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Need satisfaction and collective efficacy in undergraduate blog-driven classes: A structural equation modelling approach

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This paper investigates how psychological needs spurring self-determined motivation relate to collective efficacy for flourishing in online learning communities. Self-determination theory posits individuals experience intrinsic motivation to flourish at educational tasks because of targeted satisfaction of the three psychological needs: autonomy, relatedness, and competence. However, studies conducted to investigate collective, technology-assisted learning processes suggest competence and relatedness may play a pivotal role in online community engagement and knowledge-sharing. Moreover, informal gaming experiences may mirror the collaborative skills needed in online educational/professional communities. These insights suggest confidence in one's abilities to contribute to a community, the perception of a strong, supportive social culture in the online classroom, and informal online experiences may lead to self-determined motivation enabling agents in distributed, technology-assisted classrooms to collectively flourish. Little work has been done to examine effects of need satisfaction on collective efficacy in using online technologies. To fill this research gap, we used structural equation modelling to investigate perceptions of 636 undergraduate students enrolled in classes within an education department at a midwestern university employing weekly asynchronous blogging. Our results suggest students' experience with multiplayer gaming, and need satisfaction towards competence and relatedness correlate with higher collective efficacy in technology-assisted classrooms employing discussion forums.

Implications for practice or policy:
- For instructors, student usership and design can spur motivation in online classrooms.
- For researchers, understanding student perceptions of collaboration using technology can help understand how to design better technology-assisted classrooms.
- The design of collaborative online educational communities should focus on creating positive social cultures and fostering competence for students.

Keywords: self-determination theory, collaborative learning constructivism, self-efficacy, cybernetics

Introduction

One of the great riddles of online education, and online behaviour in general, is the development of vibrant knowledge-building collectives. The development of joint agency through electronic connections was always one of the great promises of the Internet (Bush, 1945), from early communities like the Whole Earth Lectronic Link (WELL) and early open-source coding communities, such as Linux and Apache. There have been multiple attempts to study emergent online communities in educational contexts through frameworks including classroom community (Rovai, 2002), communities of inquiry (Garrison et al., 2010) connectivism (Clarà & Barberà, 2013; Siemens, 2005), and knowledge forums (Lei & Chan, 2018; Scardamalia, 2004). These contributions paved the way for further understanding the creation and maintenance of online communities on demand (necessary for transient educational initiatives). Recently, it has been hypothesised that an important attribute of a well-functioning online community is a sense of collective efficacy among users; the belief among community members that they have something of value to offer the community, and that the other community members place importance and value on each other's

participation (Glassman et al., 2021). A big question, however, surrounds the mechanisms of online community formation.

A critical aspect of forming these communities is whether to place emphasis on those designing and leading communities (Kirschner et al., 2004) to create collective efficacy, or on users' innate desires to be members of well-functioning online collectives. In this paper, we focus on the latter perspective, that is; the users' self-determined motivations to be part of well-functioning communities. Hur et al.'s (2013) model suggests willingness to participate in online communities is mostly based on the potential for these communities to meet the needs of potential users. While self-determined motivation and self-efficacy have shown strong relationships in previous studies (see Ryan & Deci, 2020) there has been little investigation into the relationships between distributed forms of efficacy in producing self-determined motivation, and the role of these relationships in advancing online communities. We used the idea of the basic psychological needs, deemed as essential nutrients to adaptive functioning in the social world in Deci and Ryan's (2000) self determination theory to understand forms of need satisfaction that heighten collective efficacy, to augment functioning of distributed educational communities.

Our study used structural equation modelling to examine relationships between undergraduate students' need satisfaction in online collaborative learning involving blogging and online discourse, and self-determined motivation to participate in sustainable, productive communities, operationalised within a collective efficacy framework. We suggest two of the three psychological needs, namely relatedness and competence play important roles in (potential) learner attitudes towards pursuing membership in a well-functioning online community using asynchronous blogging. Our paper expands the self-determination theory framework into the realm of collaborative learning in a highly interconnected online universe.

The first part of this paper explores theoretical concepts of collective efficacy and self-determination theory, outlines their integration, and reviews studies examining relationships between self-determined motivation and online community formation in students and professionals. The second part focuses on inferential development of our hypothesis based on our literature review, and outlines our structural equation model. The third part of the paper presents results of our Structural Equation Model, and potential answers this might hold for our hypothesis. We then discuss future possibilities for research to expand the scope of self-determination theory into the study of technology-mediated distributed learning communities.

Collective efficacy and self-determination theory

There are two points of origin for the framework of collective efficacy used in this paper. The first, better known in the field of education is situated in Bandura's (2000) social-cognitive framework. The second is a sociological approach where collective efficacy is used to describe community in general. This latter model was developed primarily by Sampson et al. (1999) and Morenoff et al. (2001). Initially the two concepts had differences, but began to merge with Bandura's (2000) explication (and we would argue, re-working) of his social-cognitive model of collective efficacy. The Sampson model was developed primarily through research in criminology, attempting to understand why some neighbourhoods are stable with few dysfunctional behaviours, while others sometimes situated close by (from a material distance perspective, few blocks away) are transient, having more crime. This sociological model is an extension of social capital (Coleman, 1994), except, while social capital defines potential resources, collective efficacy defines task-specific activities related to social flourishing and heightened capability in negotiating one's educational experiences.

Sampson et al. (1999) hypothesised stable, safer neighbourhoods had higher collective efficacy. Here, we refer to collective efficacy as the belief among residents that other members of the community care about its ability to survive and prosper, are willing to engage with and within the community to make this happen (shared expectations), and that their own behaviours will frame the way others act in response to the same task (reciprocal local exchange). Sampson et al. (1999) used collective efficacy mostly for social comparison, suggesting neighbourhoods with higher collective efficacy are more likely to be successful from both a sustainability and a quality of life orientation (the two are intertwined), with intergenerational closure between children and adults playing an important role. However, this factor has little value for the transient online communities we explored. Sampson et al. (1999) believed collective efficacy was not a deficit model where individuals did not fail to form sustainable communities because they were lacking

some individual attribute. Rather it was a task-oriented, community model, where individuals were willing to put aside other needs to maintain shared expectations and reciprocal local exchange.

Bandura (2000) also developed a theoretical framework for collective efficacy, based more on development and maintenance of transient communities (e.g., sports teams) and individual's perceptions of their own and their fellow team members, to build a well-functioning community. Bandura's (2000) early writings on collective efficacy portrayed collective efficacy as resembling individual self-efficacy, in which groups developed perceptions of abilities to achieve goals in much the same way individuals did, through building of cognitive filters based on information, actions, and subsequent successful experience homeostatically recalibrating behaviours (Tilak et al., 2022). Bandura's (2009) later ideas on collective efficacy were more nuanced and qualitatively different from self-efficacy. In many ways, Bandura's (2000, 2009) extension of collective efficacy reflected Sampson's (1999) components of shared expectations and reciprocal local exchange, placing them in the age of mass media. These ideas suggest individuals may believe other community members have the same approach to shared tasks as they do, and that engagement in task-specific activities will lead other members to recognise their contribution and reciprocate. Collective efficacy is based in individual members' perceptions about specific tasks related to the community rather than general group belief systems, involving constantly shifting individual perceptions arising from both satisfaction and dissatisfaction with immediate circumstances.

Our framework of collective efficacy in using online technologies (Glassman et al., 2021) aligns with Bandura's later ideas, suggesting individual contributions to a group, and perceptions of the group's dynamic functioning contribute to development of collective efficacy. We suggest common perspectives and orientations (Hipp et al., 2018) towards tasks, developed over time, can reduce social distance, resulting in collective efficacy (it might be more difficult to develop community between participants with different backgrounds and reasons for taking courses). Individuals who have experienced successful knowledge-sharing contexts may be more likely to believe it is possible to thrive in an environment of shared expectations and reciprocal local exchange, and collectively build successful online communities. This prompts asking why students, or really any potential community members would want to do this in the first place. In the next section, we explore how self-determination theory provides a sound framework to understand intentions guiding community-building.

The role of need satisfaction in online community building

Collective efficacy cannot develop unless potential community members desire to develop and/or sustain ongoing relationships for achieving shared goals. We live in an individualistic society, and education often focuses on individual actions and achievements (Grollios et al., 2015). Entire motivation theories are focused on developing educational contexts where individual learners achieve some self-defined value, and learners will not participate unless that value is apparent (Eccles & Wigfield, 2020; Urdan & Kaplan, 2020). The types of orientations and intentions needed for individual processes may be different from aspects required to function in a shared context. Self-determination theory may align with the development of collective efficacy, suggesting individuals may be motivated by opportunities to engage with others in shared activities.

Self-determination theory suggests we are driven by three innate needs/desires and engage in activities to satisfy these needs: relatedness (psychological need to feel a strong social connection to others), competence (need to be effective at using one's abilities and interacting with others), and autonomy (need to act out of individual volition) (Ryan & Deci, 2020). In collective processes, we experience satisfaction by working with others we feel some sense of relationship with. The desire for relationships can present a dilemma for educators, as such relationships can be dependent on common goals, but this is difficult to establish in transient groups where individuals have limited shared history, entering classrooms having undergone an array of diverse experiences (Coleman, 1994).

Teachers attempt to develop shared cultures or social capital in classrooms, but this can lead to exclusionary behaviours, where some students become central and foster greater competence, while others become marginalised, many times based on superficial resemblance and/or belief systems. Even when teachers can develop shared languages, it can take extended, well-planned interactions that, especially in high-school and college, educators do not have at their disposal based on distributed school structures and/or face-to-face academic experiences. Students can gain access to opportunities for organic community formation, but

it is usually outside of educational experiences, and has little to do with academic goals (e.g., all the students in a high-school or college cheering together for the football team; attending house parties; going to prom together; chatting in online text threads, organising LAN parties to play video games).

Online educational communities can many times lead to development of superficial ties (limited personal information used based on one's individual volition) (Tilak & Glassman, 2020). If at least some individuals have a sense of online collective efficacy, and believe that these online communities are a place to find relationships (a belief in much social media activity outside of educational contexts), they might be more motivated to be part of these communities and work towards sustaining them.

Competence may be more directly related to social interaction and agentic contribution within online communities. While competence in face-to-face, individual learning scenarios is often related to abilities to successfully accomplish tasks (Miller & Prior, 2010), competence in online communities has a strong social component, interweaving abilities with an individual's belief system that those abilities are meaningful and constructive for the functioning of the larger community. Collective efficacy suggests individuals have enough confidence (self-efficacy) in their own abilities recognising that they will find a way to merge their thinking and capabilities with others. For example, in early Open-Source programming communities, new members felt an inherent sense of competence in their own abilities, so much so that they would be recognised as worthy members by the larger expert community (Kelty, 2008).

One's individual contributions are only part of the competence equation in online learning communities. Another factor is the ability to recognise and trust in the competence of others, and the idea they will be able to add to the knowledge base. There is need satisfaction not only in being able to add to the community, but being part of a dynamic community that can work with you in a relatable way to solve problems and function as a knowledge building community. Collective efficacy may be related to both social cultures or relatedness, and confidence we feel in contributing to a group and functioning within a group (perceived self-competence). In the next section, we review the handful of studies that have been conducted in the realm of self-determination theory and online community formation.

Current research in need satisfaction and online community formation

Online networks or communities involve constantly unfolding processes defined by both individual (contribution to a group) and collective (dynamic group functioning) level activity. Such communities allow individuals to both interact, and take up information presented to them (Tilak & Glassman, 2020). Supportive online environments, for example social networking websites, allow individuals to pursue their goals, develop curiosity, and engage in agentic interactions with one another. Frameworks adhering to SDT suggest that satisfaction of the three needs leads to heightened tendency for individuals to engage with online technologies (Miller & Prior, 2010). Chen and Jang (2010) conducted a study of 267 special education pre-service teachers in an online synchronous class comprising chat sessions and asynchronous discussions. Results suggested that need satisfaction directed towards the three needs, arising from contextual support provided by instructors in the online classroom leads to individual self-determined motivation, predicting expected grades, and hours spent studying. Roca and Gagne (2008) suggested that the three psychological needs are related to behavioural intention to use technology, and perceived usefulness; all pivotal facets of Davis' (1989) technology acceptance model. We studied 140 high school seniors taking a biodiversity course. The course operationalised QR code technology to ask multiple choice questions to students as they navigated a botanical garden. Results suggested that the three psychological needs led to individual student's perception of the usefulness of the technology, and perception of ease of use. This, in turn, predicted behavioural intention of students to use the software.

The effects of need satisfaction on individual's self-determined motivation has been examined extensively in informal technology use. Ryan et al. (2006) saw that autonomy and competence of undergraduate students predicted engagement and future play in individual platform gaming titles with some multiplayer capacities. All three needs contributed to individual intentions to continue play in massive multiplayer online games. Gender differences were seen in perceived intuitiveness of the gestural commands used in gaming titles. While we examined individual tendencies in informal online groups, we extend Ryan et al.'s findings by understanding whether informal collective behaviour (gaming experiences) may affect formal collaborative education. We also aim to understand the role of gaming experiences in developing collective efficacy, drawing inference from literature (see Petter et al., 2020) asserting that skills accrued via gaming

experience are in line with the ingredients required to sustain professional/educational communities (e.g., accountability, cooperation, openness to learning).

The skills explored in gaming communities may also correlate with the use of social networking platforms. Wang and Li (2016) conducted a study on 221 undergraduate students in an entry-level business course and understood how creating a culture of relatedness led to satisfaction in the use of social networking platforms. They found that belief in one's competence to use social media predicted relatedness, leading to overall satisfaction in engaging with others using these platforms. We extend these findings by understanding undergraduate students' contribution to online blogs (a form of social media) embedded within an educational environment.

Kuem et al.'s (2020) study further extends findings of Wang and Li's (2016) results. The authors investigated how need satisfaction influences community engagement on Instagram. Their study involved a sample of 152 individuals at a market research firm. The results of their Structural Equation Modelling analysis suggested that both relatedness and knowledge self-efficacy (used interchangeably with competence) predicted community engagement, and were mediated by prominence in the community. However, autonomy had no direct effect on community engagement. Both Kuem et al. (2020), and Wang and Li (2016) controlled for gender in their models a priori, but found no significant effect on need satisfaction and engagement. We include gender in our hypothesis testing to test its effects in our model without prior manipulation. Yoon and Rolland (2012) studied 209 Internet users participating in online forums and communities, to understand facets of need satisfaction affecting online knowledge-sharing. They found that perceived competence and relatedness influenced knowledge-sharing, while autonomy did not. Familiarity in these environments had a more positive effect on need satisfaction as opposed to anonymity.

Familiarity is developed in classrooms through shared social and educational histories and ongoing experiences. In blended learning settings, the Internet forms a bridge between in-person and online attendees. Butz and Stupinsky (2017) investigated the interconnective capacities of the Internet in a class of 83 graduate students in their mixed methods study, and found students attending online and in-person students were able to develop a productive social culture (relatedness) through interactions mediated by the Internet. Zhao et al. (2011) conducted a study on 3475 high school students in China, and found that while teacher autonomy support led to curiosity, parental support did not. However, relatedness (operationalised in terms of peer influence) and competence (used interchangeably with Internet self-efficacy) fully predicted both curiosity and enjoyment in online educational communities. These findings suggest confidence in one's own abilities, and a vibrant classroom culture may more decisively predict productive collaborative online activity. Our literature review provided the foundation to infer competence and relatedness play a central role in online community formation, and clarified the possible role of informal Internet experiences and gender on community interactions. We used these insights to construct the hypothesis guiding our Structural Equation Modelling analysis.

Method

Hypothesis development

Our literature review suggested that when adolescents and college age students feel they can function effectively, contribute to online communities, and sense a strong social culture, they may be more likely to develop collective efficacy, and function as a cohesive group to create new knowledge, working on projects together. We used this inference to construct the hypothesis for our structural equation model. We also investigated the role of gaming experience and gender on relationships between need satisfaction and collective efficacy. These additions, focusing on students' sociodemographic characteristics/experiences were derived from studies outlining the existence of difference in technology use based on gender (Sun et al., 2020) coupled with Internet experiences (Jung, 2020), suggesting these variables may act as covariates in understanding distributed learning. We also relied on Petter et al.'s (2020) ideas about the strong resemblance between collective behaviours in gaming experience, and the ingredients for successful educational/professional communities, and the consideration of gender as a covariate in studies on self-determined motivation and need satisfaction in online environments (Kuem et al., 2020; Ryan et al., 2006; Wang & Li, 2016). We hypothesised:

H1: While controlling for the experience students have with massive multiplayer online and role-playing games, and gender, the satisfaction of the needs for competence and relatedness correlate with heightened collective efficacy.
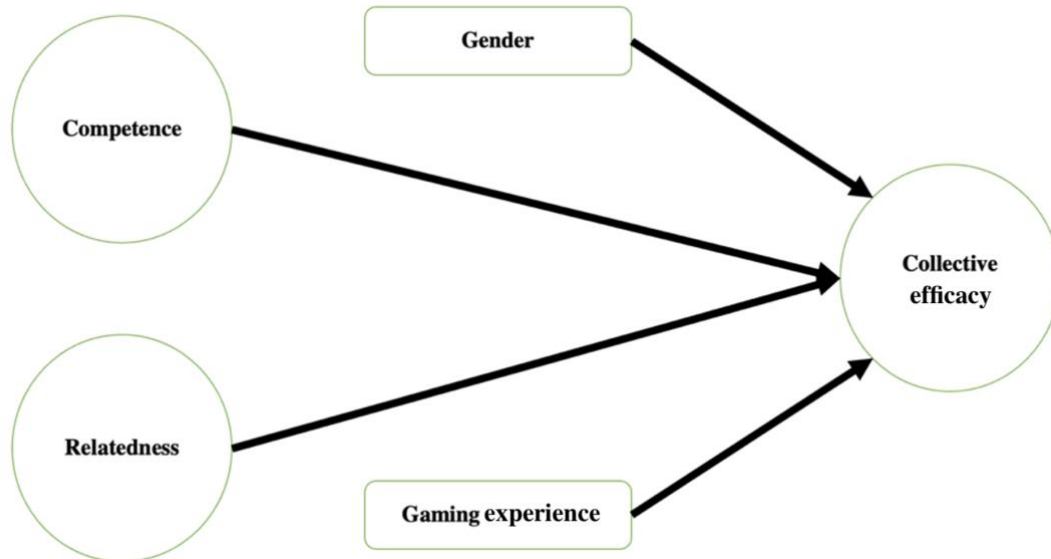

Figure 1. Hypothesised model.

By theorising collective efficacy is an outcome of need satisfaction devoted towards competence and relatedness, we suggest *distributed self-determined motivation* may manifest in technology-supported collaborative college classrooms because of strong social cultures and feelings of perceived capacity to thrive and perform.

Participants

In total, 636 undergraduate students took part in our study (30.6% male, 69.4% female). Students were enrolled in in-person classes at the education department of a large midwestern university, and syllabi in these classes involved use of the asynchronous discussion forum on the Canvas platform for posting and interacting to discuss weekly topics, and create an online learning community that informed discussions in class lectures through commenting and interaction on the class discussion forum. Participants were asked to give their consent to partake in the study. Every participant was offered a chance to win a $50 Amazon gift card, and received extra credit for participation. Research assistants entered the classrooms at the end of the semester and took 15 minutes of instructional time to distribute surveys to students via a Qualtrics-generated link.

Instruments

In this study, we consider responses to two scales to test the hypothesised relationships between collective efficacy, relatedness, and competence in online community-driven classrooms. The first scale, which measured students' collective efficacy in technology use by looking at engagement, social presence, and collaboration at both I and We levels, has been recently validated with undergraduate students in technology-assisted classrooms (Glassman et al., 2021). In this study we retained the factor structure of the collective efficacy scale. In total, all 636 students responded to this scale (Table 1).

Table 1
Online collective efficacy scale (Glassman et al., 2021)

Scale factor	"I" items	"We" items
Social presence	CE1. I can create comments and posts in online learning communities that others connect with.	CE7. Members of our online learning community can create posts and comments that we can all connect with.

	CE2. I can create comments and posts that others respond to.	CE8. Members of our online learning community can be responsive to each other.
	CE3. I can comment and post in ways that make other members of the online learning community respond thoughtfully.	CE9. Members of our online learning community can respond to each other thoughtfully.
	CE4. I can relate to the other members of the online learning community by reading their posts and comments.	CE10. Members of our online learning community can recognise each other's personalities through posting and commenting.
	CE5. I can sense there is an audience for my thinking when I post and comment online.	CE11. Members of our online learning community are able to interact with each other openly and freely.
	CE6. I can make comments and posts that other members find interesting.	CE12. Members of our online learning community can be an attentive audience for posts and comments.
Engagement	CE13. I can get myself to engage in the online learning community when there are other interesting things to do.	CE20. Members of our online learning community are capable of developing a common goal of knowledge-building.
	CE14. I can influence the online learning community to develop a common goal of knowledge-building.	CE21. Any member of our online learning community is capable of making an important contribution to our common goal.
	CE15. I can become so interested in the online learning community that I log on just to see what others are posting.	CE22. Members of our online learning community can respond thoughtfully to the ideas others are posting.
.	CE16. I can immerse myself in this online learning community without the fear of being judged.	CE23. Members of our online learning community can become interested in each other's posts.
	CE17. I can post and comment in ways that make other members of the online learning community respond in a timely manner in genuine way.	CE24. Members of our online learning community can respond to each other's posts in a timely manner.
	CE18. I can come back to the online learning community even when I am disappointed in it.	CE25. Members of our online learning community can create a judgment-free posting environment.
	CE19. I can post and comment in ways that make other members of the online learning community respond in a timely manner in genuine way.	CE26. Members of our online learning community can continue to be responsive to each other, even when there are disagreements.
Collaboration	CE27. I can contribute to the online learning community in whatever way needed.	CE32. Members of our online learning community can change each other's thinking through posts.
	CE28. I can move the thinking of the online learning community forward through my contributions.	CE33. Members of the online learning community can be open to the ideas of other members.
	CE29. I can learn more from posting and reading online than I can just by exploring topics by myself.	CE34. Any member of our online learning community is capable of contributing to the group in whatever way needed.
	CE30. I can offer constructive feedback to the ideas of other group members.	CE35. Members of our online learning community can offer constructive feedback on each other's posts.
	CE31. I can work well with other members of the online learning community to solve a problem.	CE36. Members of our online learning community can work well together in order to solve a problem.

The second instrument was Hur et al.'s (2013) democratic classroom scale, which incorporates elements of self-determination theory into its items. The scale has been validated with undergraduate students more than five years prior to this study, warranting refinement of the factor structure to better explain facets of self-determination theory (autonomy, competence, relatedness), and explain trends in community formation with current samples. In total, 334 students in the sample responded to this scale. Missing data was handled using maximum likelihood estimation. The factor structure is provided in Table 2.

Table 2
Initial democratic classroom scale (Hur et al., 2013)

Scale factor	Items
Performance orientation	DC2. The most important thing for me in taking this class is getting a good grade. DC15. The most important thing you get out of taking a class is the credits and the grade.
External motivation	DC3 I am very concerned with what my professor thinks of me and how he will judge me. DC4. I am very concerned with what the teacher thinks of my classmates and how he will judge them.
Cooperation	DC1. I feel like I can work well with others to achieve a goal. DC5 I believe my own abilities and knowledge are important when I am solving a problem. DC6 I believe my ability and willingness to work with others are important when solving a problem. DC7. I believe the abilities and willingness of others to work together is important when solving a problem.
Goals before trust	DC11. I think my classmates would betray me to get a better grade. DC12. I would betray my classmates if it meant I could get a better grade. DC13. My classmates would cheat for a better grade if they knew they would not get caught. DC14. I would cheat for a better grade if I knew I would not get caught.
Integrated activity	DC8. I tend to trust my peers when we work together on a project. DC9. I believe others will do their best when I am working together with them on a project. DC10. I am willing and ready to depend on others when doing work required for a course. DC16. The most important things you get out of a class is knowledge. DC17. The most important thing you get out of a class is a chance to work with others.

Analysis

We first conducted exploratory factor analysis using principal axis factoring in SPSS, to understand factor structure of the democratic classroom scale. Our data-driven approach did not make assumptions about patterns in the data, and allowed assessment of dimensionality of the scale in the latest phase of data collection, occurring more than 5 years after initial creation (and accompanied by drastic amplification in online technologies) (Knekta et al., 2019). We then conducted confirmatory factor analysis in Mplus to assess scale validity, and obtained factor solutions (Worthington & Whittaker, 2006). Since confirmatory factor analysis was used as an evaluation of the measurement model before proceeding to analyse the structural equation model, we did not use cross-validation procedures (Vodanovich et al., 2005) for exploratory factor analysis or confirmatory factor analysis. In total, 167 of the 334 responses were analysed for validation. The resultant factor structure mapped onto the three facets of need satisfaction examined by self-determination theory: autonomy, competence, and relatedness.

We used two subscales from the democratic classroom scale to test our hypothesis for the relatedness and competence subscales. These were used in a path model to examine relationships between collective efficacy and need satisfaction. The model represented a multiple regression to understand if need satisfaction directed towards relatedness and competence led to collective efficacy in technology use, while controlling for gender and gaming experience with multiplayer and role-playing games as covariates. Our

results elaborate our exploratory factor analysis and confirmatory factor analysis conducted using half the responses, to refine the democratic classroom scale to focus on need satisfaction in online community formation, and the path model we constructed using all 636 responses, to measure relationships between collective efficacy and need satisfaction.

Results

Refinement of democratic classroom scale

We first refined the factor structure of the democratic classroom scale to map directly onto self-determination theory, and for effective further use to gain insights into need satisfaction. The exploratory factor analysis was conducted in SPSS using half the scale responses (167 out of 334). The Kaiser-Meyer-Olkin test (0.742) and Bartlett's test for sphericity ($\chi^2(df)$ = 2306.14(136), $p < 0.001$) showed that chosen items and sampling was adequate to conduct exploratory factor analysis. We analysed the 17-item scale using a principal axis factoring method with varimax rotation. To correspond with the established tripartite framework of need satisfaction offered by self-determination theory, we extracted a fixed number of factors (3) in the exploratory factor analysis. The results of the exploratory factor analysis are presented below (Table 3). We found items 4 and 16 showed inadequate factor loadings, leading to removal. The remaining items showed strong correspondence with ideas related to autonomy, competence and relatedness, and satisfaction of these needs in educational settings.

Table 3
Rotated factor matrix from exploratory factor analysis

Items	Competence	Autonomy	Relatedness
DC1	.495	-	-
DC2	-	.305	-
DC3	-	.312	-
DC4	-	-	-.382
DC5	.740	-	-
DC6	.925	-	-
DC7	.811	-	-
DC8	-	-	.777
DC9	-	-	.837
DC10	-	-	.738
DC11	-	.736	-
DC12	-	.771	-
DC13	-	.664	-
DC14	-	.665	-
DC15	-	.478	-
DC16	-	-	-
DC17	-	-	.474

Following the exploratory factor analysis, confirmatory factor analysis was conducted in Mplus, with the remaining 15 items. We allowed for error covariances conforming with substantive theory based on Sörbom's (1989) recommendations to improve model fit. Additionally, Byrne (2013) suggested similar sounding survey items may lead to correlated errors. We adjusted for these correlations upon examining items. Two items showed poor loadings, leading to elimination. We then ran the model using the remaining 13 items. The resultant factor structure is provided below (Figure 2).
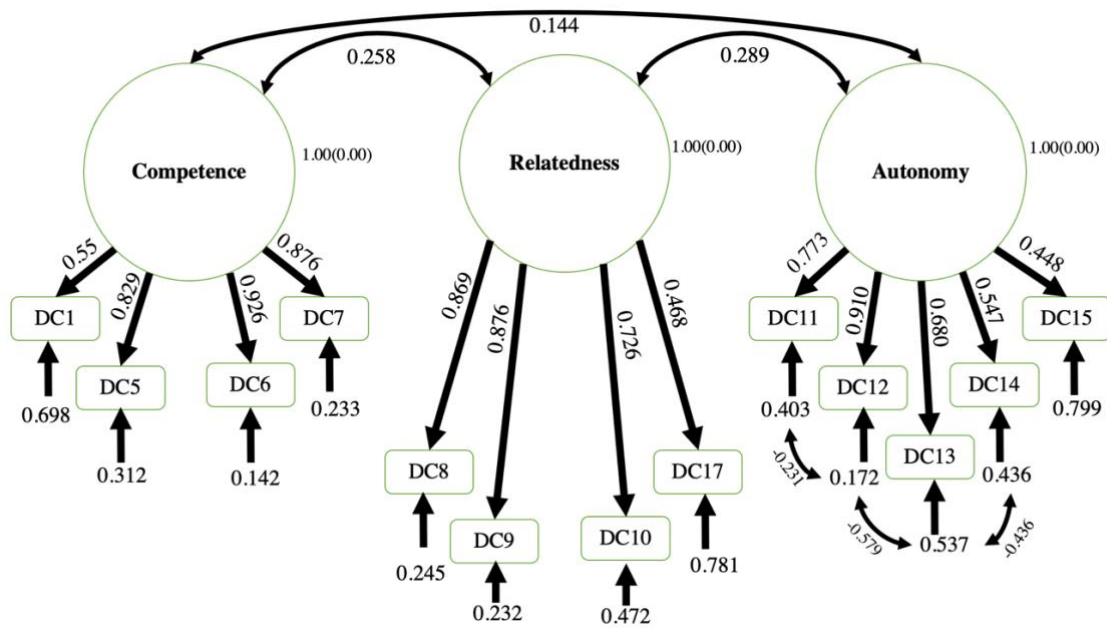
Figure 2. Measurement model for the restructured democratic classroom scale

This configuration produced a good model fit: $\chi^2(df)$ = 116.83(59), $p < 0.05$, CFI = 0.95, TLI = 0.93, RMSEA = 0.077, SRMR = 0.065. The McDonald's omega was 0.738, suggesting the scale was reliable for use with undergraduate populations in technology-supported classrooms. This process helped refine the factor structure of the democratic classroom scale to map directly onto self-determination theory. Further use of the scale within the self-determination theory framework warranted the use of items retained after the confirmatory factor analysis. The updated factor structure of the scale is presented below (Table 4). It was seen that items from the initial scale belonging to the cooperation factor, focusing on one's perception of their own skill, and that of others to succeed at tasks mapped onto the competence factor. Items in the integrated activity factor in the old scale focusing on trusting in others mapped onto the relatedness factor, which focuses on the social culture of an environment. Four items from the goals before trust factor, which focus on attaining one's goals before relying on others, and one item from the performance orientation factor (focusing on the importance of individual grades and credit hours in educational environments) mapped onto the autonomy factor in the new scale. This new structure mapped well onto self-determination theory.

Table 4
Updated factor structure of the democratic classroom scale

Scale factor	Items	Previous factor
Competence	DC1. I feel like I can work well with others to achieve a goal.	Cooperation
	DC5 I believe my own abilities and knowledge are important when I am solving a problem.	Cooperation
	DC6 I believe my ability and willingness to work with others are important when solving a problem.	Cooperation
	DC7. I believe the abilities and willingness of others to work together is important when solving a problem.	Cooperation
Relatedness	DC8. I tend to trust my peers when we work together on a project.	Integrated activity
	DC9. I believe others will do their best when I am working together with them on a project.	Integrated activity
	DC10. I am willing and ready to depend on others when doing work required for a course.	Integrated activity
	DC17. The most important thing you get out of a class is a chance to work with others.	Integrated activity
Autonomy	DC11. I think my classmates would betray me to get a better grade.	Goals before trust
	DC12. I would betray my classmates if it meant I could get a better grade.	Goals before trust
	DC13. My classmates would cheat for a better grade if they knew they would not get caught.	Goals before trust
	DC14. I would cheat for a better grade if I knew I would not get caught.	Goals before trust
	DC15. The most important thing you get out of taking a class is your credits and your grade.	Performance orientation

Path model

After factor analyses were conducted on the democratic classroom scale, we tested relationships between relatedness, competence, and collective efficacy, controlling for gender and gaming experience, using a multiple regression path model in Mplus. The items of the collective efficacy scale were converted into factors, used as composite latent variables representing the original 6-factor structure. This approach was taken to simplify the model, and to capture relationships between the specific subscales of the democratic classroom scale, and the construct produced from uniting the six factors of collective efficacy (I/We social presence, I/We engagement, I/We collaboration, and augmentation). The model terminated normally, and produced good model fit: χ^2 *(df)* - 266.85 (93), $p < .001$, CFI = 0.962, TLI = 0.951, RMSEA = 0.054, SRMR = 0.058. The correlation matrix (Table 5) and model results (Figure 3) are shown below.

Table 5
Correlation matrix for path model

|	DC1	DC5	DC6	DC7	DC8	DC9	DC 10	DC 17	CEF1	CEF2	CEF3	CEF4	CEF5	CEF6	GEN	GEX
DC1	1															
DC5	.358	1														
DC6	.481	.661	1													
DC7	.394	.594	.777	1												
DC8	.243	.210	.249	.283	1											
DC9	.231	.108	.137	.139	.738	1										
DC 10	.141	.038	.179	.212	.603	.637	1									
DC 17	.117	.073	.203	.219	.383	.375	.381	1								
CEF1	.403	.371	.455	.431	.352	.242	.252	.246	1							
CEF2	.352	.351	.412	.380	.423	.340	.300	.294	.763	1						
CEF3	.212	.129	.211	.234	.405	.383	.363	.287	.665	.735	1					
CEF4	.322	.257	.327	.358	.393	.330	.280	.275	.656	.762	.696	1				
CEF5	.266	.213	.315	.347	.386	.368	.314	.333	.676	.713	.753	.764	1			
CEF6	.332	.269	.391	.419	.452	.382	.340	.350	.62	.704	.662	.783	.783	1		
GEN	.075	.149	.138	.220	.062	.045	.078	.122	.092	.007	-.035	.01	.017	.018	1	
GEX	.009	.054	.107	.225	.058	.133	.050	.116	.187	.04	.095	.138	.146	.099	.481	1
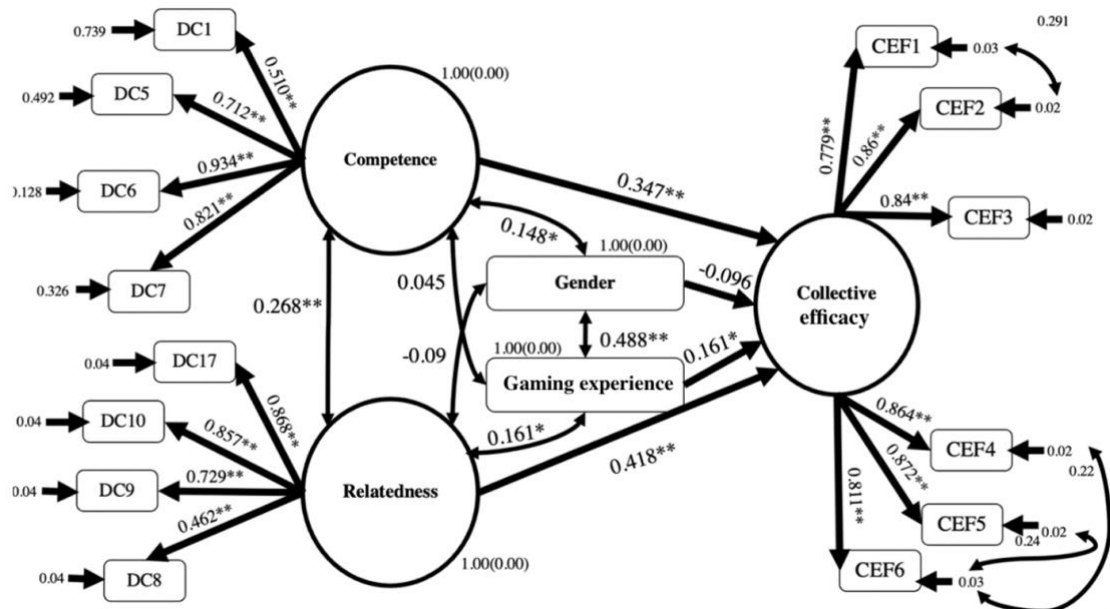
Figure 3. Path model examining relationship between need satisfaction and CE for engagement with online communities

The path model showed increase in need satisfaction for relatedness by one standard deviation, when controlling for competence, gaming experience and gender produced increases in collective efficacy by 0.418 standard deviations. This relationship was statistically significant ($\beta = 0.418$, $t = 8.06$, $p < 0.05$). An increase in need satisfaction for competence by one standard deviation, when controlling for relatedness, gender and gaming experience produced an increase in collective efficacy by 0.347 standard deviations. This relationship was also statistically significant ($\beta = 0.347$, $t = 6.378$, $p < 0.05$). An increase in gaming experience by one standard deviation produced an increase in collective efficacy by 0.161 standard deviations, when controlling for competence, relatedness, and gender. This relationship was statistically significant ($\beta = 0.161$, $SE = 2.473$, $p = 0.013$). There were no significant differences seen in collective efficacy based on participants' gender.

To summarise, we saw need satisfaction targeting relatedness and competence spurred individual's perceived capacity to meet classroom goals through individual contributions and group work in dynamic

online communities. Those with greater gaming experience with massive multiplayer online and role-playing games were seen to show greater collective efficacy, suggesting tenets of group activity in larger online systems may permeate formal educational environments. The informal online experiences that undergraduate students may have to create action-oriented communities on gaming platforms, as discussed in our literature review, may help foster accountability, cooperation, digital literacy, and openness to learning among other skills (Petter et al., 2020). These are all possible ingredients of a cohesive online learning community. The commonalities that Petter et al. (2020) describe may have explained the covariate effect of gaming experiences on the relationships between need satisfaction and collective efficacy. Overall, our results suggested that the creation of supportive social cultures (relatedness) and students' competence over educational material, fostered a cohesive learning community which displayed collective efficacy.

Discussion and limitations

This study showed need satisfaction targeted towards relatedness and competence produced increases in collective efficacy for undergraduate students' use of online blogs, Online collective efficacy comprises of both I and We levels of social presence, engagement, and collaboration. Theoretical frameworks suggest that satisfaction of all three needs (competence, relatedness, and autonomy) leads to self-determined motivation in online settings (Miller & Prior, 2010). While traditional online learning/work environments requiring students/workers to function as individual units show that need satisfaction at three levels leads to adaptive technology use (Chen & Jang, 2010; Roca & Gagne, 2008), results from empirical studies investigating distributed activity in such settings portray a different picture. By ascertaining relationships between relatedness, competence and collective efficacy, our findings add another layer to existing literature showing how relatedness and competence, rather than autonomy, predict knowledge-sharing behaviours pivotal to online learning community development (Butz & Stupinsky, 2017; Kuem et al., 2020; Wang & Li, 2016; Yoon & Rolland, 2012; Zhao et al., 2011).

We suggest satisfaction of two of the three needs contribute towards a distributed self-determined motivation, which fuels ongoing interactions in collective classroom settings utilising new media platforms like discussion forums. Our inquiry taps into the potential of social-cognitive approaches focusing on constantly evolving community-level interactions. While Bandura (2000, 2009) ruminates over the potential to better understand collective agency through creation of a nomenclature for social-cognitive theory (the concept of collective efficacy), there has been little done to understand how contemporary motivation theories map onto this concept. Our study adds to the few existing studies examining the role of need satisfaction and motivation in both informal (online gaming, social media) (Kuem et al., 2020; Wang & Li, 2016; Yoon & Rolland, 2012) and formal (learning, work) (Butz & Stupinsky, 2017; Zhao et al., 2011) online collaboration. We aimed to fill this gap by empirically extending the tenets of self-determination theory (Ryan & Deci, 2020) into an age of heightened digital interconnectivity. Our goal was to understand relationships between online collective efficacy and need satisfaction in tool-mediated classrooms, and whether these relationships are affected by experiences in informal online environments, and by individual demographic characteristics shown to influence online activity, for example gender. Our results suggest informal gaming experiences, that augment skills required for collective participation in educational and professional settings (Petter et al., 2020), may act as a covariate to psychological mechanisms of online community formation. Incorporating collaborative projects and avenues for peer-to-peer critical discourse into classrooms using online technologies may help capitalise on the opportunity for students to tap into forms of social capital they acquire in their everyday, informal activities. Engaging in such activities can spur distributed self-determined motivation.

The higher proportion of female students in our classrooms may explain non-significant negative effects of gender as a control variable on collective efficacy. A more balanced distribution of students may help understand how gender identity can affect functioning in online educational environments. Achieving such a distribution in naturalistic educational environment subject to constraints of educational institutions can be difficult, and calls for further rounds of surveying. A second limitation is that scales and variables helping understand social processes provide self-reports of observable community-building activity. Bandura suggests collective understandings of motivation are more dynamic than individual-level analyses, subject to vicissitudes of interacting groups and moving classroom contexts (Glassman et al., 2021). Self-report data used to derive our insights provided a snapshot of these community-building processes. Direct observations of social phenomena leading to strengthening of community ties may supplement results produced by self-report approaches.

Conclusion

Research in self-determination theory suggests satisfying the three psychological needs in formal and informal learning leads individuals to be motivated in performing tasks (Ryan & Deci, 2020). However, there has been little work done to understand how communities can thrive within this framework, learning together as a company of actors. With the Internet expanding exponentially, ingredients for thriving in informal online communities may intersect with skills for problem-solving and learning in technology-supported classrooms. Our results on blog-driven undergraduate classes, suggest that to enable technology-supported learning communities to thrive, individuals participating in them need to feel confident in their skills (competence), and perceive a strong social culture comprising trust and belongingness (relatedness). The students in our sample reported that such factors enabled them to perceive that they could create a strong learning community with high collective efficacy in online interactions and discourse. The online experiences that young adults and adolescents have may inform the nature of their participation in distributed educational processes, with experiences in gaming environments towards community-building influencing and augmenting capacity for online posting and discussions for educational purposes. This idea is reflected in our study through the salient effect of gaming experience on relationships between need satisfaction and collective efficacy in blog-driven classes. To tap into the potential of informal experiences in augmenting distributed self-determined motivation for educational technology use, teachers need to craft curricula capitalising on the traits of students' online realities. Using project-based approaches allowing increased collaborative interaction, and setting up forums of discussion (like blogs) may spur productive collective conversations, pointing towards the need for student-centred approaches to instruction. Further directions for research involve incorporating such informal aspects of online experience in a complex information age into classroom curricula.

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