Self-Governed Collaborative Inquiry in Action: A Case Study of a Large-Scale Online Youth Community

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Abstract: Online youth communities are fertile ground for collaborative learning. While prior research on such communities tends to focus on small-scale or adult-moderated learning spaces, this study reports on Physics Lab's Online Community (PLOC), a large-scale online youth community that has generated more than 138,000 projects. Using the framework of Community of Inquiry (CoI), our exploratory mixed-methods analysis suggested the existence of CoI's three interrelated presences: cognitive, social, and teaching in PLOC, and that in absence of instructors, it is possible for youths to perform teaching presence collaboratively.

Introduction

While most of online communities are not designed as educational spaces, virtual social spaces can be fertile grounds for collaborative and learning (Cress et al., 2016). In this study, we investigate a large, self-governed youth community with the lens of Community of Inquiry (Garrison et al., 1999), one of the most prominent frameworks for analyzing and designing online communities for teaching and learning. The CoI framework consists of three core elements: cognitive, social, and teaching presence (Swan et al., 2009). Although the majority of CoI studies situate in formal higher education settings (Kozan & Caskurlu, 2018), studies are also conducted in K-12 (Borup et al., 2014), workplaces (Garrison et al., 2010), and blended learning environments (Duncan & Barnett, 2009). Compared to open online communities, CoI communities are limited in time and space and often require a teaching presence facilitated by instructors. Yet, the framework also hypothesizes that teaching presence may be performed by any participant (Garrison et al., 1999). Here, we are interested in whether it is possible for a student-led CoI to emerge.

Many previous studies have shown that large-scale adult communities are capable of self-organizing around shared goals (e.g., Oeberst et al., 2014), regulating common practices and enforcing social norms (e.g., Konieczny, 2010), and coordinating the challenging process of distributed knowledge creation (e.g., Oeberst et al., 2014) through self-regulation and self-governance. The vision of a self-governed social system as a learning environment with room for learners to reflect, discuss, and revise criteria for knowledge and processes of learning, could have profound implications for designers of learning environments (Obberst et al., 2014). However, this is often not the case for communities of youth. Therefore, we seek to explore: *is it possible for the three presences (cognitive, social, and teaching) of the CoI framework to emerge within an online youth community?*

Physics Lab's Community (PLOC)

Physics Lab is a mobile learning software for youths to construct interactive simulations and share their projects (https://turtlesim.com/products/physics-lab/). This study is situated in Physics Lab's Online Community (PLOC), which has over 3 million users and 138,000 projects (as of 2021). In this study, we focus on the Chinese-speaking sub-community as it has the largest share of users. Most of them are K5-K12 learners in out-of-school contexts. While the technological design of Physics Lab resonates with that of the Scratch website, the emergence of self-regulation and self-governance in PLOC makes it more like Wikipedia. In 2019, the *Regulation of Physics Lab*, serving as the constitutional document of the self-governance, was drafted and enacted by youths. While the first author of this paper, the main developer of the platform since 2017, still reserves some statutory powers as defined by youths, he never intends to use them. The research team has thus relinquished the ultimate authority over PLOC.

Methodology

We adopt the stance of member-researcher as suggested by Adler (1987). Therefore, our research combined some authors' online ethnographic experiences (Hine, 2008) and qualitative content analysis. Bias due to our special designer-membership status in PLOC was controlled by possible methods as suggested by the literature, such as a) clear identification of our dual status (as facilitators of and researchers; b) refraining from making unverified claims; and c) triangulating our ethnographic experiences with other data sources (Konieczny, 2010). In this study, we present vignettes from our qualitative content analysis of PLOC. The first dataset (50 projects) was first open-coded by three authors, then one author triangulated the first round of code with the coding scheme of CoI (Garrison et al., 1999; Swan et al., 2009, with minor adaptations for informal environments). The second dataset (900 projects) was systematically coded for their social, pedagogical, and innovative features to portray the overall social landscape with an average cohen kappa coefficient of 0.71. Our insider knowledge of PLOC granted us a deeper understanding of PLOC during the collection and analysis of our datasets (Adler, 1987).

Findings

In the following sections, terms in **bold** indicate codes from Garrison (1999)'s coding scheme of CoI.

Cognitive Presence

In the CoI framework, Cognitive Presence (CP) is defined as the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse (Garrison et al., 1999). We demonstrate how cognitive presence is present in PLOC through a vignette. *Will*, the author of *the Snake Game* project, began the project with their **triggering event** (Table 1). While doubted by other youths in the community, *Will* set out for this mission by opening a development diary. In *Will's* profile page, we found dozens of projects during the making of *the Snake Game* related to *Will's* ideas, trials, and failures (Table 2, 3), signaling the **exploration** and **integration** phase. *Will* not only discussed their own projects with peers, but also spent substantial time talking with peers about their work. Through our analysis of the temporal dataset, we found all four phases to be closely intertwined, as predicted by Swan et al. (2009): the **resolution** of an issue within the project led to another **triggering event**, opening a new round of inquiry. Six months later, *Will*'s journey would culminate in the final project (Table 1) which both explains the mechanism *Will* used for other learners, and reflects on the choices they made along the way.

Table 1. Excerpt from the *Snake Game*.

@Lim once explained to me about making a Snake game in Physics Lab: "even the simplest form requires 128 bytes, but the app supports 8 - and it would be very laggy." …
Appendix 1: How to play? (From Web) …
Appendix 2: Explanation of Snake's movement …
Appendix 3: Why did I use so many relays? …
Appendix 4: Review of my previous works …
Appendix 5: Trailer of my next work …

Table 2. Excerpt from *Will*'s in-process projects.

As shown in the simulation, if every cell needs a judging structure like this, the desk would soon be full. …
Another possible solution: use the offset of D-triggers to store coordinates, and utilize fixed voltage to …
Refresh of the display: use T-triggers to invert the current…
Well, how to determine if the game is over? …
Let me think if there is a more appropriate type of trigger than RS-trigger.

Table 3. Summary of *Will*'s history of inquiry.

Aug 12	Two-dimensional moving light spot
Aug 17	A new way for movement
Aug 18	Structure to determine the visibility of Snakes
Aug 23	Another solution for Greedy Snakes
Jan 21	Progress of the Greedy Snakes
Feb 15	The Greedy Snake, 1.0

Table 4. Examples of chat rooms of different topics.

Humor	On "Nonsense Literature"
Science	Index of my mathematical works
Greeting	Welcome, a newcomer to Physics Lab!
Governance	Rise against "water"! (note: meaningless posts)
General	All-New Chatroom. Gen 2
Life	What should I do if I am trapped by illusions

Social Presence

In CoI, Social Presence (SP) is defined as the extent to which participants could construct shared meaning through sustained communication (Garrison et al., 1999). Although the technological design of Physics Lab software was focused on social interactions around projects, learners have been developing their own ways of communication and formed a friendly social culture (see quote below).

> The most attractive thing in Physics Lab is the community atmosphere. Here, you can share the circuit you designed or the celestial system you made with the community; you could write "experiments" to introduce your creations and communicate with others. Users here are all very friendly.
> - "To New Users - Introduction to Physics Lab", *Announcement* by *Immortal* (Editor; Middle schooler)

For example, a common practice is to share a project as a chat room. Dedicated to greetings, governance, humor, and various topics of school life (Table 4), chat rooms serve as a perfect indicator of **group cohesion** and **affective expression**. Similarly, we saw how *Pi* (in Table 5) demonstrates their collective identity around PLOC. Although *Pi* was a newcomer in this community, his five-month participation as a reader gave him confidence in self-disclosing their personal history, as well as in facing potential criticisms from peers.

Table 5. Description excerpt, "*Motion of Three Bodies*".

Hello everyone! I am a newcomer. I downloaded Physics Lab for five months, yet today I created my first account and released my first work. In case you found any incorrect knowledge, please understand and point it out to me. Thanks! Let's get to the point now. (…) (...) I spent four months on this model, and this is the only one that works. All other (systems) either faced collision (of stars), or they just escaped and never went back. (…)

Table 6. Discussion excerpt, "*Motion of Three Bodies*"

Pi: Hi everyone! A question for you. If someone shoots forward on a train at the speed of light. Due to inertia, people, guns, and bullets would all accelerate to the speed of light. However, (…) So where would the bullet move? **Rainbow**: Good question! But I don't know… **Luke**: Time is relative, according to the theory of relativity. The bullet might be fired. (...) BTW, I support your work! **Pi:** But nothing could be faster than light, right?

Open communication, as demonstrated in the next vignette in the form of a continuing discussion (see the snippet in Table 6), also exists in PLOC. Not only did we find many instances of such discussions, in which youths would ask questions and offer advices, they also frequently expressed their agreements and disagreements with each other like *Pi* and *Luke* and appreciate others' contributions like *Rainbow*.

Teaching Presence

In CoI, Teaching Presence (TP) is defined as the design, facilitation, and direction of cognitive and social processes for achieving personally meaningful and educationally worthwhile learning outcomes (Anderson et al., 2001). Here, we demonstrate how youths are capable to organically **facilitate discourse** for peers. Soon after sharing, *Pi* asked a question about the theory of relativity in the comment section of *Motion of Three Bodies* (Table 6). Soon, three learners tried to answer the question, though none of them was certain. *Doug*, a middle school student moderator, weighed in. They first acknowledged and encouraged the question asked by *Pi,* then answered the question in detail. Finally, *Doug* summarized his answer. This vignette suggests the complexity of Teaching Presence in PLOC. On one hand, as there is little trace of instructors' presence in PLOC, *Doug* is but a more advanced peer. On the other hand, *Doug* did perform some teaching responsibilities, blurring the boundaries between instructors and students.

In the following quote, we present another case in which *Doug* is seen to engage in **direct instruction** by presenting contents and questions to peers. In PLOC, 77% of *Featured* projects serve as "introduction", purposefully introducing scientific concepts, principles, or experiments to other youths (Table 8). Further, through a peer-review mechanism designed and enacted by youths, they also engage in providing constructive feedback to each other.

> My work is quite different from other works which explain the third cosmic velocity. I spent a lot of space discussing the definition and laying out the foundation, in order to prepare for more in-depth explanations.
> - *Description* in "Third Cosmic Velocity" by *Doug* (Middle school student moderator)

Table 7. A glance at typical "Introduction" projects.

Physics	Explanation of NE555
Physics	Measuring the capacity of inductors and capacitors
Physics	Introduction to optics
Biology	PCR technology
Math	Moving points problems in mathematics
Chem	Purification of nitric acid

Table 8. A recent list of announcements

Election	A special election of editors will be hold soon
Development	Physics Lab 3.0 Developer Assembly
Governing	Extra requirements for (submitting to) *Featured*
Governing	On plagiarizing others' works
Scaffold	Newcomers' survival guide
Scaffold	For newcomers: How to Become a Volunteer

Design and organization of PLOC happen in multiple ways. Learners not only have drafted and enacted the *Regulation of Physics Lab,* but also designed and organized the community through announcements, in which they set agenda, promote the mission, provide guidelines, formalize social norms, and create scaffolds (see Table 8); through moderation (moderators of different ranks could hide posts, ban users, or promote projects); and through involving of the technological design. The "Announcement" tag itself, the sticky feature (to allow moderators to put certain projects on top of lists), the publicization of moderation logs - an increasing number of community features in Physics Lab are proposed either by consensus or sometimes a vote among moderators. Through the self-regulated governing processes, as demonstrated by the quote, learners in PLOC seem to be able to manage the challenging landscape of this large-scale open online youth community, reflect on shared meanings and purposes, and thus support the social and cognitive presences of the whole community (Garrison et al., 1999; Swan et al, 2009) in a collaborative way.

> In order to keep the software happily used by everyone and to realize the value of this software, some users and I have worked together to formulate the "Regulation of Physics Lab". We hope that everyone could consciously abide by these regulations, and actively cooperate with moderators to "enforce the law".
> *- Preface, Announcement: "Regulation of Physics Lab" by Golan (Administrator; 10-grader)*

Discussions

In this study, we presented several vignettes that suggested the existence of Cognitive, Social, and Teaching presences from Community of Inquiry (CoI) in PLOC that come from emergent social interactions of learners. While it would be challenging to compare PLOC with CoIs in classroom settings, the possibility of CoI(s) to emerge within large-scale online youth communities is impressive in itself. In *Mindstorms*, Papert (1980) described samba schools, self-governed social clubs that set their own theme and trajectory, as a model for the ideal learning society. Based on the authentic needs of the community and individuals' histories of participation, members take turns to the roles of learners, instructors, and facilitators. While samba schools are unique for their situated cultural particularities, their sustainable meanings and purposes could be a key factor in their success (Zagal & Bruckman, 2005). Could they also be a key reason for which PLOC thrives? If so, what makes them possible? There remains much to be learned.

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