Using the Progressive Design Method in higher education: An analysis of cohesion, collaboration and inclusion dimensions

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Abstract
Many cognitive benefits for learning have been highlighted in the literature, due to peer feedback, but the relational aspects of this way of working, when it is implemented with groups of students, have been little investigated. This study aims to analyze some relational aspects of the use of peer feedback in the university context, considering in particular how the cohesion in the network of exchanges, the level of collaboration and inclusion of students, change during an activity carried out with a method based on peer feedback called Progressive Design Method. Eighteen undergraduate students participated in the study and worked in teams to develop projects in successive phases, each of which involved peer feedback in an online environment, Knowledge Forum. The results showed an increase in the values of the three dimensions (cohesion, collaboration and inclusion) in the-first phases of work and a decrease in the last phase. The implications of the study focus on the possibility of creating collaborative learning environments in universities based on this method of work.
Key words: Peer feedback; University students; Knowledge Building; Cohesion; Collaboration; Inclusion

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1. Introduction

Many cognitive benefits for learning have been highlighted in the literature, due to peer feedback, (e.g. Liu and Carless, 2006; Nicol *et al*., 2014), but the relational aspects of this way of working, when it is implemented with groups of students, have been little investigated.

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Recently a working method called Progressive Design Method (PDM), has been developed by Cacciamani (2017). The PDM is inspired by the Knowledge Building (KB) model (Scardamalia and Bereiter, 2010) and is based on Project Based Learning and peer feedback between students working in teams in an online environment.

Knowledge Building-the theoretical model by which PDM is inspired- is a pedagogical model defined by 12 principles that work together in a complex system to organize a community, whose focus is to create new knowledge through a collaborative discourse (Scardamalia and Bereiter, 2010). The core idea of Knowledge Building is the production and continuous improvement of ideas to advance community knowledge (Soliman *et al*., 2021). Students in a Knowledge Building community, indeed, are engaged to set forth questions of inquiry, formulate their initial theories to provide their explanations to these questions, and improve these theories on the base of new information, to produce more powerful explanations (Tan *et al*., 2021). Such a continuous improvement is based on discursive interactions combining *belief mode*- the work with knowledge using critical thinking- and *design mode*, a particular way to work with knowledge where the main concern is with the improvability, and the developmental of potential of ideas (Bereiter and Scardamalia, 2003). Knowledge building activity is supported by a specific online environment – Knowledge Forum – developed according to the KB model principles (Scardamalia, 2004). Literature evidences the benefits of the KB model in educational field. Braojos *et al*.. (2020), combining a scientometric analysis with a systematic review of articles published between 2013 and 2017 showed the positive effects of the implementation of KB at school in term of improvements of collaborative learning skills, active learning skills and metacognitive skills.

Project Based Learning (PjBL) – the second core component of PDM – is a student-centred form of instruction based on three constructivist principles: learning is context-specific, learners are involved actively in the learning process and they achieve their goals through social interactions oriented to share knowledge and understanding (Cocco, 2006 cited in Kokotsaki *et al.,* 2016). More specifically, PjBL create an experience of meaningful learning for students by developing a project, from a driving problem presented inside of a contextual situation (Ching and Hsu, 2013). In developing the project, students take responsibility for creating their products and are involved in various activities: asking questions, brainstorming to create ideas, seeking information from sources, and designing and testing alternative solutions to solve the problems they face (Blumenfeld *et al*., 1991). During this elaboration process, students also create a series of artifacts, as external representations of solutions to the problem faced. These artifacts can be shared and submitted for critical

evaluation by both the teachers and peersto allow their progressive improvement. Literature highlights some benefits of PjBL encouraging the adoption of this method. Kokotsaki *et al.* (2016), in their review, showed the positive effects of PjBL in higher education, on self-directed learning readiness, such as having high self-management skills. Chen and Yang (2019), in their meta-analysis evidenced that project-based learning has a medium to large positive effect on students' academic achievement compared with traditional instruction.

Peer feedback- the third core component of PDM- is described by Topping (1998) as «an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status» (p. 250). More specifically it can be defined as a communicative process in which learners talk to each other about performances and the standards required in an activity (Liu and Carless, 2006). Several learning benefits of peer feedback have been showed in literature that support the use of this method in higher education (Nicol *et al*., 2014). Students can play an active role in managing their own learning when they are involved in providing and receiving peer feedback (Liu and Carless, 2006). Moreover, receiving feedback from classmates, can promote students' self-regulation of learning- thanks to the comments and the acquisition of knowledge about evaluation standards (Cacciamani *et al*., 2018). In addition, providing or receiving peer feedback highly improve students' writing, compared to their peers who engaged in self-assessment, through rubric or guided self-assessment, as showed by Huisman *et al.* (2019) in their meta-analysis. Also, the comparison between peer feedback and feedback from teaching staff did not evidence any systematic difference on students' academic writing. Furthermore Jongsma *et al.* (2022) in their meta-analysis, contrasting online and offline peer feedback in higher education, indicate that online peer feedback is more effective than offline peer feedback. Online peer feedback is also more effective when the outcome measure students' competence rather than self-efficacy for skills. .

Considering the benefits highlighted in literature about the of use of KB model, peer feedback and PjBL, PDM combined these different components through the following principles (Cacciamani, 2017):

1. Students as members of a KB Community: students are organized within a KB community and work collaboratively in teams in order to develop a project;
2. Critical Theoretical Model Analysis: theoretical models are analyzed by students working together in groups to identify the possible advantages and critical aspects of the hypothesis when applying these models in context of interest of their project.

3. Critical Case Analysis: students analyze implementations of theoretical models considered in different contexts to identify points of strength and weaknesses and ideas to improve them.
4. Progressive improvement of the project: the elaboration of the project is organized in steps that allow the team members to progressively improve their project.
5. Distributed Feedback: for each step the partial created product is organized in a communicative artifact and published in a common online environment (such as KF) where each member of the community can analyse the others' team product and provide feedback.
6. Recursive Design: after receiving feedback in the online environment, each team is given time to reflect of any ideas that emerged through the feedback and to introduce changes to their project.

This study focuses on the relational aspects of working with PDM by analyzing if the cohesion in the network of interactions between students, the level of collaboration and inclusion of students ~~e~~change during the activities.

2. Method

2.1 Participants

Eighteen students participated in the study (17 F, Age M (SD) = 21.39 (0.61) attending the Guided Practical Exercise (EPG) of Psychology of Learning and digital technologies of the 2nd year of the Degree Course in Psychological Sciences and Techniques of the University of Valle d'Aosta in the academic year 2021-22. All participants voluntarily signed and returned the informed consent forms, allowing us to use their data for research.

2.2 Context

The EPG took place using the PDM in blended mode, with the support of Knowledge Forum (KF), an online environment developed to promote the construction of knowledge (Scardamalia, 2004). In KF specific spaces called "views" are available for discursive interaction mediated by writing. In the view the participants can insert notes (written contributions) and "build-ons" (contributions linked to other contributions via links).

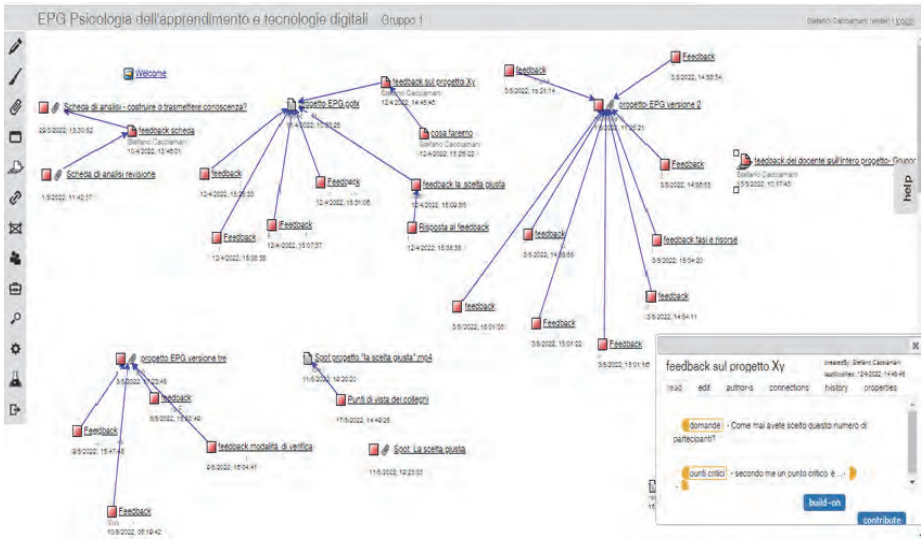

Fig. 1 - A view in KF

As can be seen in Figure 1, there is a view where each read icon represents a note. Build-ons are contributes containing a link, represented by the blue arrow, that indicate the direction of the connection.

During the EPG, the students were organized in teams to develop a project concerning the use of digital technologies in an educational context. Each teams had a view in KF as specific space of work (in Figure 1 it is possible to see the view of the Team 1). The EPG has scheduled eight meetings of three hours each, according to the PDM principles and foresees these main phases of work:

1. Critical Analysis of the KB model: The 12 principles of the KB have been presented by the teachers and its possible application in Italian school, identifying advantages and problems, was discussed.
2. Presentation in KF: The teacher showed KT and its tools, and the students were requested to introduce themselves by writing a note in a view of KF and to interact with the presentations of the other students.
3. Design 1: A critical analysis of implementation cases of the KB model, through the examination of some articles was carried out and the elaboration of the project by the students began with the indication of the principles of the KB model to which the project referred, with the definition of the objectives and the specification of the participants who would be involved.
4. Open lesson: the teacher and some expert of INDIRE (National Institute of Documentation, Innovation and Research in Education), invited to the lesson, presented to the students the "Classi in rete" project (Cacciamani et

al., 2022), as possible example of implementation of the KB model in a network of school in Italy.
5. Design 2: The students worked to define the work phases, times, tools and human resources of the project.
6. Design 3: The students were engaged in identifying methods of verification and evaluation of the project.
7. Development of an advertising: Students were requested to create an advertising through a brief video to promote their project to potential clients.
8. Advertising feedback: In a face-to-face meeting, each team presented its advertising in order to receive the feedback from the other teams and the teacher.

At the end of each Design phase, the part of the project prepared by each team was published in KF and each team member was required to provide feedback to the team they were twinned. Students were provided with a framework for providing feedback based on 4 categories (questions: strengths, weaknesses, and suggestions for improvement) and were trained on how to formulate this feedback. The teacher provided his feedback to each project only at the end of the Design 3 phase in order to avoid any influence on the feedback activity of the students. As it is possible to see in Figure 1 each part of the project received feedback in some build-on with the blue arrows indicating the direction of the connections of contributes containing feedback to the part of the project developed. After receiving the feedback, each team was asked to make changes to their project based on the feedback they received.

2.3 Procedure

The analysis of the three dimensions under study focused on the following work phases of the EPG: Presentation, Design 1, Design 2 and Design 3. For each of these phases the contributes written in KF have been detected through the Learning Analytics in KF, to measure cohesion, collaboration and inclusion.

2.4 Data Analysis

Cohesion was analyzed by calculating the density, that measures the degree of interconnectedness of network members, (Wyngaerden *et al.,* 2019). The interconnectedness of network is indicated in KF by the communicative edges realized through build-ons among participants, created by the members. Density is given by the proportion of edges in the network relative to the maximum possible number of edges (Tabassum *et al.,* 2018). Considering that the network in collaborative exchanges in KF is directed, Density was calculated through the following formula:

$D = m(G)/m_{max\,(G)}$

where D is density, m(G)= number of edges among nodes (participants) of the network, $m_{max\,(G)}$ = maximum number of the edges of the network, which is n(n-1), where n= numbers of nodes of the network (Tabassum et al., 2018). The minimum value of D is 0 (low density) and the maximum value is 1 (high density). The level of collaboration was measured by the number of build-ons created by each student on contributions from other students. The level of inclusion was measured by the number of build-ons received by each student on their contributions.

The change in cohesion was analyzed by comparing the presentation phase and the three subsequent design phases on a descriptive level. The change in the level of collaboration and inclusion was analyzed by student's t test by comparing the presentation phase and the next three design phases.

3. Results

The level of cohesion progressively increases from the presentation phase (D = 0.016) to the design phase 1 (D = 0.088) up to the design phase 2 (D = 0.101) and then decreases in the design phase 3 (D = 0.05). As regards the level of collaboration and inclusion, the data are shown in Tab. 1.

Tab. 1 - Collaboration and inclusion in the different phases

	Presentation M (SD)	Design 1 M (SD)	Design 2 M (SD)	Design 3 M (SD)
Collaboration	0.28 (0.46)	1.50 (1.82)	1.78 (1.66)	0.94 (1.06)
Inclusion	0.28 (0.46)	1.50 (2.26)	1.78 (2.58)	0.94 (1.73)

The level of collaboration increases from the presentation phase to the design phase 1 ($t(17) = -2.83$, $p < .05$), remains stable from the design phase 1 to the design phase 2 ($t(17) = -0.52$, $p > .05$) and tends to decrease from design phase 2 to design phase 3 ($t(17) = 2.09$, $p = .05$). The level of inclusion also increases from the presentation phase to the design phase 1 ($t(17) = -2.26$, $p < .05$), remains stable from design phase 1 to design phase 2 ($t(17) = -0.40$, $p > .05$) and decreases from design phase 2 at design phase 3 ($t(17) = 2.73$, $p < .05$).

4. Discussion and Conclusions

The aim of the present study was to analyse in a blended university course, organized with the PDM, if the cohesion in the network of interactions between students, the level of collaboration and inclusion of students change during the activities

The results show a similar trend in the work phases of the three dimensions: an increase in cohesion, collaboration, and inclusion from the presentation to the first design phase and a stability of the three dimensions from the first to the second design phase. It is conceivable that in these phases the PDM has favored the taking of a more active role by the students, thanks to the peer feedback activity This hypothesis appears consistent with what is indicated by the literature on peer feedback (Liu and Carless, 2006; Nicol *et al.,* 2014). More specifically the assumption of the active role could be promoted by three main aspects of the PDM: the task to develop a project in team, the request to give feedback to the other projects, the discussion in team of the feedback received, to improve their own project. In addition, also receiving feedback from peers can activate a virtuous reciprocity in giving feedback to their colleagues. A similar dynamic is foreseen in a Knoledge Building community in the Symmetric Knowledge Advances principle (Scardamalia and Bereiter, 2010).

The subsequent decrease in the values of the three dimensions could be due to the particularly complex topic for the students on which it was requested to provide feedback in the third phase: the methods of verification and evaluation of the project. The complexity of this topic could have reduced the possibility to give feedback in the last phase of design and then could have interrupted the reciprocity in peer feedback activity indicated before. To encourage further improvement in the three dimensions, in particular in the third design phase, some specific training and scaffolds could be foresee, in order to support the peer feedback activity of students. In the first case, the training can be oriented to acquire more knowledge about the specific topic of the feedback (in this case the methods of verification and evaluation of the project). In the second case, specific scaffolds can be designed, as KF foresees, in order to help the contextual analysis of the project. A possible example of this kind of scaffold could be: “some critical points of the method of verification and evaluation are…” and “you can improve these critical points by…”

The present study has some limitations that may not allow researchers to generalize the results. First of all, the number of participants is small; second, the participants were university students enrolled in only one degree course – Psychological Sciences and Techniques – and third, most of the participants were female students. Furter research could, then, extend the use of the PDM with a higher number of participants, in more university courses and with a

better balance in terms of gender. New directions of inquiry can also explore which kind of training can improve student skills to give feedback and which kind of scaffold can be designed to support the feedback activity to improve cohesion, collaboration and inclusion.

The implications of these results concern the possibility to design blended university courses, with PDM, where students can work collaboratively in developing projects of their interest and can be engaged in giving and receiving feedback from their colleagues, in order to improve progressively these projects. This kind of courses can promote a formative experience where students can assume the responsibility of their own learning.

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