A study of learners' behavior, cognition, and social-emotional dynamics in an online cooperative learning using gamification

Taufik Slamet

Introduction

Recent decades have witnessed an exponential growth in the amount of knowledge produced by cooperative efforts (e.g., crowdsourcing). Cooperation has been effective to leverage human capital strength to overcome social problems, offer solutions, and make life easier. Some notable landmarks of this phenomenon are Wikipedia, Waze, Yelp, and TripAdvisor; The platforms have been successful to draw people's attention and increase cooperative behavior to create solutions for real life problems (Morschheuser et al., 2019). Studies have agreed that the success of crowdsourcing initiatives depends on the willingness of people to participate in collective creation (Doan et al., 2011; Law & von Ahn, 2011; Morschheuser et al., 2019). To increase cooperation for crowdsourcing, studies have proven that the appeal of external enforcement (e.g., incentives) and intrinsic aspects (e.g., curiosity and sense of accomplishment) are rolling as contributing factors (Chris Zhao & Zhu, 2014; Soliman & Tuunainen, 2015). Among all available approaches, gamification has been empirically proven to be effective to increase cooperative behavior in crowdsourcing environments (Morschheuser et al., 2017).

To be successful in cooperative learning, six basic elements must be assured: individual accountability, enhanced face-to-face interactions, interdependence, interaction, social skills, and group processing (Johnson & Johnson, 1987). While the first factor is merely individual attributes associated with personalities, the remaining five factors are social dynamics that emerge through cooperative learning, regardless of what and how cooperative learning is conducted (Park et al., 2016). Positive social dynamics in cooperative learning can be a strong influence that sustains individual's loyalty to the group and continued engagement to the cooperative approaches. Although gamification has been shown to increase participants' engagement in collective action, little is known about the characteristics of gamification that retain cooperative behavior among learners.

To conclude, there is an insufficient number of empirical studies that explored how gamification designs can affect learners' academic performance and social dynamics in cooperative learning. Moreover, there exists a great need to incorporate dedicated cooperation theory into gamified learning and investigate how it can cultivate social dynamics among learners. In results, the purpose of this study is to explore how gamification can leverage cooperation theories to enhance academic performance and social dynamics among learners in cooperative learning. To answer our fundamental question, we examine the effects of the gamification designs on academic performance and social dynamics among learners in a cooperative learning setting through a quasi-experimental study and will enrich the findings with supporting qualitative data.

Purpose of the Study, Research Questions, and Hypothesis

The purpose of this study is to examine the effects of gamification on learners' academic outcomes in the context of cooperative learning. We will evaluate the effects of gamification in cooperative learning on learners' behavior, cognition, and social emotional outcomes.

Behavioral outcomes
1. RQ: How does gamification design affect learners' behavioral engagement in cooperative learning?
   - H1a – Participants in hybrid design earn the most points (number of posts, quiz completion, and badges completion).
   - H1b – Participants in hybrid design produce greater conditions of the five indicators of social network in discussion activities (measured by network size, density, degree centralization, out-degree, and in-degree centrality).
   - H1c: Participants in gamified cooperative learning produce more efficient time-to-completion (TTC).

Cognitive outcomes
2. RQ: How does gamification design affect learners' cognitive engagement in cooperative learning?
   - H2a – Participants in hybrid design produce higher levels of cognitive learning in discussion activities.
   - H2b – Participants in hybrid design perform better in cognitive test.

Social and Emotional outcomes
3. RQ: How does gamification design affect learners' social emotional engagement in cooperative learning?
   - H3a – Participants in hybrid design show a more positive attitude towards collective goals than the other two groups.
   - H3b – Participants in gamified cooperative learning show a more positive attitude towards cooperative learning.
   - H3c – Participants in hybrid design show a greater scale of altruistic (prosocial) behavior than the other two groups.
   - H3d – Participants in hybrid design show more positive attitudes and intention towards knowledge sharing.
   - H3e – Participants in hybrid design show higher group cohesion than collective group.

4. How do learners perceive the use of game design elements in online cooperative learning?

Significance of the Study

We envision that the outcome of this study will offer several contributions to the field of gamification for learning in several facets. First, from theoretical practice, this study has potential to serve empirical evidence and explanation on how dedicated cooperative learning theory can be applied to gamification. In addition, the outcomes will enrich the knowledge of how gamification can cultivate social dynamics in a cooperative learning environment. Second, the outcomes will enrich practitioners' understanding of how to enhance cooperative behavior in

gamified learning from a practical standpoint. Practitioners will have alternative guidance on how to incorporate gamification into their practice that supports cooperation among learners.

Research Design

Method

The study will be conducted through a quasi-experimental study with independent group design and test.

Context and Participants

the study will be conducted in a public university in Indonesia. The context is an undergraduate course called 'Teaching and Learning' and all the students are pre-service teachers with a varied of subject. The intervention will be conducted eight weeks after the mid-term exam and the topic will be 'AI for teaching and learning'. I am planning to include four different classes that are enrolled in a similar course. The length of the treatment will be approximately eight weeks.

Procedure

The curriculum and lesson plan will be developed soon.
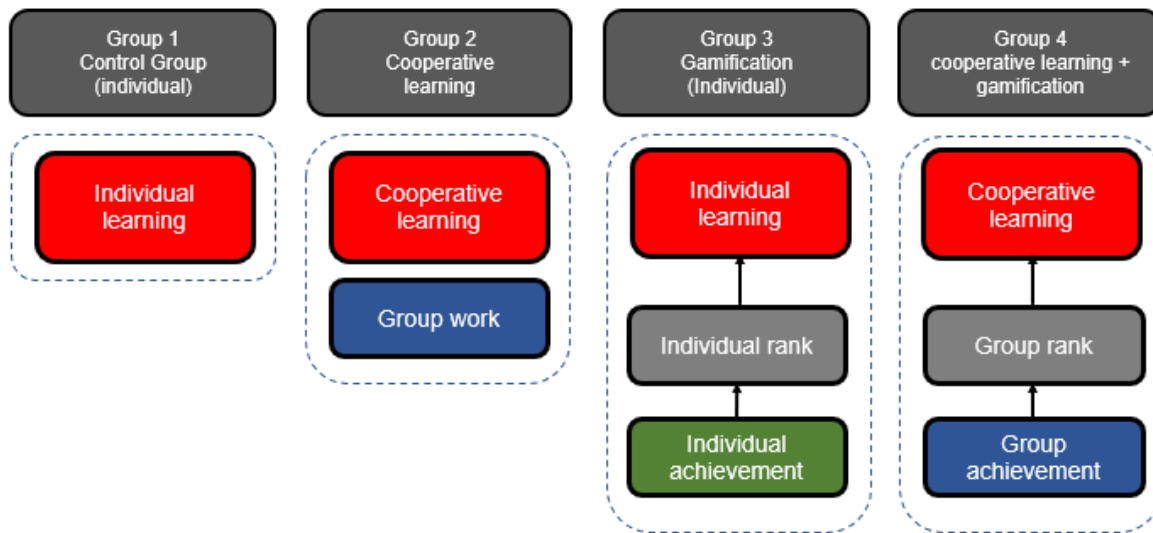
An example of cooperative unit activity in this study is shown below.

Cooperative Unit 1: Building a wiki page
- Objective: Students build a page that summarizes practical benefits of AI for teaching practices
- Guiding question: in what way AI can help teachers improve their teaching practices?
- Output: A wiki page
- Assessment:
  - Group project (wiki page)
  - Individual essay
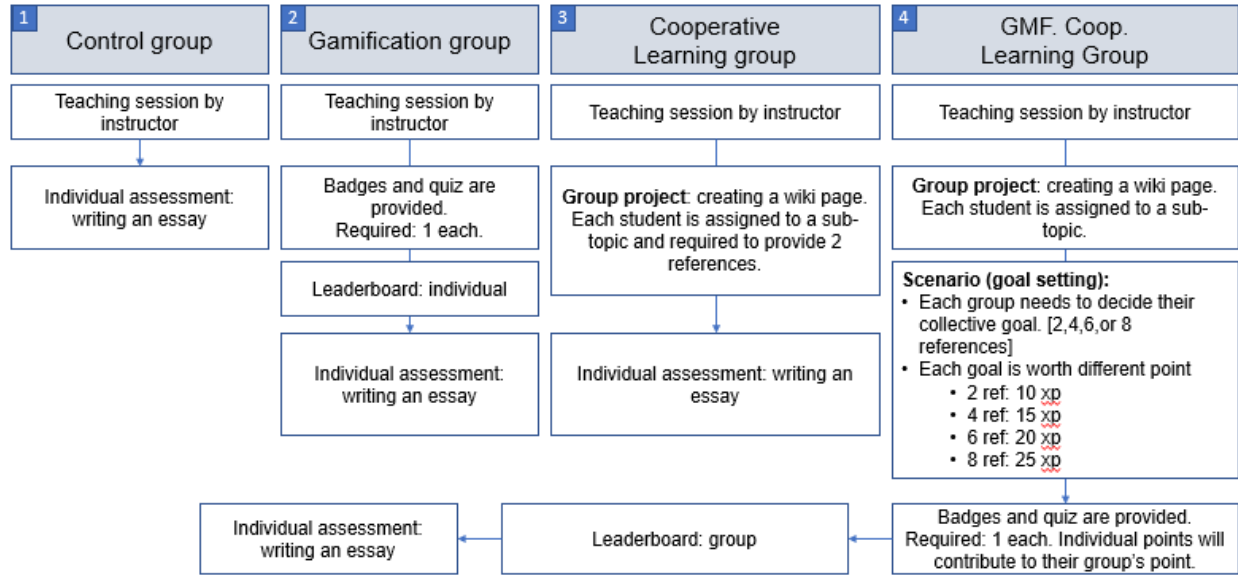
Data Collection and Analysis

Our data collection approaches include behavioral data observation, cognitive test, self-questionnaires, and interview. To determine the effect of the intervention in this study, quantitative data are prioritized, while qualitative data will follow as a complementary.

Research Questions	Hypothesis	Data Collection	Data Analysis
RQ1: How do gamification design characteristics (individualistic, collective, and hybrid) affect learners' behavioral engagement?	• H1a – Participants in hybrid design earn the most points (number of posts, quiz completion, and badges completion). • H1b – Participants in hybrid design produce greater conditions of the five indicators of social network in discussion activities. • H1c: Participants in gamified cooperative learning produce more efficient time-to-completion (TTC).	• H1a: log data • H1b: online discussion activities • H1c: log data	• H1a: mean comparison • H1b: social network analysis • H1c: mean comparison
RQ2: How do gamification design characteristics (individualistic, collective, and hybrid) affect	• H2a – Participants in hybrid design produce higher levels of cognitive learning in discussion activities.	• H2a: online discussions • H2b: cognitive tests	• H2a: content analysis (framework: levels of knowledge construction)

learners' cognitive engagement?	• H2b – Participants in hybrid design perform better in cognitive test.		• H2b: mean comparison
RQ3: How do gamification design characteristics (individualistic, collective, and hybrid) affect learners' social emotional engagement?	• H3a: Participants in gamified cooperative learning show a more positive attitude towards collective goals than the other two groups. • H3b: Participants in gamified cooperative learning show a more positive attitude towards cooperative learning. • H3c: Participants in gamified cooperative learning show a greater scale of altruistic (prosocial) behavior than the other two groups. • H3d: Participants in gamified cooperative learning show more positive attitudes and intention towards knowledge sharing. • H3e: Participants in gamified cooperative learning show higher group cohesion than collective group.	• H3a: Attitude towards collective goals self-questionnaire (Riar et al., 2020). • H3b: Attitude towards cooperative learning • H3c: Altruistic (prosocial) behavior self-questionnaire (Riar et al., 2020) • H3d: Self-questionnaire on attitudes towards knowledge sharing (Lin, 2007) and self-questionnaire on intention towards knowledge sharing (Lin, 2007) • H3e: self-questionnaire on perceived cohesion items (Chin et al., 1999) or self-questionnaire on perceived cohesion items (Tamayo Avila et al., 2022)	• H3a: mean comparison • H3b: mean comparison • H3c: mean comparison • H3d: mean comparison • H3e: mean comparison

How do learners perceive the use of game design elements into online cooperative learning?	• Interview to selected participants	• Content analysis

Instrument

We utilize a variety of research instruments to answer each of the research questions. For behavioral indicators, we use log data of the participants, including participants' earned points and social network data in online discussion activities. Following that, cognitive indicators are observed through participants' quality of online discussions and cognitive tests. On the other hand, self-questionnaires are used to measure different indicators of social emotional aspect of learning. In addition, open-ended interviews will be conducted to explain or verify the quantitative data.

Reflection

There is a growing interest in the use of game elements (gamification) in a wide range of contexts (business, health, and education) and interaction (collaboration, cooperation, or competition) to improve human participations. In educational settings, gamification has been implemented and showed positive influences on human behavior. The approach has been studied in various education levels (K-8 and Higher Ed.), across subjects (CS, Math, Language, or Social Science), mixed context (face-to-face, online, or hybrid), and different outcomes (cognitive, behavior, and social-emotional). This is an empirical proof that this study is feasible to be conducted in the intended setting (undergraduate students, cooperative learning, and online setting).

Based on a literature review, I discovered that cooperative learning in online settings is relatively rare. Collaborative learning is surprisingly superior and most investigated, so I think this is an excellent opportunity to advance the topics of cooperative learning in an online environment. Particularly, I am interested in improving learners' participation in cooperative learning. Gamification has been proven as an alternative approach to increase human participation in cooperative behavior, to wit: this approach will also help learners to engage in cooperative learning activities. The table below shows a rough agenda to conduct this study.

Phase: Preparation		
Points	**Stakeholders**	**Alternative Plan**
1. Determine the context (course and participants)	Researchers and course instructors; Interview.	Connecting with several universities in Indonesia
2. Develop the curriculum and content	Researchers and course instructors as advising partners	-
3. Develop the instrument	Researchers and course instructors as advising partners	Using existing instruments from previous studies (provided reliability is met)
4. Develop the course platform	Researchers and course instructors as advising partners	-

	Points	Stakeholders	Alternative Plan
5.	Recruit participants	Researchers and course instructors; Course announcement from instructors.	Allocate two to three weeks for the recruitment
Phase: Implementation			
	Points	**Stakeholders**	**Alternative Plan**
1.	Implementation and data collection (remote)	Researchers, course instructors, and participants; 8-week implementation; interview with 5 to 8 participants for verification purposes (RQ4).	-
Phase: Completion			
	Points	**Stakeholders**	**Alternative Plan**
1.	Data analysis	Researchers and instructor	-
2.	Report writing	Researchers	-

Appendix – Instrument

A. **RQ1**: Observations over participants' log data
B. **RQ2**: The instrument will be developed after the context (course and objectives) are determined.
C. **RQ3**: How do gamification design characteristics (individualistic, collective, and hybrid) affect learners' social emotional engagement?

- H3a – Participants in hybrid design show a more positive attitude towards collective goals than the other two groups.
    a. Attitude towards collective goals self-questionnaire (Riar et al., 2020).
        1) I intend that our group play Ingress together sometime during the next 4 weeks.
        2) We intend to play Ingress together sometime during the next 4 weeks.
        3) We plan to play Ingress together sometime during the next 4 weeks.
        4) The group and I "swim or sink" together.
        5) The members of the group and I seek compatible goals.
        6) We all know that all members are jointly committed to performing their parts of the common tasks.
        7) The members of the group and I "do our own thing".
        8) The members of the group and I pursue our own independent goals.
        9) The members of the group are most concerned about what they accomplish when playing by themselves.
- H3b – Participants in hybrid design show a greater scale of altruistic (prosocial) behavior than the other two groups.
    b. Altruistic (prosocial) behavior self-questionnaire (Riar et al., 2020)
        1) I like helping other members of the group I mentioned before in Ingress.
        2) It feels good to help other members of the group I mentioned before in Ingress.
        3) I enjoy helping other members of the group I mentioned before in Ingress.
        4) Assisting members of the group I identified before in Ingress is pleasurable.
- H3c – Participants in hybrid design show more positive attitudes and intention towards knowledge sharing.
    c. Attitudes and intention towards knowledge sharing.
    1) Instrument: self-questionnaire on attitudes towards knowledge sharing (Lin, 2007).
        1) I enjoy sharing my knowledge with colleagues.
        2) I enjoy helping colleagues by sharing my knowledge.
        3) It feels good to help someone by sharing my knowledge.
        4) Sharing my knowledge with colleagues is pleasurable.
    2) Instrument: self-questionnaire on intention towards knowledge sharing (Lin, 2007).
        1) I intend to share knowledge with my colleagues more frequently in the future.
        2) I will try to share knowledge with my colleagues.
        3) I will always make an effort to share knowledge with my colleagues.
        4) I intend to share knowledge with colleagues who ask.

- H3d – Participants in hybrid design show higher group cohesion than collective group.
    d. Group cohesion self-questionnaire (Chin et al., 1999; Tamayo Avila et al., 2022).
    1) Instrument: self-questionnaire on perceived cohesion items (Chin et al., 1999)
        1) I feel that I belong to this group.
        2) I am happy to be part of this group.

3) I see myself as part of this group.
4) This group is one of the best anywhere.
5) I feel that I am a member of this group.
6) I am content to be part of this group.

2) Instrument: self-questionnaire on perceived cohesion items (Tamayo Avila et al., 2022)
   1) I do not enjoy being a part of the social activities of this team.
   2) I'm not happy with my participation in the project.
   3) I am not going to miss the members of this team when the project ends.
   4) I'm unhappy with my team's level of desire to successfully end the project.
   5) Some of my best friends are on this team.
   6) This team does not give me enough opportunities to improve my personal performance.
   7) I enjoy other parties rather than team parties.
   8) I do not like the style of work on this team.
   9) For me, this team is one of the most important social groups to which I belong.
   10) Our team is united in trying to reach its project goals.
   11) Members of our team would rather go out on their own than get together as a team.
   12) We all take responsibility for any failure or poor performance by our team.
   13) Our team members rarely party together.
   14) Our team members have conflicting aspirations for the team's performance.
   15) Our team would like to meet sometime after the project is completed.
   16) If members of our team have problems, everyone wants to help them so we can get back together again.
   17) Team members do not like to meet after work on the project.
   18) Our team members do not express themselves honestly about each other's responsibilities in completing the project.

D. **RQ4**: The instrument will be developed after quantitative data are analyzed.

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