Research paper

Foreign Language Learning in Knowledge Forums: using a Knowledge Building Forum in an EFL Classroom

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Abstract

This paper presents the first phase of a study conducted to analyze Knowledge Building forums for evidence of second language acquisition. This study is an analysis of the posts within an existing forum in search of evidence of foreign language learning. The analysis found that the collaborative writing project shows evidence that the students passed through the stages of construction of knowledge within their foreign language classroom, however factors, such as confounding variables, inconsistencies in error types, and the small number of posts by the participants made it challenging to determine whether there is evidence of language acquisition for each student. The forum posts show evidence of knowledge acquisition, but further investigation is required to determine whether collaborative writing in knowledge forums is effective for foreign language acquisition.

Keywords: Knowledge-building forums, second language acquisition, online collaborative learning, knowledge building, English as a foreign language.

1. Introduction

Knowledge Building (KB) results from decades of research on the knowledge creation process where children share their insights, solve problems, and create expertise collectively (Bereiter & Scardamalia, 2014; Bereiter & Scardamalia, 2010; Bielaczyc & Collins, 2005; Scardamalia & Bereiter, 1991). Children can work together to create knowledge (Bereiter & Scardamalia, 2010) and they do so while addressing problems in various topics, including when conversing in a foreign language. The Knowledge Building International Project (KBIP) was created based on the notion of the classroom-as-a-knowledge-creation-organization where participating grade schools have been working together internationally in computer-assisted learning environments (Montane, Amoros & Gisbert, 2017; Laferriere, Law & Montane, 2012). Participating students collaborate with others around the globe using a common language, which, in many of these collaborative international forums, is English. While the majority of the research on KBIP focuses on the collective acquisition of knowledge based on the discussion of the topics in the forum, second language acquisition (SLA) has not been extensively studied. This paper presents the results of the first phase of an experiment designed to determine whether knowledge building in classrooms can facilitate foreign language acquisition.

Scardamalia and Bereiter (1994, 1991) coined the term knowledge forum to identify the software designed for knowledge building communities to be used in classrooms. The idea for the knowledge forum was based on the system proposed by W. Edward Deming (1986), the System of Profound Knowledge. This system suggests that, in order for businesses to run efficiently, each employee should be viewed as an integral component of the business. While this was designed as a proposal to revolutionize businesses, it also applies to education. When students work together, they become engaged in the learning process (Johnson & Johnson, 2009). They make purposeful advances and learning becomes conscious and intentional (Kim, Tan & Bielaczyc, 2015; Bielaczyc & Collins,

2005). When testing the knowledge building approach in grade 2 and grade 4 classrooms, Chuy, Scardamalia, Bereiter, Prinsen, Resendes, Messina, Hunsburger, Teplovs & Chow (2010) found that it resulted in a deeper understanding of the theoretical progress, the connections between theories and facts, and the role of ideas in scientific theory. In general, students not only learn factual information from each other, but they also develop a deeper understanding of the process of connecting theories and facts together, or as Nami, Marandi & Sotoudehnama (2018) state it: "Collaboration is considered as a necessary condition for cognitive development" (p.377).

The term *knowledge building* is often used interchangeably with constructivist learning and inquiry learning with a focus on individual knowledge construction. Individual learning is a by-product rather than the focus of community learning (Scardamalia & Bereiter 2006). Knowledge building first appeared in the learning science literature, conveying knowledge creation ideas similar to those in the organizational literature (Scardamalia & Bereiter 1991, Scardamalia, Bereiter, Brett, Burtis, Calhoun & Smith Lea, 1992) demonstrating knowledge as the product of purposeful acts of creation created through building ideas out of ideas (Bereiter & Scardamalia 2014). Analysis of discourse in mathematics students found that students identified multiple rules for the problems, provided meaningful justifications for them and revised their conjectures regarding rules over an extended period (Moss & Beatty, 2006)

These studies demonstrate that when children work together, they develop a stronger understanding, not only of the topic they are discussing but also of the knowledge building process.

1.1. The Knowledge Building International Project procedure

The KBIP methodology, as used in the classroom for this study, is consistent among participating classrooms, and is outlined by the Consell Superior d'Avaluació del Sistema Educatiu (2015) as follows. First, a theme or a real problem, which the students find interesting, is introduced to the students in a learning and knowledge-construction community. Second, cognitive tools, such as categories or scaffolding, are utilized to identify the students' knowledge of the topics, development of ideas, and any issues raised that require further attention. Third, the 12 principles of the co-production of knowledge are applied, and learning is achieved through participation (Bereiter & Scardamalia, 2010). These principles are further defined in Table 1 below. Finally, the teachers should attain adequate leadership qualities and behave as stimulators of learning, guides for the knowledge-construction process, facilitators, researchers, assessors, and modulators as required by the students to assist in the students' acquisition of expertise, since, according to Chen-Chung, Pin-Ching & Shu-Ju (2016), "flow theory and strategic motivation framework are useful constructs for displaying student engagement in learning" (p.105).

Within this current study, the following questions will be explored. Can children become more proficient in their L2 (second language) using the 12 steps of knowledge building in the KBIP forums than when immersed in traditional lecture-style classrooms? Is it possible to determine the acquisition of the second language from analyzing the existing posts within a forum, or is a study with a more extensive scope necessary to assess SLA?

This paper has been divided into sections to explain the main concepts behind the study, explanations of knowledge building through collaboration, followed by online collaborative learning in foreign language education, and finally computer-supported collaborative writing. Following these chapters, the preliminary study will be presented where the data from a forum was examined to check for evidence of SLA and to potentially answer the above questions. The findings are reported, along with suggestions for further studies.

1.2. Knowledge building through collaboration

A *knowledge community* is defined as an organized group or assembly of people who engage in knowledge related activities (Paavola, Lipponen & Hakkarainen, 2004). As the definition of collaborative learning may vary, the stages of construction of knowledge also vary from the 12 KB principles identified by Scardamalia and Bereiter (1994, 1991). Gunawardena, Lowe & Anderson (1997) identified five stages of the construction of knowledge, which are: sharing and comparing information, discovery and exploration among inconsistency of ideas/concepts/statements, negotiation of meaning and

construction of knowledge, testing and modification of proposed synthesis, and agreement and application of new meaning. Kimmerle, Moskaliuk, Brendle, & Cress (2017) analyzed the stages people go through when reaching decisions or shared opinions on collaborative writing tasks. They conducted a quantitative analysis using inferential statistics and determined that the five stages identified by Gunawardena et al. (1997) are, in fact, three main stages: knowledge introduction, restructuring, and shared opinion. The scaffolding identified by Scardamalia & Bereiter (1991, 1994, 2006) frames the individual contributions and uses registration and communication supported in holding constructive discussions. The majority of these principles, which relate to the discussion, creation, and clarification of ideas fall into the first stage of the construction of knowledge.

The following table shows how the 12 KB principles align with the stages of the construction of knowledge.

Table 1. Comparison of the 12 KB Principles with the Stages of Construction of Knowledge.

Knowledge Building Principles (Scardamalia & Bereiter, 1991)	Five Stages of Construction of Knowledge (Gunawardena et al., 1997)	Three Stages of Construction of Knowledge (Kimmerle et al., 2017)
1) Real Ideas, Authentic Problems – problems arise from an effort to understand the world	1) Sharing and Comparing Information	1) Knowledge Introduction
2) Improvable Ideas – advance ill-conceived ideas to improve them		
3) Idea Diversity – improve ideas through comparison, combination and alignment with other ideas		
4) Rise Above – work with complexity, diversity, & messiness to improve ideas		
5) Epistemic Agency – participants recognize personal and collective responsibility for knowledge building efforts		
6) Community Knowledge – aim to produce knowledge as a value to others		
7) Democratizing Knowledge – all participants are legitimate contributors to shared goals.		
8) Symmetric Knowledge of Advancement – expertise is distributed within and outside the community	2) Discovering and Exploring Among Inconsistency of Ideas	
9) Pervasive Knowledge Building – creative working with ideas		
10) Constructive Use with Authoritative Sources – report	3) Negotiate Meaning and Construction of Knowledge	2) Restructuring

and understand the sources of knowledge		
11) Knowledge Building Discourse – knowledge is defined and transformed through discussion	4) Testing and Modification of Proposed Synthesis	
12) Concurrent, Embedded, and Transformative Assessment – the community has an internal assessment	5) Agreement and Application of Meaning	3) Shared Opinion

1.3. Online collaborative learning in foreign language education

To better understand online collaborative language learning, it is best to establish the definition of an online learning community. An online learning community is located on the Internet and is designed to facilitate learning amid its members by encouraging interactions among them (Cook & Smith, 2004; Zhan, Xu & Ye, 2011). People share knowledge in these communities and work together to help others acquire knowledge and share information (Cook & Smith, 2004). Online learning communities are built to support both in-classroom learning or formal learning, such as the KBIP, and informal learning.

Formal learning and in-classroom learning studies are advantageous to informal learning studies because formal learning environments most often provide the researcher with access to the participant data. Informal learning communities, such as blogs or social networking sites (SNS) tend not to allow the researchers access to the data and analytics. Therefore the findings are often based on qualitative data collected through questionnaires and interviews (Lin, Warshouer, & Blake, 2016; Stevenson & Liu, 2010)

Thus, early research on language learning in SNS focus on attitudes, usage, and progress, instead of the acquisition of vocabulary, advancements of knowledge of grammar rules, and fluency in the L2 (Stevenson & Liu, 2010; Pinkman, 2005) Informal learning has no limits on space and time and therefore is common in language learning. Such examples occur when language learners engage in conversations, listen to the radio, read news online, or watch movies. Through these methods, they are able to learn without intention (Comas-Quinn, Mardomingo & Valentine, 2009).

2. Computer-supported collaborative writing

In the field of L2 studies, there have been many approaches to analyze collaborative writing, but none of these studies have focused on individual L2 learning: according to Bikowski & Vithanage (2016), technology-enhanced collaborative tools have evolved significantly, but research in this field focuses primarily on specific aspects, such as the relationships between pairs, the technological tools used, and the environment. Bikowski & Vithanage state that "no research has been published to date; however, focusing on the possible individual English language learning gains via technology-enhanced collaborative writing projects" (p. 79).

While the knowledge forums in the KBIP are set in a formal classroom learning environment, the participants often behave similarly to those participating in an informal learning environment, where people also acquire knowledge unintentionally when they participate in collaborative online activities (Thorne, Black & Sykes 2009). Not only do the students show gains in literacy, but they also show evidence of stronger collaborative writing skills with improved content and organization, especially in foreign language contexts (Yim & Warschauer, 2017). These findings suggest that knowledge forums would assist in foreign language acquisition and production due to the contributing of, building on, and development of foreign language knowledge.

The current study aims to determine whether children can become more proficient in their L2 using the 12 steps of knowledge building in the KBIP forums and the stages of construction of knowledge. The first phase of this study is presented below where the data within existing forums were analyzed for evidence of foreign language acquisition.

2.1. The study

This study was conducted to analyze existing data in KBIP forums for evidence of SLA, and it is an ad hoc analysis of the posts of the students to determine whether there is any evidence of language learning. The discussions were created between October 2015 and February 2016, and, at the time of the discussions, there was no study set up to monitor the participants' actions nor create any pre- and post-testing. The hypotheses are as follows.

- Because students feel more comfortable in online discussions than face-to-face discussions (Al-Jarf, 2007) an increase in their writing skills (syntax, spelling and acquisition of vocabulary) in their L2 should be observed.
- The information in the forums will determine how and when the 12 KB principles and the three stages of knowledge construction take place in relation to SLA.

3. Method

3.1. Sample

The sample for the study consists of a group of 35 secondary school students of a Spanish school, who are bilingual in Spanish and Catalan. The students were in the same grade and they were approximately 16 years old at the time of the study. These students participated in an online collaborative learning project (Knowledge Building International Project) together with a group of 35 Greek secondary students in the framework of a European project, which is referred to as COMconèixer in the Catalan region of Spain.

3.2. Procedure

Both the Spanish and Greek students participated in the knowledge forum within a classroom environment. They engaged in several discussions on the topics of historical Mediterranean fashion and archaeology and all of the posts were in their L2 (English). According to the teachers, the students were given instructions on how to use the KB tool, which is necessary, because, in order to have effective online communication, students should be given explicit information about the platform and methodology, as well as trained in that specific communication technology (Heiser, Stickler & Furnborough, 2013, p.231). They then entered the questions in the forum and, through the course of the semester, they responded to the questions and built on the ideas.

All of the posts in the forums were sorted by date and time in a spreadsheet to follow the flow of ideas of the students. The sorting of the posts occurred more than 12 months after the students participated in the forum. At the onset of data sorting, there was little information on the students' English language exposure or level of English. To find further information, the participants were given a questionnaire to understand their linguistic backgrounds better. The questionnaire was conducted digitally in Catalan to ensure the students understood the questions. It inquired about the participants' native languages, languages spoken with family members, exposure to English outside of the classroom, and their history of foreign language learning.

3.3. Data analysis

Each post was checked first in Google for evidence of copying from a website and second with a plagiarism checker in order to determine whether the posts were novel, created using the students' own words, since SLA cannot be determined from copied text. Therefore, it is necessary to remove such posts from the analysis. The posts were then checked for grammatical errors using a digital grammar checker, which identified syntax and orthographic errors, and then for repetition of chunks, learning phrases from peers, and modifications to language over time. This was done through following the flow of ideas, as each forum post was time-stamped and the ideas were built on in sequential order.

In conjunction with any posts removed due to copying, the posts from the students in the Greek school were removed and excluded from the study, as there was no permission statement to work with the data from this school. Fortunately, the posts from the Spanish students were mainly novel posts, and all but two of these posts were analyzed in the study.

4. Results

As explained in the former section, only the posts from the students in the Spanish school were analyzed. While there were 35 students in the class, only 12 of the students entered posts in the knowledge forum (see Table 2).

Table 2. Participation.

School and location	# of students	Forum participation	Participation in discussions without posting the Forums
Kalamata, Greece	35	21	14
Sant Pau, Tarragona	35	12	23

Only the responses from these 12 students could be included. Of these 12 students, ten are female and two are male. They are all in the same grade and were around 16 years old at the time they participated in the forum. Therefore, they should all be at the same developmental stage.

There was a total of 52 posts from the Spanish and, with the exception of two posts, all of the posts provided novel descriptions using the students' own words to provide further information. Thus, all but two of the posts from the Spanish students were eligible for analysis.

The posts per student were then isolated to determine the frequency the students were participating in the forum (see Table 4).

Table 3. Number of posts per student.

# of posts	1	2	3	4	5	6	7	8	9	10
# of students	2	2	2	1	1	1	1	1	0	1

The mean number of posts by student is 4.33 and the median is 3.5.

The questionnaire data revealed that there are confounding variables, which could influence the production of English in the posts. Some of the students have private English tutors after school, some have travelled to English-speaking countries, and three of the students claim to be native speakers of English and speak English in the home (see Table 3).

Table 4. English language background.

L2 Background	Number	Travel to English speaking countries	Private English tutor
Native English Speaker	3	2	1
Non-Native English Speaker	9	4	3
Total	12	6	4

Finally, the error types were analyzed by running the posts through an English language digital grammar checker. The data was sorted by participant to determine whether there were any trends and whether any errors were consistent amongst the participants. (See Table 5).

Table 5: Types of errors per student.

Error Type	Total	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Punctuation or Comma Use	20	0	2	3	7	1	4	0	2	0	0	1	0
Spelling Error	19	1	1	2	3	4	3	0	2	0	2	0	1
Word Order	16	1	0	1	3	0	4	1	1	1	1	2	1
Singular/Plural Inflection	9	2	1	1	2	0	2	0	0	0	1	0	0
Incorrect Word	8	1	1	1	1	0	0	0	0	0	1	2	1
Incorrect Verb Tense	8	1	0	0	0	0	1	0	0	0	3	1	2
Capitalization Error	7	0	1	0	2	1	1	0	1	0	1	0	0
Missing Pronoun	6	1	0	0	0	0	0	0	1	0	1	1	2
Missing Determiner	5	1	0	1	0	1	0	0	2	0	0	0	0
Missing Conjunction	4	2	0	0	1	0	0	0	0	0	0	1	0
Total	102	10	6	9	19	7	15	1	9	1	10	8	7

5. Discussion

Once we removed the posts from the Greek students and the copied posts, the remaining posts in the forum were few in number (mean 4.33/student) with inconsistent errors. The number of errors and types of errors were not consistent amongst the participants and the majority of errors appeared similar to what is seen when using mobile devices, such as an omission of punctuations, or typos (Cingel & Sundar, 2012).

Since we were not present in the classroom while the students participated in the forums, we were not able to observe how the students arrived at their main questions for their forum nor how they organized their ideas and built on the ideas to discover new information. It is, however, easy to determine which posts fall into the Three Stages of Knowledge Construction (Kimmerle et al., 2017) as these posts can be simplified to say when the questions are introduced, how they are answered, and when the students arrive at a shared opinion (See Appendix A).

The students were working in groups and only one person from each group was posting in the forums; therefore, we cannot determine from this analysis the full extent to which students discovered and explored ideas and negotiated meaning, as in the Five Stages of Construction of Knowledge (Gunawardena et al. 1997). We also cannot effectively identify when the students advanced from one Knowledge Building Principle (Scardamalia & Bereiter, 1991) to the next, since a large portion of their idea sharing came from group discussions prior to the post entries.

6. Recommendations for further research

It is best to use a design containing both method triangulation and data triangulation (Sun, Franklin & Gao, 2015; Brantlinger, Jimenez, Klinger, Pugach & Richardson, 2005). Brantlinger et al. (2005) coined the term *method triangulation* for the use of multiple research methods to explore a research question, which includes collecting both qualitative and quantitative data. Once the topic is determined for use in the forum, a pre-test, post-test, and delayed post-test may be created to test the participants' knowledge of vocabulary relating to the subject, relevant grammar at the participants' CEFR (Central European Framework of Reference) level, and general knowledge of the subject.

In conjunction with using method triangulation, it is recommended to use data triangulation. *Data triangulation* was coined by Brantlinger et al. (2005) to refer to the use of multiple data sources to explore a research question. To analyze whether an increase in performance between a pre-test and post-test is statistically significant, T-Tests and Cohen's D may be used. Any data not initially collected for the purpose of the study could be analysed for any interaction effect (using an analysis of variance) and to see whether there are any correlations between this data and other variables.

7. Conclusion

The present study analyzed data in a discussion forum where the participants were writing and collaborating using their L2 (English). We were able to identify through this analysis how the students moved through the Three Stages of Knowledge Construction (Kimmerle et al., 2017) from the posts in the forum, but without classroom observation, we could not precisely identify how the students moved through the Knowledge Building Principles (Scardamalia & Bereiter, 1991). Even though we could not identify the moments the students transitioned through the Knowledge Building Stages, we were able to determine when the students' ideas passed through the Three Stages of Construction of Knowledge (knowledge introduction, restructuring, and shared ideas). We believe, therefore, that those students who did participate developed knowledge on the topic of historical fashion based on their forum discussions within a foreign language classroom. However, due to the small sample size, confounding variables, inconsistencies in error types, and the small number of posts by the participants, there is not enough information within these forum posts to provide an accurate measurement of foreign language acquisition for each student.

References

Al-Jarf, R. (2007). Teaching Vocabulary to EFL College Students Online. *CALL-EJ*, 8(2). 1-16. *http://econf.uob.edu.bh/conf1/pdf%20files/133.pdf*

Bielaczyc, K. & Collins, A. (2005). Technology as a catalyst for fostering knowledge-creating communities. A. M. O'Donnell, C. E. Hmelo-Silver & J. van der Linden (Eds.), *Using technology to enhance learning*. Mahwah NJ: Lawrence Erlbaum Associates.

Bielaczyc, K. & Collins, A. (2006). Fostering knowledge-creating communities. A. M. O'Donnell, C. E. Hmelo-Silver & G. Erkens (Eds.), *Collaborative Learning, Reasoning, and Technology.* Mahwah NJ: Lawrence Erlbaum Associates.

Bereiter, C. & Scardamalia, M. (2010). Can Children Really Create Knowledge?. *Canadian Journal of Learning and Technology / La revue canadienne de l'apprentissage et de la technologie, 36* (1). Canadian Network for Innovation in Education. doi: 10.21432/T2ZP43

Bereiter C., Scardamalia M. (2014) Knowledge Building and Knowledge Creation: One Concept, Two Hills to Climb. In: Tan S., So H., Yeo J. (Eds.) *Knowledge Creation in Education. Education Innovation Series,* pp. 35-52. Singapore: Springer. doi: 10.1007/978-981-287-047-6_3

Bikowski, D. & Vithanage, R. (2016). Effects of Web-Based Collaborative Writing on Individual L2 writing Development. *Language Learning & Technology*, 20(1), 79-

99.https://scholarspace.manoa.hawaii.edu/bitstream/10125/44447/1/20_01_bikowskivithanage.pdf

Brantlinger, E., Jimenez, R., Klinger, J., Pugach, M. & Richardson, V. (2005). Qualitative Studies in Special Education. *Exceptional Children*. 71(2), 195-207. doi: 10.1177/001440290507100205

Chen-Chung, L., Pin-Ching, W. & Shu-Ju, T., (2016). An analysis of student engagement patterns in language learning facilitated by Web 2.0 Technologies. ReCALL 28(2), 104-122. doi: 10.1017/S095834401600001X

Chuy, M., Scardamalia, M., Bereiter, C., Prinsen, F., Resendes, M., Messina, R., Hunsburger, W., Teplovs, C., & Chow, A. (2010). Understanding the nature of science and scientific process: A theory building approach. *Canadian Journal of Learning and Technology, 36*(1). doi: 10.21432/T2GP4R

Cingel, D. P. & Sundar, S. (2012). Texting, techspeak, and tweens: The relationship between text messaging and English grammar skills. *New Media & Society.* 14(8).https://journals.sagepub.com/doi/10.1177/1461444812442927

Comas-Quinn, A., Mardomingo, R. & Valentine, C. (2009). Mobile blogs in language learning: Making the most of informal and situated learning opportunities. ReCALL 21(1), 96-112. doi:10.1017/S0958344009000032

Consell Superior d'Avaluació del Sistema Educatiu (2015). Avaluació del projecte COMconèixer. Barcelona, Departament d'Ensenyament, Consell Superior d'Avaluació del Sistema Educatiu, col·lecció 'Documents' 32. http://cdl3.cdl.cat/COMconeixer/docs/Avaluacio_Projecte_COMconeixer.pdf

Cook, J. & Smith, M. (2004). Beyond formal learning: Informal community eLearning. *Computers & Education*. 43(1-2), 35-47. doi: 10.1016/j.compedu.2003.12.003

Deming, W. E. (1986). *Out of the Crisis. MIT Press*.

Gunawardena, C. N, Lowe, C. A., & Anderson, T. (1997). Analysis of a Global Online Debate and the Development of an Interaction Analysis Model for Examining Social Construction of Knowledge in Computer Conferencing. *Journal of Educational Computing Research.* 17(4). doi: 10.2190/7MQV-X9UJ-C7Q3-NRAG

Heiser, S., Stickler, U. & Furnborough, C. (2013). Student training in the use of an online synchronous conferencing tool. *CALICO Journal*, 30(2), 226-251. doi: 10.11139/cj.30.2.226-25

Johnson, D.W. & Johnson, R.T. (1999). Making cooperative learning work, *Theory Into Practice*, 38:2, 67-73. doi: 10.1080/00405849909543834

Kim, B., Tan, L., & Bielaczyc, K. (2015). Learner-generated designs in participatory culture: What they are and how they are shaping learning. *Interactive Learning Environments, 23*(5), 545-555. doi: 10.1080/10494820.2015.1067974

Kimmerle, J., Moskaliuk, J., Brendle, D. & Cress, U. (2017). All in Good Time: Knowledge Introduction, Restructuring, and Development of Shared Opinions as Different Stages in Collaborative Writing. *International Journal of Computer Supported Collaborative Learning.* 12(2), 195-213. doi: 10.1007/s11412-017-9258-6

Laferriere, T., Law, N. & Montaine, M. (2012). An International Knowledge Building Network for Sustainable Curriculum and Pedagogical Information. *International Education Studies*, 5(3), 148-160. doi: 10.5539/ies.v5n3p148

Montane, M., Amaros, C. & Gisbert, M. (2017). The COMknowledge project: evaluation of methodological aspects of the project based on pupils' perceptions. *Unpublished conference paper.*

Moss, J. & Beatty, R. (2006). Knowledge building in mathematics: Supporting collaborative learning in pattern problems. *International Journal of Computer Supported Collaborative Learning, 1*(4), 441- 465. doi: https://doi.org/10.1007/s11412-006-9003-z

Nami, F, Marandi, S.S., Sotoudehnama, E., (2018). Interaction in a discussion list: An exploration of cognitive, social, and teaching presence in teachers' online collaborations. *ReCALL,*30(3), 375-398. doi: 10.1017/S0958344017000349

Paavola, S., Lipponen, L. & Hakkarainen, K. (2004). Models of Innovative Knowledge Communities and Three Metaphors of Learning. *Review of Educational Research.* 74(4), 557-576. doi: 10.3102/00346543074004557

Scardamalia, M. & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1,*37-68. doi 10.1207/s15327809jls0101_3

Scardamalia, M. & Bereiter, C. (1994). Computer Support for Knowledge Based Communities. *Journal of the Learning Sciences 3(3*), 265-283. doi: 10.1207/s15327809jls0303_3

Scardamalia, M. & Bereiter, C. (2006). Knowledge building: Theory, Pedagogy, and Technology. In K. Sawyer (Ed.) *Cambridge Handbook of the Learning Sciences,* pp. 97-118. New York: Cambridge University Press. doi: 10.1017/CBO9781139519526.025

Scardamalia, M., Bereiter, C., Brett, C., Burtis, P.J., Calhoun, C., & Smith Lea, N. (1992). Educational applications of networked communal database. *Interactive Learning Environments. 2*(1), 45-71. doi: 10.1080/1049482920020105

Sun, Y., Franklin, T. & Gao, F. (2015). Learning Outside of Classroom: Exploring the Active Part of an Informal Online English Learning Community in China. *British Journal of Educational Technology.* doi: 10.1111/bjet.12340

Thorne, S., Black, R. W. & Sykes, J. M. (2009). Second language use, socialization, and learning in internet interest communities and online gaming. *The Modern Language Journal, 93*(1), 802-821. doi: 10.1111/j.1540-4781.2009.00974.x

Yim, S., Warschauer, M., (2017). Web-Based Collaborative Writing in L2 Contexts: Methodological Insights From Text Mining. *Language Learning & Technology, 21*(1), 146-165.
https://scholarspace.manoa.hawaii.edu/bitstream/10125/44599/1/21_01_yimwarschauer.pdf

Zhan, Z., Xu, F. & Ye, H. (2011). Effects of an online learning community on active and reflective learners' learning performance and attitudes in a face-to-face undergraduate course. *Computers & Education*, 56(4), 961- 968. doi: 10.1016/j.compedu.2010.11.012

APPENDIX A

Sample forum posts

Knowledge introduction

I need to understand - Can you tell something about building materials in Tarragona, Verona and Messinia

Restructuring

My theory - The materials we can see are rocks. Limestones, marble, cement, wood, and different thing made out of clay.

My theory - In their buildings 600- 250BCE, the Greeks used mud brick, wood, cane, stone, fired clay, tar, weak mortar.

Shared ideas

Putting Our Knowledge Together - Romans used limestones to build the majority part of the buildings, but they also used different materials like marble, cement, wood, and different things made out of clay. The rocks are between 23 and 5 years old. Fossils can help us to know where does the rock come from, its environment, when it was formed. We can also know the age of the rock by calculating the level of radiation that they have. People involved in building materials were soldiers, salves, sculptors and engineers.