit, and LinkedIn) in January 2022. All students are eligible to participate in the survey to embody the vast implications of ECAs and break the common misconception that hackathons are exclusive to coding-based events. Steered by an assumption that most students have not yet attended a hackathon event, a separate invitation was dispatched to universities known for their active involvement in this kind of event. This tactic was to gather enough responses to measure the continuance participation variable. The assistance of teachers was crucial in this process because they pinpointed students with hackathon experience. As the present study concentrates on students with and without hackathon experience, an upfront question was set to identify which questionnaire and dependent variable (i.e., participation intention or continuance participation) will be displayed. Thus, there are two questionnaire versions with different item wordings. Appendix A shows the version for the continuance

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TABLE 1 Construct definitions

Constructs	Definition
Intrinsic motivations	
Practical Experience (PEXP)	The degree to which students perceive that the incentive value of engaging in hackathons is instrumental to the attainment of their future goals.
Social Connection (SOCO)	The degree to which students desire the human emotional need to affiliate with and be accepted by others or as a member of a social group.
Vocational Skills (VOSK)	The degree to which students believe that hackathon participation results in the acquisition or enhancement of existing skills transferrable into a workplace.
Challenge Demand (CDEM)	The degree to which students tend to engage in and enjoy challenges as a unique opportunity for personal growth and development.
Extrinsic motivations	
Competition Prize (PRZE)	The degree to which students participate in hackathons because of the tangible rewards (e.g., money, trophy, medal, certificate) given to winning participants.
Additional Credit (ADDC)	The degree to which students participate in hackathons because of the promised extra academic rewards offered simply by joining the events.
Career Opportunities (CAOP)	The degree to which students believe that hackathon events are an exceptional avenue where they can obtain an internship or job offer.
Personal Reputation (PERS)	The degree to which students believe that hackathon participation improves their reputation and profile within a social system.

participation, and the items for the participation intention were included to showcase all statements on one page. The survey items were also randomized to decrease common method bias [58]. Overall, 437 students from 12 countries participated in the survey, of whom most were from the Philippines ($n = 174$, 39.8%), Egypt ($n = 82$, 18.8%), and India ($n = 59$, 13.5%). The majority of students were male ($n = 254$, 58.1%) with a mean age of 19.54 ± 1.4 years, and sophomore ($n = 143$, 32.7%) in a public university ($n = 234$, 53.5%). Of the sample, 259 students (59.3%) indicated that they had not yet tried to participate in a hackathon although 296 (67.7%) students disclosed that they are familiar with this kind of event. Lastly, there was almost an equal proportion of students from computing ($n = 209$, 47.8%) and non-computing ($n = 228$, 52.2%) disciplines. Of the non-computing disciplines, there were 157 engineering students, 45 health students, and 26 business students.

4.3 | Model and hypotheses testing

To test the research model and hypotheses, the component-based partial least squares structural equation modeling (PLS-SEM; [10]) approach was adopted using *SmartPLS* 3.3.5 software. As described by Hair et al. [33], PLS-SEM is a technique following an iterative approach that maximizes the explained variance of endogenous constructs. It was selected because it can process noncontinuous variables [31] and does not make assumptions about data distribution [22]. In this study, the data is not normally distributed according to Kolmogorov–Smirnov's test. The model was first assessed in terms of reliability and validity, and the results are presented in Table 2.

In PLS-SEM, reliability is tested through composite reliability (CR). According to the results, the CR values ranged from 0.813 to 0.952, all exceeding the acceptable level of 0.70, thus showing good internal consistency. Meanwhile, the convergent validity was measured by examining the average variance extracted (AVE). The AVE values ranged from 0.542 to 0.794, which was well above the threshold of 0.50. On the other hand, the discriminant validity was calculated by using the Fornell and Larcker [21] criterion. The correlations among constructs were all below the square root of AVE (i.e., the diagonal values in italic), indicating compliance with the criterion. The collinearity measurements of tolerance and variance inflation factor (VIF) were also well within recognized parameters (VIF < 5, Tolerance <0.1; [32]). Thus, multicollinearity is not an issue in this study. To expose a possible nonresponse bias, the wave analysis was conducted. For this approach, the collected data were divided into two groups (i.e., the early and late respondent datasets) and evaluated using a *t*-test to determine the difference between the means. There was no significant difference between groups, confirming that nonresponse bias was not a problem for this study.

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TABLE 2 Validity and reliability testing

	α	CR	AVE	PEXP	SOCO	VOSK	CDEM	PRZE	ADDC	CAOP	PERS	PINT	CONP
PEXP	.898	0.904	0.702	*0.838*									
SOCO	.857	0.891	0.654	0.562	*0.809*								
VOSK	.772	0.813	0.676	0.425	0.596	*0.822*							
CDEM	.781	0.828	0.638	0.562	0.532	0.676	*0.799*						
PRZE	.945	0.952	0.775	0.345	0.425	0.452	0.354	*0.880*					
ADDC	.859	0.875	0.662	0.290	0.678	0.369	0.125	0.653	*0.814*				
CAOP	.876	0.891	0.544	0.301	0.556	0.268	0.532	0.686	0.653	*0.758*			
PERS	.823	0.867	0.542	0.178	0.804	0.732	0.353	0.446	0.356	0.656	*0.736*		
PINT	.944	0.950	0.760	0.381	0.246	0.553	0.256	0.576	0.743	0.734	0.465	*0.842*	
CONP	.934	0.943	0.794	0.397	0.357	0.357	0.347	0.359	0.414	0.356	0.645	0.692	*0.831*

Note: The italic value stands for the square root of AVE.

Abbreviations: ADDC, additional credit; AVE, average variance extracted; CAOP, career opportunities; CDEM, challenge demand; CONP, continuance participation; CR, composite reliability; PERS, personal reputation; PEXP, personal experience; PINT, participation intention; PRZE, competition prize; SOCO, social connection; VOSK, vocational skills.

Finally, the construct correlation matrix was also assessed to determine a common method bias issue. Upon assessment, none of the constructs were correlated above 0.90 indicating that there is no common method variance. Overall, the results of the measurement model (Table 2) warrant further testing of the structural model.

5 | RESULTS AND DISCUSSION

5.1 | Analysis of demographic profiles as control variables

Prior works have shown that the demographic profile influences students' intention to participate in ECAs [16,57]. These factors may also affect the interrelationships between the core variables in the hackathon context. Thus, variables including age, gender, education level, type of institution, and hackathon familiarity have been controlled for in the analysis. The findings show that age and education level influence participation intention ($\beta = .116$, $p < .046$; $\beta = .143$, $p < .038$) and continuance participation ($\beta = .114$, $p < .043$; $\beta = .125$, $p < .021$). These significant effects indicate that older students with more extensive educational experience may have higher intentions to participate and continue participating in these events. Conversely, gender, institution type, and familiarity do not influence either participation intention or continuance participation in hackathons.

The significant association of age and education level with participation intention and continuance participation in hackathons may have something to do with the self-esteem and self-efficacy that students may have developed through the years. Ogihara and Kusumi [55] investigated the developmental trajectory of self-esteem over the life course and found that the average level of self-esteem suggests an upward trend as people age. A high level of self-esteem implies students are free of social anxiety (e.g., fear of social situations and lack of self-confidence) that may restrict them from participating in hackathons [47]. Meanwhile, the correlation between educational experience and self-efficacy can be found in Bandura's [5] theory, which postulates mastery experience as the most influential source of efficacy information. In the educational setting, students with high self-efficacy are more likely to accept challenging tasks (e.g., hackathon competitions) than students with low self-efficacy. This is supported by Griffiths et al. [29], who uncovered the relationship between self-efficacy and ECA participation, and that self-efficacy increases over time. Finally, these findings offer practical insights for the education sector to formulate strategies that may reinforce self-esteem and self-efficacy, especially among younger students. More importantly, the effects should be recognized not only within the classroom walls but even beyond the school gate.

One unconventional finding of this analysis was the insignificant effect of gender. In the ECA context, Dang and Nguyen Viet [16] found the opposite: gender has a significant impact on the participation and attitude of students. For instance, girls have a more favorable attitude and stronger intention to partake in extracurricular dance than boys [3]. Undoubtedly, the type of ECAs has a moderating role in this example since students

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naturally prefer the activity compatible with their gender identity (i.e., gender norms) or parallel to the acceptable behavior in society (i.e., social norms). However, hackathons are also vulnerable when peeked through these vantage points because they are often orchestrated as coding-based events. The academic field of computing is a prime example of disparity along gender lines where women have been historically underrepresented. In addition to the gender gap issue, Warner and Guo [77] pointed out that hackathons embody a geeky environment that implicitly excludes women. Consequently, a possible explanation for why gender was insignificant is that the study was not restricted to coding-based events and computing students.

5.2 | Analysis of overall intrinsic and extrinsic motivations

The results of the hypothesis testing for the analysis of overall intrinsic and extrinsic motivations are summarized in Table 3. A crisscross pattern was evident on the results: intrinsic motivations were statistically significantly associated with participation intention ($p = .038$, *H1* supported) but not with continuance participation ($p = .154$, *H2* rejected) while extrinsic motivations ($p = .310$, *H3* rejected) were not statistically significantly associated with influence participation intention but with continuance participation ($p = .000$, *H4* supported). These associations indicate that albeit intrinsic motivation influences initial participation, extrinsic motivation drives subsequent participation. A potential example is that students initially participate in a competition to acquire *practical experience* but continue to do so to boost their *personal reputation*. This finding extended the work of Lepper et al. [44] on the coexistence of intrinsic and extrinsic motivations by ascertaining that students may be more intrinsically motivated at first before becoming more extrinsically motivated on succeeding participation. Conversely, this finding is in contrast to the study of Liu [46], which identified extrinsic motivation as the most significant determinant of competition participation intention. However, continuance participation was unaccounted for in that study, indicating that prior experience may affect the motivational orientation behind student participation. Nevertheless, this study cannot prove the transition of motivation from intrinsic to extrinsic after initial participation because the data were gathered from two groups of students (with and without hackathon experience) and analyzed separately. It is therefore recommended for future research to conduct a longitudinal study to validate the switching of motivational orientations.

5.3 | Analysis of specific intrinsic and extrinsic motivations

A more detailed analysis of specific intrinsic and extrinsic motivations is presented in Figure 2. The path analyses revealed mixed findings, in the sense that they are only in part in line with the foregoing result (e.g., intrinsic motivation → participation intention). Explicitly, there are specific intrinsic and extrinsic motivation constructs that are positively associated with continuance participation, which parades the coexistence of both motivation types [44]. For instance, continuance participation is significantly positively associated with both intrinsic motivations such as *social connection* ($\beta = .293$, $p < .038$) and *vocational skills* ($\beta = .152$, $p < .043$), and extrinsic motivations such as *career opportunities* ($\beta = .183$, $p < .046$) and *personal reputation* ($\beta = .114$, $p < .037$). Drawing on the number of significant constructs associated with the dependent variables, it can be inferred that it may take more than intrinsic motivations for students to continue participating in hackathons after their initial experience.

A common denominator among the significant constructs is the predilection towards the employability benefits of hackathon participation. This emerging pattern is supported by prior studies [61,69,71] that unravel student motives behind ECA participation. The

TABLE 3 Hypotheses testing results (overall intrinsic and extrinsic motivations)

Hypothesis	Path	β	CI	*p* value	Decision
H1	INMO → PINT	.142*	0.016–0.271	.038	Supported
H2	INMO → CONP	.234	−0.034–0.212	.154	Rejected
H3	EXMO → PINT	.156	−0.046–0.257	.310	Rejected
H4	EXMO → CONP	.566***	0.492–0.664	.000	Supported

Abbreviations: CONP, Continuance Participation; EXMO: Extrinsic Motivations; INMO: Intrinsic Motivations; PINT: Participation Intention.

*$p < .05$; **$p < .01$; ***$p < .001$.

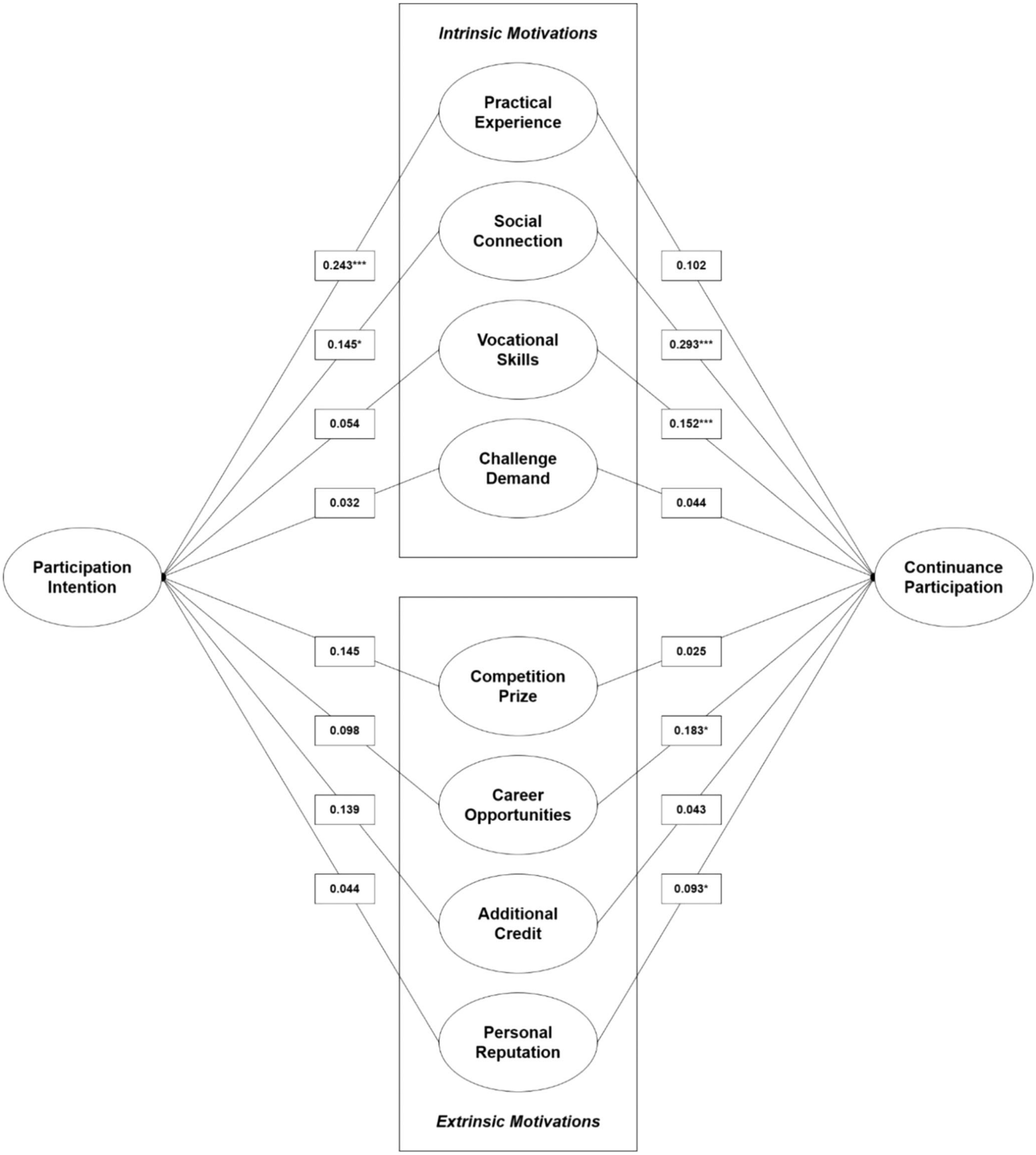

FIGURE 2 Analysis of specific intrinsic and extrinsic motivations

evidence suggests students exploit ECAs to develop their employability narrative and obtain a positional advantage over their competitors. In hackathons, students accumulate *practical experience* valued in the workplace by formulating different approaches that solve intricate real-life problems. Together with academic credentials, students consider this acquired experience (i.e., hard currencies) as charismatic qualities to present themselves distinctively to employers [61]. The nature of hackathons likewise affords students developmentally appropriate opportunities to earn soft currencies [20,70], including teamwork, problem-solving, time management, and

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interpersonal skills. Both hard and soft currencies (*vocational skills*), combined with self (e.g., personality and *personal reputation*), are packaged as a narrative of employability according to the social construction of personal capital [6].

The positive bearing of *career opportunities* not only reinforces this employability pattern but also insinuates a stronger association of hackathons with business enterprises than education providers. While the former host hackathons to attract new talents, the latter merely send students to represent their institution at these events. This innuendo may indicate that the education sector has not yet fully embraced hackathons as a form of ECAs and that this sprint-like event is still somehow exclusive to the industry where it emanated. From an academic standpoint, this is a missed opportunity to suffuse a mindset of innovation and prepare students for the workforce. More importantly, the familiar presence of corporate sponsorships in company-hosted hackathons is turning the events into full-fledged competitions instead of authentic learning environments [77]. It is therefore paramount that schools also organize in-house hackathons rather than send representatives to competitions hosted by outside organizations. If the involvement of external enterprises is a necessity, a university-industry collaborative approach (e.g., [48,79]) is worth consideration. By arranging regular hackathons either at a school (as an ECA) or classroom (as a pedagogy) level, students can master job-related competencies and characteristics that can put a veneer on their lack of significant work experience [13]. Although the allure of acclaimed companies offering to fund school-hosted hackathons can be a powerful persuader, as an ECA, it is compulsory to preserve the core values (e.g., informal learning, collaboration, community building) that benefit students and not simply sponsors.

Among the specific motivations, only *social connection* was positively associated with both participation intention ($\beta = .145$, $p < .024$) and continuance participation ($\beta = .293$, $p < .038$). The relevance of social connection as a motivator in hackathon participation may not be surprising as the event is highly social in nature, where participants typically assemble groups of about 2–5 individuals. Students perceive hackathons as a weekend social event where they can hang out with their friends and other like-minded people. This finding reinforces the work of Al-Ansari et al. [2], where socialization was the most frequently cited motive for ECA participation. By participating in activities together, students have a sense of belonging and a support mechanism to cope with stressful times [71]. Regardless, there is a paradox between why students choose and choose not to participate in hackathons. Warner and Guo [77] uncovered that *novice fear* is the primary reason students choose not to participate—something that social connection can alleviate. Garcia [25] authenticated the value of social elements by operating cooperative learning in computer programming with novice students who usually experience a *fear of coding* when alone. In practice, this dichotomy accentuates the implication of building social ties at a classroom level and regularly integrating social interaction elements in the pedagogical techniques of teachers. The formation of these social relationships is not only vital academically, but also in improving one's quality of life, self-esteem, life satisfaction, and human and societal development [24,27].

5.4 | Implications, limitations, and future directions

From a theoretical standpoint, this study contributes to the scant literature on hackathons in education and advances our cognizance of ECAs. By wearing the lens of SDT, it realizes a holistic model of student participation (both participation intention and continuance participation) in hackathons rooted in motivation factors and ECA research. Consequently, it extended the study of Dang and Nguyen Viet [16] by integrating intrinsic and extrinsic motivations as additional antecedents of ECA participation via hackathons as the central point of investigation. While intrinsic motivation influences initial participation, students will continue to partake because of extrinsic motivation. The materialization of this finding is attributed to the inclusion of continuance intention—a construct absent in prior works (e.g., [16,46]). Nevertheless, whether there is a changeover of motivational orientation (e.g., from intrinsic to extrinsic) in the subsequent involvement is for future studies to find out.

Although a deeper investigation is warranted, the number of associated factors with the dependent variables implies that it may take more than intrinsic motivation for students to continue participating in hackathons after their initial experience. Unlike most ECAs, the attractiveness of hackathon events is ascribed to its primordial form (business-sponsored) and the affixed promising rewards, such as prize money, venture capital, internship, and employment [39,37]. Paradoxically, the inability of its academic variant to afford all these rewards may impact the continuous engagement of students. The reliance on extrinsic motivation is also deleterious because it neither supports learning nor long-lasting lifetime performance and can lead to obsessive behavior problems, procrastination, and negativism [12]. This certitude suggests that schools may need to rebrand

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hackathons as primarily ECAs where internal factors are in the foreground to preclude the ascendancy of extrinsic over intrinsic motivation. According to a 40-year meta-analysis [8], extrinsic motivation matters less when intrinsic motivation matters more to performance. Therefore, another managerial implication of this study concerns the exigency of school-wide strategies for fostering intrinsic motivation in students. For courses with laboratory or hands-on components, intrinsic motivation is important because it shows the highest relationship with academic achievement [54,4].

This study likewise deepened its discovery by heeding specific constructs derived from the vast literature of ECAs. Specifying individual motives unlocks a unique line of interpretation that is much deeper than merely scratching the surface of the motivation theory. For instance, the appeal of *practical experience* as a participation driver regurgitates the unabating challenge of balancing the teaching of foundational theoretical concepts with the pragmatic skills instrumental to one's future goals. Students discern hackathons as an avenue of worthwhile experience that may not always be accessible in curricular activities. From a methodological point of view, it is apparent to recommend the promotion of hackathons as a core ECA at a school level, and more indispensably, as pedagogy at a classroom level. For instance, teachers may administer mini hackathons inside the classroom where students conceive small open-ended projects aligned with the subject matter. One empirical example is the *Engineering Design Days* deployed by Christopher et al. [11] in different undergraduate programs (Mechanical, Electrical, Computer, and Mechatronics Engineering). These in-house engineering hackathon events replaced several traditional class sessions allowing students to collaborate in designing and building solutions to real-life problems. According to Mehta et al. [51], this implementation of pedagogical hackathons is supported by engineering educators. Not only does it introduce hackathons as more of a learning ecology rather than a business-sponsored competition, but it also diversifies the praxis into other academic programs. With hackathons temporarily disguised as a project-based learning approach, time is afforded to scholastic leaders and researchers to cultivate an inclusive version where students can take part, regardless of age, gender, educational experience, or major.

These implications raise enthralling points on the migration of hackathons in education thus unlocking important research avenues to pursue in the coming years. From the outset, sparking these discussions commences the proliferation of hackathon literature that presently lacks sufficient exploration. First, there should be a consensus on how corporate (e.g., [74]) academic (e.g., [41]), and university-industry (e.g., [79]) hackathons differ in terms of proper implementation and their effectiveness when utilized in an educational context. This differentiation will draw a line between these formats, allowing teachers to choose whether, what, and how to host hackathons. Then, it is crucial to substantiate which positive and negative effects of ECAs are inheritable by hackathons when implemented as such. Isolating these effects is imperative because prior works seldom considered the specific type of ECA in their investigations. With the growing implementation of hackathons in academia, future research should also investigate how they are conducted in different disciplines. For instance, differentiating a healthcare hackathon [76] from an engineering hackathon [11] will pinpoint tailored experiences and recommendations. As a pedagogy, it is also beneficial to explore how hackathons influence traditional classroom teaching. Would students experience tension between hackathons and academic work like in other ECAs? How effective would hackathons be if teachers deploy them as a regular learning activity rather than an occasional ECA? With teachers being included in the conversation, examining the factors affecting their intention to host hackathon events is recommended to guarantee coordination between stakeholders. Finally, it is also worth exploring the possibilities of using hackathons in non-computing and nonengineering degrees, especially in programs where innovation should be highlighted as part of the core curriculum. As argued by Falk et al. [18], carefully designed activities and mechanisms are necessary to encourage broader and more diverse participation. Future works therefore should draft a guideline on transforming hackathons into an ECA that is more inclusive, diverse, and welcoming to everyone.

In addition to these future work suggestions, researchers may likewise address the limitations of the study. First, the cross-sectional nature of this study restricts its ability to demonstrate the changeover from intrinsic to extrinsic motivation after initial participation in hackathon events. Employing a longitudinal research design is recommended to determine whether there is a transition in motivational orientation. Second, the data collection was carried out in the middle of the COVID-19 pandemic when students suffered periods of isolation due to lockdown regulations. These social effects experienced by students at the time of the study could have affected their self-reported responses [26]. Finally, although it is a strength of the study to involve students from different programs because of its anchor to ECA,

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these students may have different perceptions toward hackathons. For instance, engineering and computing students may have perceived hackathons as an avenue to acquire new or enhance existing skills that are transferrable to the workplace while others are driven by different motivators. Replicating the study at a per-program level is therefore recommended.

6 | CONCLUSION

The education sector is constantly progressing its competency paradigm by establishing nexus between practical, theoretical, and technical dimensions of teaching and learning. This undertaking has initiated continuous curriculum adjustments, introducing new courses and activities relevant to sustainable development. In the modern age of education, hackathons are becoming increasingly prominent in providing an optimal academic environment that allows students to connect what they learned in the classroom to real-life scenarios. Despite the potential for academic transformation, there is still a shortage of research that empirically examines the occupation of hackathons in education. Following the notion that motivation is a prerequisite of student engagement, this study explored the motivational orientation behind student participation in hackathons. According to the findings, although intrinsic motivation influences participation intention, extrinsic motivation drives continuance participation. When specific constructs are analyzed individually, continuance participation demands both motivational orientations. Following the pattern among significant constructs, students exploit hackathons to develop their employability narrative and obtain a positional advantage over their competitors. Comparisons of demographic characteristics indicate that older students with more extensive educational experience may have higher intentions to participate and continue participating in these events. Taking everything into consideration, the findings and implications of the study offer insights into how the education sector can increase hackathon participation by tapping on the motivational orientation of students. In a world where students are encouraged to fail early, fast, and often, participating in hackathons is preparation for eventual success.

AUTHOR CONTRIBUTIONS

M.B.G. conceived and wrote the entire article.

CONFLICT OF INTEREST

The author declares no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: M. B. Garcia, *Hackathons as extracurricular activities: unraveling the motivational orientation behind student participation*, Comput. Appl. Eng. Educ. 2022;30:1903–1918. https://doi.org/10.1002/cae.22564

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APPENDIX A: RESEARCH QUESTIONNAIRE ITEMS

Personal Experience	
PEXP1	Participating in a hackathon adds value to my learning
PEXP2	Participating in a hackathon prepares me for my career
PEXP3	Participating in a hackathon lets me apply theories in the real world
PEXP4	Participating in a hackathon gives an experience that is useful in the future
Social Connection	
SOCO1	I feel connected when I participate in a hackathon
SOCO2	I feel accepted by my hackathon teammates
SOCO3	I feel like I am an important member of my hackathon team
SOCO4	I receive support from my hackathon teammates
Vocational Skills	
VOSK1	When I participate in a hackathon, I improve my soft skills
VOSK2	When I participate in a hackathon, I improve my hard skills
VOSK3	When I participate in a hackathon, I improve my skills related to my degree
VOSK4	When I participate in a hackathon, I improve my skills for my future job
Challenge Demand	
CDEM1	Participating in a hackathon put my skills to the test
CDEM2	Participating in a hackathon brings out my competitive nature
CDEM3	Participating in a hackathon means I get to solve complex problems
CDEM4	Participating in a hackathon is a challenging yet rewarding experience
Competition Prize	
PRZE1	I participate in a hackathon to win the prize money
PRZE2	I participate in a hackathon to acquire certificates
PRZE3	I participate in a hackathon to receive promotional products
PRZE4	I participate in a hackathon to acquire funding for my projects
PRZE5	I participate in a hackathon to collect trophies and medals
Career Opportunities	
CAOP1	I feel like participating in a hackathon will get me a job offer
CAOP2	I feel like participating in a hackathon will get me an internship offer
CAOP3	I am perceived better by employers because of my hackathon experience
CAOP4	My hackathon experience can have a positive impact on my future career
CAOP5	Because of my hackathon experience, I have a bright career ahead of me
Additional Credit	
ADDC1	I participate in a hackathon to receive additional course grades
ADDC2	I participate in a hackathon to excuse my absences
ADDC3	I participate in a hackathon to receive extra examination points
Personal Reputation	
PERS1	I participate in a hackathon to improve my image at school
PERS2	I participate in a hackathon to enhance my social status
PERS3	I participate in a hackathon to gain respect
PERS4	I participate in a hackathon to enhance my popularity
PERS5	I participate in a hackathon to make myself noticed by others
Continuance Participation	
CONP1	I intend to continue participating in a hackathon in the future
CONP2	I predict that I would continue participating in a hackathon in the future
CONP3	I expect to continue participating in a hackathon in the future

(Continues)

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Participation Intention	
PINT1	I intend to participate in hackathons in the future
PINT2	I predict that I would participate in hackathons in the future
PINT3	I expect to participate in hackathons in the future

Note: As mentioned in the *Procedure and Sample* subsection, the wording in this questionnaire shows the version for the continuance participation (students with hackathon experience), and the items for the participation intention were included to showcase all statements on one page.

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