

**Effects of Different Implementations
of The “Embedded and Transformative Assessment” Principle on Knowledge Building
in Online University Courses**

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Abstract

The aim of this study is to analyze different implementations of the KBC principle “Embedded and transformative assessment” in online courses at the University of Valle d’Aosta. For this purpose, using a design based research approach, three online courses, different for the planned phases of the strategies and knowledge assessment, were implemented. The assessment of knowledge and of strategies were considered in face-to-face meetings during the course in the first case, in an online portfolio at the end of each online module of the course in the second case, and for strategies in an online portfolio in the middle of the course, and for knowledge assessment in face to face meetings in the third case (see the excerpts in the Appendix). The results show that in the second implementation interdependence emerges between reading and writing from the module immediately following the online portfolio, but not interdependence among participants in reading and writing, which is probably due to the dimension of the community. Some implications concerning the relationship between the implementation of the “Embedded and transformative assessment” principle and the knowledge building activity, with reference to student Epistemic Agency, have been identified for future direction of inquiry.

1. Introduction

The social constructivist perspective applied to designing online courses highlights the importance to consider the active role of students in the knowledge building process (Garrison & Anderson, 2002). In this scenario, Scardamalia and Bereiter (1999) proposed their Knowledge Building Community (KBC) model defined by 12 principles (Scardamalia & Bereiter, 2006), suggesting that, in educational contexts, it is possible to organize a community that creates new knowledge through a collaborative inquiry activity. One of the 12 KBC model principles, called “Embedded and transformative assessment”, requires the active involvement of students in a continuous evaluation process, focused on the knowledge built by the community and the strategies of work used (Scardamalia, 2002).

With reference to the central role of the community engaged in an activity of inquiry, it is important to consider two different aspects in analyzing the efficacy of the knowledge building process in an online course.

The first aspect refers to the interdependence between writing and reading: it is only if each member of the community understands the relevance to connect reading and writing activities that the inquiry takes place as a common enterprise. In fact, in online courses when people write without reading others' texts a self-referential situation is created, where each author remains encapsulated within their own ideas. On the other hand, when people read without writing, it results in a passive participation, typical of "lurking" (Preece, Nonnecke & Andrews, 2004). Hence, the presence of interdependence between reading and writing in the activity of each member of the community is a signal that knowledge building activity works.

The second aspect concerns the social interactions inside the community, so relevant in an online course that Garrison and Anderson (2002) introduce the idea of "Social presence" as an important component of knowledge building. The community works well if in writing and reading it is possible to identify interdependence among the community members that can be studied using the parameter of "density" through Social Network Analysis (Ehrich & Carboni, 2005). Reffay and Chanier (2002), for instance, used "density" to describe the evolution of social interdependence inside four groups involved in online activities and identified a progressive decrease in online interactions among participants, with reference to some changes in the group composition (Mazzoni, 2002).

The aim of this study is to analyze different implementations of the KBC model principle, "Embedded and transformative assessment principle", that has effective functioning in online courses shown by the interdependence between writing and reading, and by the level of interdependence among participants. It follows the Design-Based Research (DBR) methodological approach (The Design Based Research Collective, 2003): a systematic but flexible methodology

aimed to improve educational practices through iterative analysis, design, development and implementation, which is based on collaboration amongst researchers and practitioners in real-world settings, and leads to contextually-sensitive design and principle theories (Anderson & Shattuck, 2012).

2. Method

2.1 Educational Setting

The Psychology of Education online course is for first-year students in the Faculty of Science of Education and second-year students in the Faculty of Science for Primary School at the University of Valle d'Aosta. It aims to develop a critical understanding of the main approaches and theoretical models of this discipline with reference to learning at school. The course is typically organized into four modules, each of which addresses a specific subject area (e.g. theories of learning, motivation, collaborative learning, classroom observation, disciplinary learning, and the use of new technologies). Three modules are in common among the students of the two faculties and the last one is specific for students of Science Education. Each module starts with a face-to-face meeting in which the teacher introduces the content and sets the conditions to start an online discussion to be held for a period of two weeks. The online environment used for the course is Knowledge Forum (KF herein after), created by the research group of IKIT (Institute for Knowledge Innovation and Technology) of the University of Toronto. Each student is able to insert notes in KF through written texts to which graphs and images can be added. These notes can also be connected to one another through some links (in this case the notes are called "build-on"), meaning they represent some developments of the knowledge building activity. In KF there are also "views", which are specific spaces that can be used to organize online discussions about specific topics.

2.2 Participants

This DBR project included three different implementations with the following participants:

-1st cycle: 16 students (1 male and 15 females), 7 of whom were students enrolled in Science for Primary School and 9 in Science of Education.

-2nd cycle: 26 students (5 males and 21 females), including 7 students enrolled in Science for Primary School and 19 students in Science of Education.

-3rd cycle: 14 students (2 males and 12 females). Of these, 5 were enrolled in Science for Primary School and 9 in Science of Education.

2.3 Description of Implementations

The different features of the three implementations of the “Embedded and transformative assessment” principle are showed in Table 1.

Table 1. The “Embedded and transformative assessment” principle implementation

	Knowledge Assessment	Strategies Assessment
<i>1st implementation</i>	<p><i>1st phase: each student wrote an “assessment note” in KF in face to face meeting</i></p> <p><i>2nd phase: face-to-face meeting discussions of the “assessment notes” take place in small groups</i></p> <p><i>3rd phase: in face-to-face meetings plenary discussion takes place on the issues to be clarified</i></p>	<p><i>1st phase: in face-to-face meetings in the “assessment note” in KF , description of the strategies used and identification of the strengths and weaknesses</i></p> <p><i>2nd phases: in face-to-face meetings plenary discussion for sharing reflections on the strategies</i></p>
<i>2nd implementation</i>	<p><i>1st phase: “online community portfolio” on knowledge built at the end of each module</i></p> <p><i>2nd phase: in face-to-face meetings small group discussions take place to identify issues to be clarified</i></p>	<p><i>1st phase “online community portfolio” on the strategies used at the end of each module</i></p>

	<i>3rd phase: in face-to-face meetings plenary discussion takes place on issues to be clarified</i>	
3rd implementation	<i>1st phase: face-to-face discussions in small groups to highlight relevant ideas emerged in KF and the most important issues to be clarified</i> <i>2nd phase: in face-to-face meetings plenary discussion on issues to be clarified</i>	<i>1st phase: mid-course “online community portfolio” on the strategies used</i>

First implementation: 2004-2005. In this online course the assessment of knowledge was managed in three phases: each student was asked at the end of each module in the face to face meeting to insert an “assessment note” in KF on the knowledge developed by the community, to indicate from his or her point of view the important ideas that emerged. This assessment was then reviewed in a small group discussion, and asked students to identify the more relevant ideas from the discussion and the most important issues to be clarified. In the third phase issues previously identified were discussed with the teacher in a plenary debate. The strategies assessment took place in two phases in the face-to-face meeting at the end of each module. First, in the “assessment note” each student described the strategies used to deal with the online course and identified the strengths and weaknesses, and then there was a subsequent discussion with the teacher who facilitated the sharing of reflections on the strategies of the entire community.

This implementation of the principle revealed two main limits: the first concerned the difficulties of attending face-to-face meetings by students, the second was the limited time in the meetings, to manage the assessment of knowledge and of the strategies of work

Second implementation: 2006-2007. Considering the limits of the previous experience, in the second implementation it was decided to manage the strategies and knowledge assessment

online; this was completed in the following way. At the end of each module, an “online community portfolio” was organized, where each student was asked to answer two questions:

1. What are the two most interesting ideas that emerged from the discussion in this module?
2. What strategies did you use? What strengths and critical points did they reveal?

The assessment of knowledge developed was completed in a second phase in the face-to-face meetings in small groups, where students were asked to identify the open questions to which they returned in the third phase to discuss with the teacher.

Reflecting at the organizational level at the end of the on line course, a problem emerged in this implementation: the compilation of a portfolio at the end of each module seemed to be an expensive request for the students.

Third implementation: 2008-2009. In this implementation, considering the limit emerged from the previous one, it was decided to only opt for a single online space for strategies assessment to be carried out mid-course. Each student was asked to describe the strategy used to study in the first part of the online course, highlighting two strengths and two weaknesses. The assessment of knowledge built by the community took place in the face-to-face meetings in two phases: the first was in small groups, asking each group to highlight the relevant ideas and the most important open questions that had emerged. This was followed by the next phase where they were discussed with the teacher.

2.4 Observed Variables

The observed variables have been analyzed in the first three modules of each course because they are the modules in common among the students of the two faculties.

In particular, the following variables were analyzed:

a) Interdependence between reading and writing

The notes written and read by each participant have been counted by a specific software program called Analytic Toolkit (ATK). ATK provides summary statistics on activities in a KF database. It shows how many notes are in the database, how connected they are, how many notes a user has created, in which views a user has worked, and what percentage of the notes have been read. The number of notes read by each participant was then calculated using the percentage indicated by ATK.

b) Interdependence among members

The interdependence among members in writing and reading has been detected using the parameter of “density”, calculated thanks to the Social Network tool provided by Analytic Tools (AT) in KF. Density indicates the number of network edges activated by the members and then divided by the number of the edges potentially available in the community in writing and reading.

2.5 Data Analysis

Due to the small number of cases considered, the interdependence between the read and written notes has been analyzed in each module through the statistical correlation using Rho of Spearman. The density parameter was analyzed in each module with a descriptive approach.

3. Results

The correlations between reading and writing in each implementation are shown in Table 2.

Table 2. Correlations (Rho of Spearman) between reading and writing

Academic Year	Participants	Module 1	Module 2	Module 3
2004-2005	16	0.31	0.30	0.36
2006-2007	26	0.11	0.44*	0.51**
2008-2009	14	-0.29	0.43	0.49°

*p<.05**p<.01 °p=.09

As can be seen, in the first implementation the correlations between writing and reading are not significant in all the modules. In the second implementation, in which the “portfolio” was introduced, the correlation between reading and writing are significant only in the second and third modules. Finally, in the third implementation, there is the emergence of a high correlation between reading and writing in the third module even if it did not reach a significant statistical level.

The densities in writing activity among students for each module in each implementation are shown in Table 3.

Table 3. Densities in writing activity in each implementation

Academic Year	Number of Participants	Total Network Edge	1 st module % (Network edges activated)	2 nd module % (Network edges activated)	3 rd module % (Network edges activated)
2004-2005	16	120	21,66% (26)	14,16% (17)	8,33% (10)
2006-2007	26	325	6,15% (20)	8,3% (27)	4% (13)
2008-2009	14	91	13,18% (12)	31,86% (29)	18,68% (17)

From the above, it is seen that the second implementation shows a lower level of density in each module when compared to the other implementations. In addition, in the first implementation the density value decreases from the first to the third module, whereas in the second and the third implementations the density value reaches the higher level in the second module.

Densities in the reading activity among students in each implementation are shown in Table 4.

Table 4. Densities in reading activity for each module in each implementation

Academic Year	Number of Participants	Total Network Edge	1 st module % (Network edges activated)	2 nd module % (Network edges activated)	3rd module % (Network edges activated)
2004-2005	16	120	99,16% (119)	98,33% (118)	100% (120)
2006-2007	26	325	56,61% (184)	88,92% (289)	44% (143)
2008-2009	14	91	100% (91)	86,81% (79)	85,71% (78)

As it is possible to see, the second implementation shows a lower level of density in the first and third modules when compared to the other implementations, which overcome 85 per cent of density in each module.

4. Discussion

It is possible to summarize the “lessons learned” from the different implementation cycles in the following aspects.

First, the way in which the principle of KBC was implemented in the second cycle seems to have favoured a correlation between reading and writing in the second module of the course (immediately after the first portfolio) and was present in the subsequent module too. This may be connected to the innovation introduced in the assessment of the strategies: the mediation of online writing may have allowed students to examine the strategies used by their colleagues more in depth compared to the oral discussion used in the first implementation. Reflecting on their own strategies and on those of their colleagues, students may have understood the importance of reading the notes of others and intervening with their own contributions. They may have decided to adopt the strategy of “first read then write”, creating the correlation that emerged in the results. This interpretation is

consistent with Meyer (2003) that through a content analysis of the threaded on line discussions supported that online discussions promote higher-order thinking, especially by contributing comments that are exploratory, integrative or resolution (cfr. Garrison et al. 2001). In addition Balaji and Chakrabarti (2010) showed that the perceived richness of online discussion forum has significant positive effect on student participation and interaction, and learning, when used along with traditional classroom lecture.

The importance of continuity of the strategies assessment seems to be confirmed by the third implementation: a high correlation, although not significant, between reading and writing was found only in the third module following the online metacognitive reflection on strategies. In support of this claim, other studies state that the presence of a space for reflection on the metacognitive strategies in an online course will encourage the development of discussions (e.g. Cesareni et al., 2008).

A second lesson learned concerns the interdependence among community members. The lower level of density in the second implementation can depend on the higher number of participants, compared to other courses. Considering the data of the other implementations, the optimal number of participants in an online course – to ensure a high level of interdependence among individuals – is considered to be around 15. Overcoming this limit implies managing the “Embedded and transformative assessment” principle in a different way to make it more distributive, for instance proposing students assume some roles to improve collaboration (Strijbos & Weinberger, 2010).

5. Conclusion

By the results of our study, it is possible to conclude that the implementation which seems to favour the development of a better interdependence between writing and reading is the second one: where metacognitive assessment of knowledge and strategies at the individual level is shared, continuous and available all of the time in the online environment. We need to highlight also some

limits in the present study. The main approach used was quantitative analysis of notes: we recognize that this kind of analysis need to be enriched by a qualitative analysis of students' ideas to verify if different implementations of the embedded and transformative assessment principle support different ways in the advancement of knowledge creation. It could be possible to use a Content Analysis with a coding scheme adopted in previous research (Cacciamani & Ferrini, 2012), for instance, to analyze the development of the Epistemic Agency (Scardamalia, 2002) in students activity.

At the same time, it is necessary to pay attention to the dimension of community that can require creating, in a more intentional way, interdependence among participants. However, in this regard it is desirable to conduct further investigations.

Acknowledgements

We want to express our gratitude to University of Valle d'Aosta that provided funds to support the present study.

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Appendix

1st Implementation: Assessment note at the end of each module in face to face meeting

Teacher oral instructions in face to face meeting:

“Write a note in KF about, in 15 minutes, considering the following questions :

1. Assessment of knowledge created

-Which elements of knowledge relevant to me have emerged from the discussion?

-What issues remain open or be clarified?

2. Assessment of strategies

-What strategies I used in the work in this community?

-What are the point of strengths and the aspects that it seems useful to change? Why? "

Note in KF by S: “Conclusion”

1.a) I must say it was very interesting to know the experiences of other people, find out their ideas on the subject which are then found to be the same or different. Furthermore, the possibility to ask questions quite immediatly. 1.b) Additional information on the "community of learners" at a practical level. 2.a) At first I read the messages of colleagues then later I tried to give my contribute. 2.b) Strengths: carry out the task at home - new experience - the exchange of ideas and information

2nd Implementation: on line community portfolio at the end of each module

Teacher note in KF:

We are at the end of this first module of the online course, where we conducted an analysis of the main theories of learning.

I ask each of you to make an assessment on two aspects:

1. What are the two ideas that you think are the most interesting for you emerged from the comparison in this module?
2. What strategy did you use to work? What strengths and what critical points showed?

Note in KF by M: “Interesting ideas”.

I have noticed that there are two interesting ideas related to the work of a group and the other related to the motivation to study.

The team work is very useful because in addition to learning develops social skills (help, understanding and mediation). In the group emerge a theory in which you create reference points to avoid or take into consideration. Through social interaction you can progress in the area of proximal development, crossing thresholds of logical reasoning that it would be very difficult to make by themselves.

Even the idea of the project work was very impressive for me because it raises the student's need to know in order to create a product, that it is material or abstract (a model - an explanation). In carrying out the project which is based on real problems rather than theoretical, the student makes his own theories for use in solving the problem, or better yet the sub-problems, who will meet in the course of development. Here comes the utility of the scaffolding from which to draw the answers not pre-packaged. These two ideas of course can be connected together to create a project group work.

Note in KF by M: “Strategies of work”

To participate in the KF I started by reading the first two chapters of the book "Psychology for teaching" and then I tried to insert myself in open discussions or responding to direct questions

posed by teachers.

One of the strengths of this methodology was to understand the questions asked or interventions carried out by my classmates having a common land base.

The weak point is that I did not feel ready to intervene until I finished reading the chapter proposed.

One of my weakness that I will try to avoid in the next module is the time delay on the KF, which is related to my time required for the analysis of the material to think about. The weak point of weakness is that I have to improve in search of the essential concepts in the text to be analyzed, without dwelling too much on parts of lesser importance for the intervention of KF.

3rd implementation: *mid-course “online community portfolio” on the strategies used*

Teacher note in KF:

Answer the following question:

What strategy I'm using to study in this course online? (List the actions that make up the strategy)

A point of strength of this strategy is ...

A critical point of this strategy is ...:

Note in KF by F. :“Strategy”

I have not adopted a different strategy than the one I normally use to study: I read the chapter, highlighter in hand, and fixed the most important points (e.g. authors and keywords), then I elaborate schemes of the chapters, to have the material, as well books, with which prepare for the exam.

One of the point of strengths I think the passage repeated several times, at different levels of detail, on the topics; a source of concern is the long time period that this strategy requires.