Toward Designing Innovation Learning Experiences: Examining Engagement and Affective Traits Based on Learner and Course Characteristics

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Abstract

Expanding innovation education research beyond the business domain, this study introduces learning assignments using individual and group knowledge acquisition to mimic participation in today's digital innovation platforms, examining learner affective and course characteristics as important factors for designing appropriate innovation learning experiences. Findings suggest that graduate students are more engaged and report higher perceptions of quality and quantity of social capital as well as learning from such assignments and also report higher perceptions of affective characteristics. Groups assigned by instructors (rather than self-selected) are also more engaged with higher perceptions of learning and quantity of social capital. Learners for whom the course is in their degree program are also more engaged, storing more knowledge resources individually and reporting higher perceptions of perceived learning, quantity of social capital, task value, and system satisfaction. Together, these findings have practical implications for educators seeking to engage students in meaningful innovation learning experiences.

Keywords: Innovation education, perceived learning, knowledge sharing, social capital.

1. Introduction

While corporations are keenly aware of the critical importance of innovation, most struggle to achieve it, with researchers identifying challenges to innovation including a lack of properly trained and prepared individuals capable of successfully undertaking such activities (Kuratko et al., 2014). In response, an increasing number of higher education institutions are offering courses or even degrees in entrepreneurship and innovation (Ilonen & Heinonen, 2018; Kuratko & Morris, 2018). These programs most often have a business focus with the intention of preparing students to launch their own companies or ventures, and pedagogical studies relating to entrepreneurship education have focused on educational outcomes including a change in entrepreneurial intention or attitude toward risk taking (see for example Kim, 2017; Bandera, Collins, & Passerini, 2018). While these variables are relevant for those learners interested in launching their own ventures, they do not necessarily reflect a student's preparation for corporate intrapreneurship or innovation in the digital economy (Antoncic & Hisrich, 2001).

At the same time, innovation is required in almost every discipline as both entrepreneurs and mature corporations seek to develop novel solutions to complex real-world problems (Hamel, 2000), necessitating a multidisciplinary perspective that teaches students how to innovate by collaborating with others from different backgrounds or disciplines (Foster & Yaoyuneyong, 2016; Friedman & Deek, 2003). This suggests that education toward entrepreneurship and innovation is not exclusively the domain of business majors, nor only those aspiring to become entrepreneurs, but is critical for all students preparing to bring value to employers in a highly competitive, globalized economy. This research therefore focuses on students taking courses in the Information Systems discipline at a major northeastern university, recognizing the importance of computing and digitization as drivers of innovation not only within their own spheres but also in every other discipline (Si et al., 2022).

In response to a lack of research examining learner characteristics and perceived learning outcomes in entrepreneurship and innovation education (Mets et al., 2017; Nabi et al., 2017), this research introduces assignments with real-world context that require learners to conduct independent Internet-based research to develop an individual response. Such learning activities recognize Internet information foraging as an important activity for innovation, particularly in light of research that has examined the impact of the Internet as a platform for knowledge diffusion that boosts productivity and innovation (Paunov & Rollo, 2016; Sawhney et al., 2005).

After submitting their individual assignments and curating their knowledge resources, learners were placed in groups (either self-selected or randomly

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assigned) and instructed to share their individual responses and the knowledge resources they identified to collaboratively negotiate a group response. This portion of the assignment exposes learners to interactions similar to the social interactions that occur in online innovation communities (Akman et al., 2018). Researchers have investigated these interactions and the resulting contributions to innovation, finding a positive relationship between the amount of user interaction in the community and the number of implemented innovations (Yang & Han, 2021). In this study, the number of resources learners curate individually, as well as those shared by all group members during the collaborative part of the assignment, were evaluated to capture engagement and knowledge sharing behaviors.

Using assignments requiring individual and collaborative knowledge creation as a foundation, this study examines the affective traits of learners to understand how these traits may vary depending on learner and course characteristics when students are exposed to learning experiences encouraging knowledge creation and innovation (Popadiuk & Choo, 2006). Student and course characteristics examined include the level and gender of the student, whether the course was in or out of the student's degree program, and whether group membership was assigned or self-selected for the collaborative portion of the assignment. Understanding how learner affective traits and engagement may vary depending on learner and course characteristics can inform improvements to pedagogical activities that seek to prepare students as innovators and critical thinkers.

In summary, this study explores the following research questions:

RQ1: What influence do student characteristics (gender and level of education) have on the quantity of knowledge resources used and shared, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning?

RQ2: What influence do course characteristics (group formation and course being in the student's degree program) have on the quantity of knowledge resources used and shared, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning?

2. Prior Work

The foundations for the theoretical model (Collins, 2015) used in this paper are based upon established measures of perceived learning, quality and quantity of social capital, self-efficacy, learning goal orientation, task value, and system satisfaction. These, along with a general overview of innovation education research, are discussed in the following sections.

2.1. Innovation education

Innovation is fundamental to success in business. It is therefore reasonable to advocate for the development of innovative competencies through formal educational experiences. Although a single definition of innovation education remains elusive, the general principles of teaching innovation focus on the "application of knowledge to produce new knowledge" (Drucker, 1993, p. 173). The breadth of this definition reflects the universal nature of innovation, which can be taught in any discipline at any age (e.g., Gunnarsdottir, 2013).

Innovation is different from creativity. While creativity can be nurtured, there has long existed a debate as to whether it can be explicitly taught (Amabile, 1996). Conversely, like other tangible skills, innovation can be formally taught and learned. In fact, a simple web search will yield a myriad of syllabi relating to the teaching of innovation. This suggests that not only can innovative skills be developed, but they can also be improved by practice.

Prior studies have sought to define a framework for evaluating innovation education programs (Maritz et al., 2014) through interrelated components that can be used for development and assessment. Other studies have focused on specific types of innovation such as social innovation, defined as innovation that supports positive societal changes (Rivers et al., 2015). These researchers examined the common elements of several learning theories, identifying a "zone of pedagogical praxis for social innovation education" (Rivers et al., 2015, p. 9). The characteristics included in this zone focused on the transformation of the learner's beliefs, attitudes, and behaviors through critical reflection and discourse; the impact of location when identifying social issues that could be addressed through innovation; and the importance of critical reflection as a mechanism for learning how to innovate.

Innovation education and entrepreneurship education differ in that innovation education focuses on the generation of new ideas, while entrepreneurship education focuses on the knowledge necessary to implement, monetize, or productize the innovation. Unfortunately, these activities are often conflated, with one entrepreneurship practitioner stating, "Teaching individuals the skills and behaviors for how to think about approaching opportunities to identify or create something new of value is the education component" of entrepreneurship education (Neck & Corbett, 2018). Yet innovation education researchers would identify these skills and behaviors as innovation rather than entrepreneurship.

While innovation is essential in the rapidly changing science and technology domains, curricula and academic programs that promote explicit training in

innovation and entrepreneurship, at all levels of education, typically exist within business schools. Other disciplines, particularly in STEM, must also promote innovative thinking and nurture creative skills as essential competencies among their learning outcomes. Thursby, Fuller, and Thursby (2009) investigated the challenges faced by professionals in jobs requiring innovation, finding that the connections between technology and business posed a unique challenge that could be addressed through education. These researchers found a positive relationship between experiential learning modules and students' perceptions of the capabilities demanded by a technological business environment. Building on this, many STEM disciplines are integrating real-world capstone learning experiences that focus on identifying or developing entrepreneurial innovations through effective leveraging of advances in knowledge, making innovation education a necessary component of these disciplines. This study therefore examines student and course characteristics in a STEM discipline (Information Systems) and their impact on learner engagement and perceived learning during an assignment that requires individual and collaborative knowledge creation.

2.2. Knowledge Creation, Social Capital, and Perceived Learning

Researchers have explored the effects of social capital, specifically interactions within a community, on both the quality and quantity of knowledge created or shared within that community, with mixed results. Some researchers have found that interactions among community of practice members affect the quantity, but not the quality, of the knowledge shared (Chiu, Hsu, & Wang, 2006). These researchers captured participants' perceptions regarding the quality of the shared knowledge, while quantity was calculated as an average volume of knowledge shared per month.

Other researchers have reported that social interactions had a positive effect on the quality, but not the quantity, of knowledge sharing behavior (Chang & Chuang, 2011). These researchers captured perceptions of the quality of shared knowledge, adapting a second measure to capture participants' perceptions of the quantity of shared knowledge (Wasko & Faraj, 2005). This research explores learners' perceptions of the quality and quantity of social capital that develop through a two-part knowledge creation assignment, captured using scales validated by Chang and Chuang (2011).

Previous research has explored perceived learning as predicted by social presence (Richardson & Swan, 2003) and sense of community (Top, 2011), suggesting the importance of engagement (as measured through the quantity of knowledge resources shared) in collaborative learning. Students with high overall perceptions of social presence scored high in terms of perceived learning, with sense of community similarly being a significant predictor of learning perceptions. These findings suggest the importance of learner interactions in providing a positive learning experience. Therefore, in this research, interactions between students are explored through the quantity of knowledge resources curated and shared during the assignment as a measure of learner engagement.

Benbunan-Fich and Arbaugh (2006) explored different modes of knowledge delivery in online courses, finding that collaborative activities requiring knowledge construction improved students' actual grades. This research similarly requires knowledge construction through the sharing of individually curated knowledge resources, assessing perceived learning resulting from such activities. In this study, perceived learning is assessed through the scale previously validated by Benbunan-Fich and Arbaugh (2006).

2.3. Task Value

Task value – the extent to which a learning task is perceived as being of value to the learner – has been shown to be a significant predictor of learner satisfaction and achievement because learners who perceive a task as useful and relevant implement cognitive strategies that result in a positive learning outcome (Joo, Lim, & Kim, 2013; Schunk 1995). Other studies have shown that the task value of learners is positively correlated with their achievement scores (Yukselturk & Bulut, 2007), with their satisfaction with their educational program (Artino, 2008), and with their persistence (Chiu et al., 2007). In this research, perceived task value is therefore explored as an important factor in the design of the learning experience and is captured through a scale validated by Joo et al. (2013).

2.4. Self-Efficacy and Learning Goal Orientation

Self-efficacy is a measure of an individual's belief that they are competent and capable (Bandura, 2006), with these perceptions leading to greater perseverance in mastering a challenging task (Bandura & Schunk 1981; Schunk, 1995; Zimmerman, 2000) and to more positive outcomes later in educational achievement and career stability (Sherer et al., 1982). In learning, higher self-efficacy leads to more positive academic performance (Alivernini & Lucidi, 2011; Dunbar et al., 2018) including in collaborative learning activities. Self-efficacy is therefore captured as an affective

characteristic of the learner that may influence engagement with the assignment. Perceived self-efficacy is captured through a scale used in prior studies of student motivation, self-regulated learning, locus of control, and task value (Joo et al., 2013; Pintrich & De Groot, 1990).

Self-efficacy is also correlated with higher goal-directed behaviors (Sherer et al., 1982). That is, learners with higher self-efficacy are driven by learning goals through which they seek to master new competencies, rather than by performance goals through which they are simply concerned with getting a good grade or achieving a positive outcome (Mun & Hwang, 2003; Ng & Bereiter, 1991; Pintrich, 2000). Lim and Lim (2020) found that while mastery (learning) goal orientation positively predicted learners' co-regulation in collaborative learning activities, performance goal orientation did not. Learning goal orientation is therefore captured as an important learner affective characteristic using a scale validated by Mun and Hwang (2003).

2.5. System Satisfaction

Learner satisfaction with their experience with course technologies has been shown to be strongly correlated with their perceptions of learning from the course (Swan, 2001), with researchers arguing that the usefulness and ease of use of collaborative learning technologies impact learners' attitudes towards the overall experience (Edmunds et al., 2012). Other studies focusing on collaborative learning systems for knowledge management identified attitude factors that affect the use of such systems, including characteristics of the learners themselves and satisfaction with the collaborative learning system (Liaw et al., 2008). Because the assignments included in this study involve technologies enabling students to curate their knowledge resources and subsequently to share those resources with group members, system satisfaction is considered an important affective variable that is captured through the scale validated by Wang (2003).

2.6. Differences Based on Learner Traits

Because this is the first study of collaborative knowledge acquisition as a method of teaching innovation, there is no solid foundation on which to base specific hypotheses. Therefore, our expected findings of differences are stated as more fully developed research questions, rather than as directional hypotheses.

Research question 1 explores how the research variables are affected by student characteristics including gender and level of education. Prior research has suggested that gender may exert a moderating effect on an individual's perceived self-efficacy, particularly in domains seen as "traditionally" male such as Science, Technology, Engineering, and Mathematics (STEM). (Betz & Hacket, 1981; Busch, 1995). Other research has suggested that undergraduate and graduate students differ in their perceptions of self-efficacy and the value of learning tasks (Artino & Stephens, 2009). This suggests the following research sub-questions:

RQ1.1: What influence does student gender have on learner engagement and perceptions of the quality and quantity of social capital, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning?

RQ1.2: What influence does student level of education (graduate or undergraduate) have on engagement and perceptions of the quality and quantity of social capital, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning?

2.7. Differences Based on Course Characteristics

Research question 2 explores how the research variables are affected by course characteristics including how groups were formed and whether or not the course was in the student's degree program. Purposeful group formation has been explored as a meaningful activity for computer-supported collaborative learning environments and is expected to have an influence on the development of social capital, system satisfaction, and perceived learning (Wessner & Pfister, 2001). At the same time, prior research has found that students rated learning modules in elective courses higher than those in required courses (Smart & Cappel, 2006). To understand the impact of these course characteristics, the following two research sub-questions are explored:

RQ2.1: What influence does the method of group formation in a course have on perceptions of the quality and quantity of social capital, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning?

RQ2.2: If a course is in the student's degree program or outside of the student's degree program, do perceptions of quality and quantity of social capital, self-efficacy, learning goal orientation, task value, system satisfaction, and perceived learning differ?

3. Methodology

This research involved course assignments requiring students to complete two-part constructed response tasks (Bennett, 1993; ETS, 2009). These constructed response tasks instructed students to first

conduct individual Internet-based research. Students were typically given one week to complete the individual part of the assignment and submit their written responses. After completing the individual portion of the assignment, learners were instructed to share and discuss the knowledge resources they used in their individual assignments, along with their opinions and viewpoints, to negotiate a group consensus, most often responding to the same set of questions. This group submission was typically due one week after the individual assignment.

Although the assignments were required parts of each course, students were offered extra credit for completing two surveys, the first before starting the individual part of the assignment (pre-assignment survey) and the second after submitting the group part of the assignment (post-assignment survey). The pre-assignment survey captured students' affective characteristics including self-efficacy and learning goal orientation, as well as their perceived value of the task. The pre-assignment survey also captured students' demographic information including gender, level of study (undergraduate or graduate), and degree program. The post-assignment survey captured students' perceptions of the quality and quantity of social capital that developed during the individual and group parts of the assignment, their system satisfaction, and their perceptions of learning from the assignment. The number of knowledge resources curated and shared were also captured.

This quasi-experimental field study was conducted in eight classes over the course of two semesters. Most students enrolled in the courses consented to participate in the pre-assignment and post-assignment surveys and to allow the researcher to capture their individual and shared knowledge resources.

Table 1. Reliability of research variables.

Research Variable	Cronbach's alpha	Number of Scale Items
Self-Efficacy	0.891	9
Learning Goal Orient.	0.837	5
Task Value	0.865	6
Quality of Social Cap.	0.818	4
Quantity of Social Cap.	0.720	3
System Satisfaction	0.857	9
Perceived Learning	0.889	9

The quantitative data from the surveys was first tested for unengaged responses by computing the standard deviation of all scale item responses. Any participants having a standard deviation of zero were removed from the sample set. Scale items for each research variable were then summed, and Cronbach's alpha was tested for all of the research variables to verify their reliability. The Cronbach's alphas and the number of items in each scale are shown in Table 1.

Univariate data analysis using independent samples t-tests was conducted to evaluate the sub-questions of RQ1 and RQ2, with all data analysis conducted in SPSS. Only those variables that exhibited statistically significant differences are listed in the following sections.

4. Results

After preliminary data screening, a sample size of 210 students who completed both research surveys was obtained. A summary of the participant demographics is listed in Table 2.

Table 2. Participant demographics.

Gender	147 Male	63 Female
Level	74 Undergraduate	136 Graduate

4.1. Gender Differences

An independent samples t-test was used to compare the means of all the research variables based on gender (RQ1.1). Despite previous studies finding gender effects, particularly for variables such as self-efficacy, the t-test revealed no statistically significant differences for any of the research variables based on gender. This lack of difference may be the result of women students viewing themselves as highly capable at this university because they must compete in a setting with a challenging curriculum in which males significantly outnumber females.

4.2. Differences Based on Level of Education

RQ1.2 investigates differences in the research variables based on students' level of education. An independent samples t-test suggests differences for all of the research variables, listed in Table 3.

These results suggest that graduate students are generally more positive about their learning experiences and capabilities than undergraduate students. Graduate students not only reported higher perceived learning than undergraduates, but they also reported higher perceptions of system satisfaction, the value of the learning task, and quality and quantity of social capital. They also were more engaged in the learning activity as evidenced by higher numbers of resources stored both individually and as a group. Finally, graduate students reported higher perceptions of their self-efficacy and learning goal orientation. These positive perceptions could be the result of graduate students' increased engagement in their educational experience and

confidence in their abilities; not only are graduate students typically older than undergraduate students (and therefore possibly more mature), but at this university, most graduate students are either working or have previous work experience that may cause them to feel more capable.

Table 3. Differences based on student level.

	Undergrad Mean, SD	Graduate Mean, SD	t-statistic
Individual Resources	2.27 3.38	4.41 4.59	3.53**
Group Resources	3.41 4.68	6.66 8.77	2.97**
Self-Efficacy	34.45 4.87	36.58 4.53	3.18**
Task Value	23.64 3.39	25.25 2.88	3.65***
Learning Goal	20.11 3.06	21.60 2.33	3.96***
Quantity of Social Cap.	10.50 2.24	11.82 1.92	4.50***
Quality of Social Cap.	15.28 1.60	16.01 2.31	2.06*
System Satisfaction	31.87 5.79	33.56 5.99	1.98*
Perceived Learning	32.47 5.11	35.52 5.01	4.18***
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$			

4.3. Differences Based on Group Formation

RQ2.1 asks if the method of group formation in the course has any influence on the research variables of interest in the study.

Table 4. Assignments and group formation.

Course	Assignment	Group Formation
A	Research database-related topic	Self-selected
B	Research non-relational databases	Randomly assigned
C	Compare two IS security breaches	Self-selected
D	Research object-oriented modeling	Self-selected
E	Analyze an IS project failure	Randomly assigned
F	Analyze FBI and other org structures	Randomly assigned
G	Apply theoretical framework to business	Randomly assigned
H	Create a video about a societal issue	Instructor assigned

Table 4 lists the courses, a brief description of the relevant learning activity, and the method of group formation.

In each course, the method of group formation was left to the instructor; that is, group assignment was not controlled by the researcher. In the three courses in which students self-selected into groups, students were already interacting with their team members on semester-long group projects. In the remaining five courses, the groups were either purposefully assigned by the instructor or were randomly assigned by the learning management system. In these courses, learners' first interactions with their team members occurred as a result of this assignment.

Group formation method is an important course characteristic, particularly in research that explores student interaction and social capital formation. Self-selected groups represent students who have chosen to work together. Because self-selected groups have expressed a desire to work together, and because they are already familiar with one another through prior course-related group work, the expectation was that students in these courses would share more resources and would report higher perceptions of learning. Results of an independent samples t-test, however, suggest that the opposite is true, as shown in Table 5.

Table 5. Differences based on group formation.

	Random Mean, SD	Self-Select Mean, SD	t-stat.
Individual Resources	4.04 4.72	2.93 3.32	1.97*
Quantity of Social Cap.	11.59 1.97	10.80 2.35	2.26*
Perceived Learning	35.09 4.93	33.21 5.63	2.51*
* $p < 0.05$			

These results suggest that students may be more engaged in learning activities when they are assigned to groups in which they may not know the other students as evidenced by the differences in individual use and perceptions of quantity of social capital. There are several possible explanations for this difference. One could be that students feel a greater need to earn the respect of their teammates by participating and contributing to the group's success. On the other hand, students may feel that they cannot rely on unknown others to be as thorough, necessitating a greater self-reliance on their own efforts.

Perceived learning was also significantly higher for students in assigned rather than self-selected groups. One possible explanation for this result is that students who are not familiar with one another must expend additional effort to develop a shared language when

discussing their findings, and that this additional effort increased their perceptions of learning from the assignment. Another possible explanation is that students who self-select into groups are more like-minded and therefore find more similar resources for the research assignment, while students who are assigned to groups may discover a broader range of Internet resources that, when shared, introduce them to different perspectives about the topic, thereby increasing their perception of learning.

4.4. Differences Based on the Course Being In or Out of the Learner's Degree Program

Table 6 shows significant differences in several research variables based on whether or not the course was part of the student's degree program (RQ2.2).

Table 6. Differences based on degree program.

	Not In Prog. Mean, SD	In Prog. Mean, SD	t-stat.
Individual Resources	3.20 4.09	4.46 4.60	2.05*
Task Value	24.16 3.30	25.61 2.69	3.27**
Quantity of Social Cap.	11.10 2.19	11.82 1.94	2.38*
System Satisfaction	32.16 6.19	34.37 5.28	2.61*
Perceived Learning	33.66 5.12	35.84 5.19	2.96**
* $p < 0.05$, ** $p < 0.01$			

These results suggest that students reported higher perceived learning, and were more engaged in the learning activity, when the course was part of their degree program. As shown in Table 6, students for whom the course was part of their degree program reported higher perceptions about the value of the assignment task, suggesting that students see more value from learning experiences directly related to their long-term learning goals. They also stored more resources individually, reported higher perceptions of the quantity of social capital that developed during the assignment, and reported higher levels of system satisfaction. However, there was no difference in reported self-efficacy between students for whom the course was part of their degree program and students for whom it was not. This could be because self-efficacy captures students' perceptions of their general capabilities as students, rather than their perceptions about performance in a particular assignment or course. Alternatively, the lack of difference in perceived self-efficacy could be that the students felt capable of successfully completing the assignment regardless of whether or not it was in their major.

5. Discussion

The success of Internet-based online innovation communities suggests that integrating learning activities requiring students to curate and share Internet knowledge resources can help prepare learners for success as innovators and entrepreneurs. Yet other factors influence learner engagement and perceptions of learning, including the characteristics of the assignment and course, and affective traits of the learners themselves. This research therefore integrates a two-part assignment requiring individual and collaborative knowledge creation activities with pre- and post-surveys capturing learner affective characteristics and engagement through the number of knowledge resources curated and shared (RQ1). It also tests for differences in these characteristics and engagement based on course characteristics (RQ2).

Although there were no differences in any of the research variables based on gender (RQ1.1), all research variables differed based on students' level of education (RQ1.2), with graduate students being more engaged (as measured by both individual and group resources used) and more positive in their self-perceptions of all affective variables (self-efficacy, learning goal orientation, task value, and system satisfaction) than undergraduate students. Graduate students also reported higher perceptions of quality and quantity of developed social capital and higher perceived learning from the activity. This suggests that assignments seeking to introduce learners to innovation activities using the Internet as a platform are more effective in graduate programs because of increased engagement and improved affective characteristics of the learners.

Furthermore, instructors integrating these types of assignments into their courses may wish to assign learners to groups rather than allowing them to self-select (RQ2.1) because results suggest that randomly assigned groups in which the group members had not previously interacted during the course stored more resources individually and reported higher perceptions of learning and the quantity of social capital that developed from the assignment than groups in which members self-selected their teammates.

Finally, students for whom the course was part of their degree program were more engaged (i.e. they stored more resources individually) and reported higher perceptions of the quantity of social capital shared as well as system satisfaction and perceived learning (RQ2.2) than students for whom the course was not part of their degree program. Although these findings suggest that this type of assignment may be better suited

in courses that are part of a student's degree program, this presents challenges for educators who are striving to expose students to the multidisciplinary nature of innovation. One possible solution may be to ensure that the topic of the assignment is sufficiently broad to ensure that the value of the task is meaningful to all students regardless of major. By making the learning task relevant to all students' educational goals, students will be more engaged and will have improved perceptions of the learning activity.

Together, the results of this research make an important contribution to pedagogy and the preparation of learners as innovators. First, it introduces Internet information foraging as an important activity that can contribute to innovation and proposes knowledge sharing as a model preparing learners for later contributions to Internet innovation communities. Findings also suggest that educators introducing these types of learning activities into their coursework as a means of preparing learners to participate in digital innovation must design the learning activity to be meaningful to multidisciplinary teams of students. To ensure such a multidisciplinary perspective, instructors should assign group members who will collaborate through negotiation of their unique perspectives, avoiding self-selected teams that may already have shared perspectives and understanding. Finally, educators must design tasks seen as meaningful regardless of a student's major in order to actively engage learners in knowledge acquisition activities individually and collaboratively, thus ensuring positive learning outcomes.

6. Limitations and Future Work

There are several limitations that may affect the generalizability of this research. First, students who participated in this research were all enrolled in Information Systems courses at the same northeastern technological university. This research should be repeated with courses outside of this discipline and at other universities, including liberal arts colleges.

Additionally, there was a significant amount of non-compliance of curating knowledge resources. Of the 210 students participating in the study, only 121 (57.6%) actually curated resources in their assigned systems for the individual portion of the assignment. It is unclear why over 40 percent of students did not curate their knowledge resources, although one explanation may be that students stored their resources using other methods such as bookmarks or simply copying the resources' links into the references section of their individual assignments. In future research, the post-assignment survey should be modified to include questions asking students if they utilized any other tools for collecting, managing and sharing their resources. For the purposes of this analysis, students who did not store any resources were given an ICT usage value of zero (0).

Similarly, at the group level, resources that were shared by a group were assigned to all individuals in the group. In other words, if group A stored 19 resources, the group ICT usage value for every student in group A was set to 19. This is because all students had access to the resource sharing area and to the Internet knowledge resources shared there. Future research should attempt to assign shared resources to the individual who shared them to further explore collaborative knowledge sharing and perceptions of social capital and perceived learning.

Finally, future research should investigate the relationship between individual and collaborative knowledge acquisition activities and innovation to further inform pedagogical modifications that prepare learners to be entrepreneurs, intrapreneurs, and innovators.

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