Embedded and Transformative Assessment in an Online Course:
A Design-Based Research Project

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Abstract

The Knowledge Building Community model suggests that it is possible to organise a community that creates new knowledge through a collaborative inquiry activity. An effective indicator that a knowledge-building activity works is the presence of a relationship between reading and writing and the presence of Advanced Epistemic Agency in the activity of each member of the community. The focus of this study is to analyse how to implement the KBC principle "Embedded and transformative assessment" in online courses at the University. For this purpose, two implementations of the principle in two different online courses have been analysed, considering in the first case the evaluation of knowledge in face-to-face meetings, and in the second case, the evaluation of knowledge and a metacognitive reflection on the work strategies in an online portfolio. The results show that in the second implementation exists a correlation between reading and writing from the module immediately following the online portfolio and maintenance of Advanced Epistemic Agency, comparing the activity from the beginning to the end of an online course.

1. Introduction

The social constructivist perspective applied to implement online courses at the University emphasises the importance of the active role that individuals play in the collaborative learning activities within a community (Garrison & Anderson, 2002). In this scenario, the Knowledge Building Community (KBC hereinafter) model suggests that in educational contexts, it is possible to organise a community that creates new knowledge through a collaborative inquiry activity (Scardamalia & Bereiter, 2006). This model, described through 12 principles (Scardamalia, 2002), is oriented to create the organisational conditions at school to build cultural capacity for innovation.

A high level of participation in the knowledge-building activity happens in an online environment if two phenomena concerning reading and writing are avoided: when individuals write without reading, thus creating a situation of self-reference, or when people read without writing, resulting in a passive participation, typical of "lurking" (Morris & Ogan, 1996). Hence, a signal that a knowledge-building activity works is the presence of a relationship between reading and writing in the activity of each member of the community. In addition, considering the KBC principle called "Epistemic Agency" (Scardamalia, 2002), a high level of participation in the knowledge-building activity can be verified in the following instance when:

> "Participants set forth their ideas and negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them. They deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers or managers. (Scardamalia, 2002, p.10)

A possible operationalisation of this concept is, in terms of "Basic Epistemic Agency", focused on proposing and elaborating information about a common problem of inquiry, and Advanced Epistemic Agency based on exploring the problem and evaluating the content and strategies: both kinds of epistemic agency are involved in the knowledge-building process, but "Advanced Epistemic Agency" (consisting of actions such as posing questions or making a hypothesis) is an indicator of the process of advancement toward new knowledge (Author 1 et al., 2012).

Another specific aspect of the KBC is described by the principle called "Embedded and transformative assessment". This principle requires the active involvement of students in a continuous evaluation process, focused on the knowledge built and the strategies of work used by the community itself (Scardamalia, 2002). The principle seems to have some connections with metacognition. The term "metacognition" was created to indicate the reflective processes entailed in knowledge *about* cognitive activity—the knowledge an individual possesses about cognitive processes (Flavell & Wellman, 1977) and the active control of those processes (Brown, 1978). The online work seems to encourage students to use new problem-solving strategies (Herrington, Oliver, & Reeves, 2003), and the reflection about them is a relevant aspect of improving knowledge work.

This paper describes the design of online courses that have implemented a KBC whose effective functioning is shown by the correlation between writing and reading and by Epistemic Agency. In doing so, it follows a methodological approach known as Design-Based Research (DBR) (The Design Based Research Collective, 2003). DBR is a systematic but flexible methodology aimed to improve educational practices through the iterative analysis, design, development, and implementation. It is based on collaboration amongst researchers and practitioners in real-world settings, and leads to contextually-sensitive design and principle theories (Anderson & Shattuck, 2012).

In particular, this study focuses on two different implementations of the KBC principle "Embedded and transformative assessment", considering in the first case the evaluation of knowledge, and in the second case, also a metacognitive reflection on work strategies. The effects on student participation in terms of the relationship between reading and writing and epistemic agency have been analysed.

2. Method

2.1 Educational Setting

The Psychology of Education online course is for first-year students in the Faculty of Science 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 organised into four modules each of which address a specific subject area (e.g. theories of learning, motivation, collaborative learning, classroom observation, disciplinary learning, and the use of new technologies). 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 held for a period of two weeks. The on-line environment used for the course is a Knowledge Forum (KF hereinafter), created by the research team of the University of Toronto, coordinated by Bereiter and Scardamalia. In such an environment, the students can insert some notes (written texts to which graphs and images can be added). The notes can also be connected to each other through links, meaning they represent some development of the knowledge-building activity. In KF, there are also the "views", specific spaces that can be used to organise the online discussion about specific topics.

2.2 Participants

This design-based research project included two different implementations with the following   participants:
1st cycle: 32 students; 3 males and 29 females enrolled in the Educational Psychology (2nd year) course of the Science for Primary School Faculty (a.y. 2006-07)
2nd cycle: 23 students, including 4 males and 19 females enrolled in the Educational Psychology (2nd year) online course of the Science for Primary School and Science Education Faculties (a.y. 2006-2007).
All of the participants were students/workers.

2.3 Description of Each Implementation

a) First Implementation: 1st October – 31st January

In the first implementation, the "embedded and distributive assessment" was focused mainly on the knowledge built, and managed in two phases: in a face-to-face meeting, one after the first module and one at the end of the course. In the face to face meetings the students worked in groups of 6-7 to identify the more relevant ideas from the discussion in KF and the most important issues to be clarified; during a plenary discussion in the second phase, the students presented to the teacher the more relevant ideas identified and the questions that remained unanswered. In the final meeting, the students were also requested to indicate what skills they had developed and how it was possible to improve the online course.

A staff evaluation of the online course at the end highlighted that the space for the "embedded and transformative assessment" was very limited in the face-to-face meetings. In particular, the evaluation of the strategies of work remained too implicit. Hence, it was decided to introduce an innovation in the next implementation: an online portfolio for the assessment of knowledge built and the work strategies.

b) *Second Implementation: 1st March – 31st May*

In this implementation, the assessment of knowledge built was completed in three phases: each student was asked at the end of each module to assess the knowledge developed by the community, writing a note in an "online portfolio" in KF. In this note they had to indicate, from their point of view, the important ideas that emerged. This assessment was then reviewed in a face-to-face meeting at the end of each module, in a small group discussion. The students were asked to identify the more relevant ideas from the discussion and the most important issues to be clarified in a third phase of the plenary discussion with the teacher. It was also decided to strengthen the evaluation component of the strategies, introducing a metacognitive reflection activity articulated in two phases. At the end of each module, in the "online community portfolio" each student was asked to answer these questions: "What strategies did you use? What strengths and critical points did they reveal?" In the face-to-face meeting at the end of each module, the critical points identified were discussed with the teacher to find possible solutions.

2.4 Observed Variables

a) Relationship between reading and writing

This variable was analysed in each module of the course, considering the notes written and read by each participant and counted by a specific software programme called Analytic Toolkit (ATK). ATK was developed by Jud Burtis at OISE/UT and it 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 is working, and what percentage of the notes have been read. The number of notes read by each participant were calculated using the percentage indicated by ATK.

b) Epistemic agency

This variable was analysed in the first and last module of each online course. A content analysis of the notes written was managed using the coding scheme presented in Table 1.

Table 1. Coding scheme for the content analysis.

Epistemic Agency	Second-Level Categories (Activities)	First-Level Categories (Content)
Advanced	E = Exploring problems	**C1** Research questions or problems: questions regarding the content of the course, presence of question marks or interrogative expressions. E.g.: *I wonder how the attachment bond develops*
		C2 Hypotheses concerning the content: proposed explanations of questions discussed E.g.: *This fact could be explained by ...*
	V = Evaluating contents and strategies	**C3** Comments (evaluations of the content): expressions of agreement or disagreement, positive or negative judgments on an idea expressed by another participant
		E.g.: *According to me what you have said is very useful ...*
		N.B. this category does not include global judgments. E.g.: *It seems to me that the level of debate and the capacity for analysis are considerable.*
		C4 Metacognitive reflections: evaluations or comments about study strategies used during the online course. Explicit reference is made to cognitive activity.
		E.g.: *I want to concentrate on... This post has made me reflect.*
		These also include metacommunications. E.g.: *I shall now briefly reflect on my work as an educator.*
Basic	I 1 = Proposing information	**C5** Practical examples: examples drawn from the participants' experience
		E.g.: *It happened to me that ...*
		C6 Information obtained from reliable sources, and data relative to experimentation: theoretical information whose source is explicitly cited. E.g: *I've read in the book that...*
		Also belonging to this category is information drawn from sources containing research data. E.g.: *As Cole shows in his study…*

I 2 = Elaborating information	**C7** Repetition of ideas expressed by other members of the community: explicit statement that reference is being made to someone else's idea. E.g: *It reminds me of your message in the previous module about the language developed to achieve distant goals (freedom)...*
	C8 Syntheses of the ideas of several participants: assemblies of several ideas (e.g. indented or bulleted lists). E.g.: *Experience has shown:* *- that MDUs can be characterised differently in different contexts ("he's a child spoiled by his family" is typical of the school);* *- the effects that they have on people in such contexts;* *- the ways and means to change them.*

Note: All segments not pertaining to the above categories are allocated to the residual category "**C9** = Other"

The Epistemic Agency variable was operationalised in Basic and Advanced Epistemic Agency. The coding scheme was tested in previous inquiries with positive results in terms of agreement amongst the independent judges (Author 1 & Author 2, 2007; Cesareni et al., 2008). The content coding categories are divided into two levels. The first-level categories were built according to the thinking types foreseen as scaffolds of the discursive interaction in KF. These categories aim to detect the different kinds of interventions that the participants in a KBC can carry out in a knowledge-building activity. The second-level categories, grouping the first-level category, have been defined in terms of activity, such as:

- Proposing information: including categorising interventions like "practical examples" and "Information drawn from reliable sources and data concerning experimentations";

- Elaborating information: including categorising interventions like "Repetition of another community member's idea" and "Synthesis of several ideas";

- Exploring problems: including categorising interventions like "Inquiry questions or problems" and "Hypothesis on contents";

- Evaluating content and strategies: including categorising interventions like "Comments" and "Metacognitive reflections".

The first two activities (Proposing and Elaborating information) were considered markers of a Basic Epistemic Agency, as expressing an attitude to work with the knowledge created by others. The last two activities (Exploring and Evaluating) were considered markers of an Advanced Epistemic Agency, and as more suitable to stimulate the knowledge-building process: they are markers to an attitude to create new knowledge by themselves.

The coding scheme was applied to the "segments" of the notes in KF, in other words, a unit of meaning identified through the punctuation used by the same authors of the notes themselves (full stop, semicolon, colons, suspension dots, exclamation and question marks). Two independent judges codified the segments as far as the first and second implementation, with a level of agreement respectively of 83 per cent (for the first implementation) and 69.6 per cent (for the second implementation).

2.5 Data Analysis

The relationship between the read and written notes has been analysed through the statistical correlation using Rho of Spearman due to the small number of cases considered. The data concerning Epistemic Agency was analysed by comparing the first module (when the "embedded and transformative assessment" activity was not implemented) and the fourth module of the online course using the t-Student test.

3. Results

Table 1 shows the correlation between reading and writing in each implementation of the online course.

Table 1. Correlation between reading and writing

Implementation	Participants	Module 1	Module 2	Module 3	Module 4
1st	31	0.17	0.06	0.39*	0.45*
2nd	23	0.03	0.44*	0.48*	0.35°

*p < .05** p < .01 p = .09°

At the end of the first implementation, there was a correlation between writing and reading only in the third and fourth module. In the second implementation cycle, in which the "online portfolio" was introduced, the results show the presence of a correlation between reading and writing in the second module and third module. In the fourth module, the results are not very far from the statistical significance.

One can now consider the results concerning epistemic agency (Table 2 and 3).

Table 2. Epistemic Agency in the 1st Implementation

1st Implementation	Mean	Standard Deviation
Module1-Advanced EA	16.55	11.85
Module 4-Advanced EA	11.29	10.47
Module 1-Basic EA	10.52	15.11
Module 4-Basic EA	9.71	10.66

Advanced EA M1-M4 t (30) = 1.96 p = .05; Basic EA M1-M4 t (30) = 0.27 p > .05

Table 3. Epistemic Agency in the 2nd Implementation

2nd Implementation	Mean	Standard Deviation
Module1-Advanced EA	9.86	8.37
Module 4-Advanced EA	9.60	7.58
Module 1-Basic EA	22.73	22.56
Module 4-Basic EA	10.47	13.73

Advanced EA M1-M4 t (22) = 0.13 p > .05; Basic EA M1-M4 t (22) = 2.09 p < .05

Table 2 shows that in the first implementation, Advanced Epistemic Agency is lower in Module 4 than in the Module 1, but the Basic Epistemic Agency remains at the same level.
As reported in Table 3, in the second implementation, Basic Epistemic Agency is lower in Module 4 than in Module 1, but the Advanced Epistemic is unchanged.

4. Discussion

The following are the "lessons learned" from the different implementation cycles. First, the way in which the "Embedded an transformative assessment" principle was implemented in the first cycle seems to have favoured a correlation between reading and writing only in the third and fourth module of the course: the development of awareness of the importance of the relationship between reading and writing seems to be needed of the practice within the community for at least the first two modules. The correlation between reading and writing emerged in the second cycle from the second module (immediately after the first online portfolio), was present in the third module, and was very close to a statistically significant level in the fourth module. In addition, students in the second implementation maintained their Advanced Epistemic Agency and reduced the basic one, unlike in the first implementation.

These results may be connected to two aspects of the innovation introduced. On one hand, the online portfolio is a shared space of metacognitive reflection. It may have allowed students to examine the strategies of their partners: some of them may have highlighted the importance of reading the notes of others, in order to gain an idea about the question and information provided by their colleagues, before intervening with their own contribution. Furthermore, it is possible that most of the students reflected on their strategies and decided to adopt the same strategy ("writing after reading" or "answering other's questions") described by their colleagues. On the other hand, the online portfolio is a space where metacognitive reflection is oriented to analyse the point of weaknesses of their own strategies. This work, which focused on the progressive improvement of strategies, may have helped the participants to maintain an attitude of problem exploration and an evaluation of strategies that represent the core aspects of the Advanced Epistemic Agency. Cesareni et al. (2008) also highlight that a metacognitive reflection activity in an online course tends to support a higher level of Advanced Epistemic Agency.

5. Conclusion

It is possible to conclude that the implementation, which seems to favour the development of a better relationship between writing and reading and maintenance of the Advanced Epistemic Agency over time, is the second one. One can thus assume that the metacognitive reflection supported by the writing activity and shared in an online portfolio may play an important role.

Other studies highlight the relevance of the presence of a space for reflection on the metacognitive strategies in an online course (Author 1 et al., 2012). However, new directions of inquiry should be explored to analyse whether a more collaborative metacognitive reflection in an online portfolio (e.g. with reciprocal feedback about their strategies amongst the students) could represent a new innovation to testa new Implementation of the "Embedded and transformative assessment principle".

Acknowledgements

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