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Running head: ICT-ASSISTED COLLABORATIVE PROJECT-BASED LEARNING

The Underutilization of Internet and Communication Technology-assisted Collaborative
Project-Based Learning Among International Educators: A Delphi Study

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Abstract

This study explores the barriers associated with teachers implementing Internet and Communication Technology-assisted Collaborative Project-based Learning (ICTCPrjBL) as a classroom teaching methodology with students. We used a Web-based Delphi method to engage experienced educators in anonymous consensus building consisting of three rounds of surveys. The Round 1 analysis yielded 51 barriers. The Round 2 analysis produced descriptive statistics (range, mean, and standard deviation) on the importance of each barrier. The Round 3 analysis confirmed 16 of the 51 (31.4%) barriers as “moderately significant” to “very significant” to implementing ICTCPrjBL. Important contributions of this study include: (a) identification of barriers to implementing ICTCPrjBL that can inform the literature and promote greater utilization throughout the educational community and (b) a cross comparison of barriers between North America, Eastern Europe, and Africa to examine regional differences.

Investigating the Underutilization of Internet and Communication Technology-assisted Collaborative Project-based Learning Among International Educators

The idea of the Internet as a community where learners could come together, interact, and share knowledge was envisioned as a way to transform the field of education (Kozma & Schank, 1998). The initial promise of introducing the information superhighway into education brought with it the hope that global learning networks could be established in which students could participate in intercultural collaborative learning tasks (Cummins & Sayers, 1995). This led to the establishment of new teaching methodologies such as Internet and Communication Technology-assisted Collaborative Project-based Learning (ICTCPrjBL) that combine the use of Information and Communication Technology (ICT), online student collaboration, and the constructivist orientation of project-based learning (PrjBL) (Moursund & Smith, 2000).

Research has shown benefits derived from using PrjBL in a classroom (Blumenfeld et al., 1991). There is also a good deal of research on the benefits of using ICT for instructional purposes (British Educational and Communication and Technology Agency, 2002). Furthermore, there is research that looks at the benefits of using ICT for collaborative learning between classrooms (Moursund, Bielefeldt, & Underwood, 1997). Yet despite these findings, ICTCPrjBL is one of the least used methods among teachers who are characterized by their innovative use of technology (Kozma & Anderson, 2002).

ICT is the merging of computing and communications (Ducatel & Webster, 2000), but it can also be thought of any “activities that contribute to the display, processing, storing, and transmission of information through electronic means” (Bruneau & Lacroix, 2001, p. 4). BECTA, the British Educational Communications and

Technology Agency (2004), recommended the need for research that specifically looks at ICT-related teaching methodologies in a study that investigated barriers and enablers that affect the use of ICT by teachers. Their study concluded that there is little research that looks at barriers that exist in specific areas of educational ICT use as well as barriers that affect practitioners in specific roles. Furthermore they recognized a need to seek out examples of ways in which educators have overcome barriers and have successfully integrated specific types of ICT use.

The Value of Project-based Learning

PrjBL is an instructional model that “engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks (Markham, Larmer, & Ravit, 2003, p. 3)” Students are encouraged “to solve challenging problems that are authentic, curriculum-based, and often interdisciplinary” (Solomon, 2003, p. 1). The nature of these tasks frequently requires collaboration and teamwork. One factor that motivates students is having the opportunity to share their findings in presentations to their peers and community (The George Lucas Educational Foundation, 2004). A research report by Moursund et al. (1997) credited PrjBL with the promotion of increased student motivation, problem-solving ability, collaboration, resource-management skills, and improved library research skills. Thomas (2000) identified research that showed gains in student achievement, problem solving capabilities, understanding of subject matter, as well as other specific skills that were directly related to PrjBL tasks.

PrjBL has been used in conjunction with ubiquitous laptop initiatives in the area of Geography (Grant & Branch, 2005). It has also been used alongside Computer

Mediated Communication tools in high school (Lang, Peer, & Divaharan, 2005) in middle level science (Rivet & Krajcik, 2004), and as a means of technology integration for pre-service teachers (Gubacs, 2004). Thus, project-based learning appears to be an effective (Stites, 1998) and well-utilized curriculum tool for promoting student learning.

Student's Use of Internet and Communication Technology

Since The International Society for Technology in Education (ISTE) published the *National Educational Technology Standards for Students* (1998) communication technology has become a necessary component of a student's educational experience. Various uses of communication technology are found as performance indicators in the recommended "Profiles for Technology Literate Students" at every age bracket. In addition to student use, technology communication tools are one of the six major standards for teaching practice. The use of ICT standards is not limited to those published by ISTE. Similar standards regarding the educational use of ICT have been adopted by Australia (Educational Network Australia, 2004), The United Kingdom (Qualifications and Curriculum Authority, 2001), Ireland (National Center for Technology in Education, 2003), Canada (Government of Alberta, Canada, 2004; Province of British Columbia, Canada, 2001), Poland (Ministry of National Education of Poland, 2001), Hungary (Ministry of Education: Republic of Hungary, 2004), Russia (UNESCO Institute for Information Technologies in Education, 2004) and many countries in Africa and Asia who use the standards established by the United Nations Educational, Scientific and Cultural Organization (UNESCO Asia and Pacific Regional Bureau for Education, 2003).

The Department for Education and Skills in England concluded that the "weight of evidence suggested clearly" that "ICT provision and pupil ICT use do impact

positively on pupil attainment and school standards” (Pittard, Bannister, & Dunn, 2003, p. 17). BECTA (2002) identified that the value of using ICT for teaching and learning could be measured by increased student skills in motivation, presentation, questioning, problem solving, information handling, and techniques of modeling. Law and Chow (2002) in a study of primary school children in Hong Kong concluded that the most important outcome of learning practices that used ICT was the empowerment it provided teachers and students. Thus, educators across the world continue to ascribe value to the use of ICT in student learning.

Internet and Communication Technology and Collaborative Project-based Learning

New pedagogical methodologies that combine collaborative PrjBL and ICT teach students to work together, learn from each other, and share knowledge by developing powerful online learning communities (Gordin, Gomez, Pea, & Fishman, 1996).

Cifuentes, Murphy and Davis (1998) found that when high school classrooms collaborated using the Internet, students demonstrated an increase in self-esteem, academic achievement, and multicultural understanding. Cifuentes et al. also found that students grew personally and intellectually, felt empowered to achieve goals, became comfortable with technology, provided and/or received mentorship, and learned from each other.

Gragert (2000) contended that primary through high school students were more motivated to learn as a result of engaging in collaborative online project work. He also summarized teacher testimonials concluding that online collaborative project work heightens student interests in subject content, language skills, motivation, and opportunities for action from learning. Schultz-Zander, Butcher, and Dalmer (2002)

researching student cooperation concluded that problem-oriented learning facilitated by ICT promotes students in primary, lower and upper secondary levels in teaching each other, functioning as a learning community, and collaborating in joint partnerships with other schools. Collaborative PrjBL facilitated by ICT has been identified as an innovative classroom practice (Andersen, 2002) and educational projects that use ICT are an established form of collaborative PrjBL and are found in school educational programs throughout the world (Moursund & Smith, 2000).

Underutilization

Two major studies have shown a low usage among classroom teachers of ICT for collaborative PrjBL-type activities. A report by the National Center for Education Statistics (2000) found that when computer use among teachers in public schools was examined, ICT use that involved student collaboration was the lowest of the assessed categories at 7%. More recently, Kozma (2003) found that ICT use within innovative, technology-rich school settings supported student project collaboration only 17% of the time.

There is a substantial research base on the barriers that have prevented educators from using innovative technology rich teaching practices in general (see for example, Fabry & Higgs, 1997; Preston, Cox, & Cox, 2001; Riel & Becker, 1999). Studies also exist specifically on the obstacles associated with the use of ICT in teaching (British Educational and Communication and Technology Agency, 2004; Butler & Sellburn, 2002; Cox, Preston, & Cox, 1999). Barriers that frequently appear in assessments of technology use among teachers include the lack of: Reliable Internet access (Pelgrum, 2001), teacher preparation time (Fabry & Higgs, 1997), time in student schedules

(Drenoyianni & Selwood, 1998), support regarding ways to integrate technology (VanFossen, 1999), and training opportunities (Veen, 1993).

It is likely that some of the obstacles that are associated with the barriers to adoption of technology teaching and teaching with ICT are the same as those associated with ICTCPrjBL. Still, there has been little research that looks specifically at the barriers that exist for ICTCPrjBL. The purpose of this study is to research this specific area of ICT use to identify barriers teachers have encountered in implementing it as an educational methodology. To that end, this research investigated the following questions:

- What barriers have teachers experienced in using Internet and Communication Technology-assisted Collaborative Project-based Learning with students?
- Do these barriers vary substantially across the regions of North America, Eastern Europe, and Africa?

With an eye towards generating recommendations for practitioners, this research also investigated reasons for initial ICTCPrjBL adoption and success. Findings regarding these two additional questions will be reported in future articles.

Methodology

A Web-based Delphi survey was used to collect data for this study, because it allowed a panel of experts located in diverse geographic locations to consider an open-ended question, present their opinions and ideas, and then work toward reaching consensus on the effects of ICTCPrjBL barriers and the importance of successful practices (Adler & Ziglio, 1996; Dalkey, 1969; Hemler, 1983).

Design of the Study

Linstone and Turoff (1975) have identified that the conventional Delphi Method uses the following components: 1) careful development of research questions, 2) identification of experts in the field, 3) use of a pilot study to determine the understandability of the research questions, 4) obtainment of voluntary participation by a panel of experts, 5) distribution of an initial questionnaire to the experts (Round 1), 6) evaluation of the responses from Round 1 and returning the results to the experts to apply rankings or ratings (Round 2), and 7) continuing the process until the expert panel obtains a consensus and a final interpretive report is completed (Round 3 or more).

As is often the case, these procedures are modified to meet specific research needs (Linstone & Turnoff, 1975; Murray & Hammons, 1995). This study amended the process outlined above by using the Round 1 survey both to present the initial question and to refine the panel of experts. Ultimately, all surveys were designed and delivered online. Before each round, a small pilot study was given to 5 educators who have extensive experience with online collaborative project work to check for functionality and clarity (Baker, 1994).

Procedure

Developing the initial questions (Simmonds, 1977) and selecting an expert panel (Andranovich, 1995; Bernard 1998; Delbecq, et al., 1975; Lang, 1998) are two major concerns that every Delphi study must address. Bernard (1998) warned that in purposive sampling, it is necessary to decide the purpose you want respondents to serve and then develop appropriate criteria for identifying and soliciting their participation. Andranovich (1995) emphasized that the study problem and the questions posed by the survey must

match the interest of the participants in order to gain participation that is meaningful.

Both of these concerns are addressed below.

Round 1

Participants were selected by screening for educators from the International Education and Resource Network's (iEARN) Conference (2004) because the majority of attendees are teaching professionals from a number of countries that regularly use ICTCPrjBL. It was our belief that the close association, dedication, and interest of the conference participants in ICTCPrjBL practice meant that they would have an intimate and experiential knowledge of the problem to be investigated and would invest their time and expertise in a multi-survey research study (Delbecq, Van de Ven, & Gustafson, 1975). Since ICTCPrjBL is a relatively new teaching methodology (Moursund, 2002), we determined that respondents who indicated that they had two or more years of experience facilitating ICTCPrjBL and using Internet communication technologies had a level of experience that would allow them to provide meaningful information on the underutilization of ICTCPrjBL (Moursund, 2004). We found that the first round participants had 6.3 average years of facilitating experience with ICTCPrjBL. Overall the respondents had 7.6 average years of experience using Internet communication technologies.

Teaching location was another major identifier we considered in our study. Since our research was an international study, our sampling frame consisted of educators from the six major populated continents. We decided to focus in on specific regions such as Africa, Eastern Europe, and North America to determine if there were similarities and differences in obstacles that have led to the use of ICTCPrjBL (Schmidt, Lyytinen, Keil,

& Cule, 2001). All other participants from Asia, Australia, Western Europe, and South America were dropped. Africa, Eastern Europe, and North America were targeted because there were a significant number of attendees at the iEARN Conference from each of these regions (International Education and Resource Network, 2004) and in anticipation barriers would vary by region. For instance, teachers in Africa have been known to have difficulties with connectivity and Internet access; teachers in Eastern Europe often experience resistance to change that limits their ability to implement project-based learning activities; and teachers in North America often experience a lack of time for training (British Educational and Communication and Technology Agency, 2004).

We sent email invitations for our Round 1 survey to 323 individuals. 294 of these consisted of iEARN-attendees who were known to have experience with ICTCPrjBL due to their position as a country coordinator ($n=38$), project leader ($n=108$), conference presenter ($n=113$), or well-known project facilitator ($n=35$). The other 29 individuals were referred by conference attendees as individuals who had a great deal of experience with ICTCPrjBL, a sampling technique for Delphi studies used by Brill, Bishop, & Walker (2005). We received 138 (42.7%) responses to the survey. This number represented a large cross section of participants who had diverse experiences with ICTCPrjBL. It also gave us the geographic diversity we were looking for among the respondents (Cuhls, Blind, & Grupp, 2002). Table 1 provides a summary of response rates for Round 1 and each subsequent round to assist in tracking the evolution from the initial sample of 323.

Table 1. *Sample Size (n), Response Frequency (f) to each Round, Response Rate by Survey Round, and Response Rate to Initial Sample.*

Source	Sample <i>n</i>	Response <i>f</i>	Response Rate	Response Rate To Initial Sample
Round 1				
Targeted sample of iEARN conference attendees	294	116	39.5%	
Referrals from other participants	29	22	75.7%	
<i>Round 1 total</i>	323	138	42.7%	42.7%
Round 2				
Purposeful sample of experts	103	59	57.3%	18.7%
Round 3				
Purposeful sample of experts	59	44	74.6%	13.6%

An analysis of the participant background data collected from Round 1 allowed us to determine that 35 respondents did not meet our inclusion criteria, either on the basis of expertise or because they did not come from one of the three targeted regions. The primary researcher used the constant comparative method (Merriam, 2001) to analyze the data collected from the remaining 103 respondents. The responses to the three open-ended questions were hand-coded to look for recurring themes. In addition, a word frequency count was administered as a validity check of the Round 1 analysis.

The initial analysis yielded 50 barriers. The assistance of an outside survey analysis expert and an ICTCPrjBL expert was requested to review and provide further validation for the data. They suggested that one barrier be divided into two different responses to create 51 barriers. By doing this, all items that were identified by the respondents were addressed in the final list. Our analysis of the data also yielded general categories, such as issues regarding Internet connectivity, technology difficulties, curriculum/program concerns, teacher training, ICT support, project-related concerns,

and miscellaneous items. Instead of randomizing the choices, we decided to place related items next to each other. As an example, items associated with connectivity barriers were grouped together so that the respondents could rate their experience with unreliable connectivity, low bandwidth, lack of access, and the high cost of connectivity.

Round 2

In Round 2, we asked all 126 panelists from Round 1 to use a 5-point Likert scale to rate the responses to the question on barriers based on their level of significance (1=Not Significant, 2=Somewhat Significant, 3=Moderately Significant, 4=Very Significant, 5=Extremely Significant). In addition, participants were given the opportunity to add new barriers or elaborate on their responses. Of the 103 who were asked to continue participating, 59 responded in Round 2.

The goal of the Round 2 data analysis was to baseline the degree of consensus among the respondents regarding the barriers identified from Round 1. Descriptive statistics were produced for each factor. A few participants supplied open-ended comments. An analysis of these comments determined that participants either elaborated on opinions that were already expressed or duplicated an item that already existed in the survey.

Round 3

In Round 3 all 59 panelists from Round 2 were presented with the group mean scores for each item from Round 1 and asked to express agreement or disagreement by rating the items again. During this round 44 of the participants (74.6%) responded. They recommended only minor changes in the mean ratings among all the items presented. These final results are found in Appendix A. An examination of the inter-quartile ranges

between Rounds 2 and 3 showed a decrease, indicating a consensus among the experts that is unlikely to be improved upon (Lindstone & Turoff, 1975).

Results

None of the 51 barriers achieved a mean in the “very significant” to “extremely significant” ($4.00 \leq M \leq 5.00$) range. Twelve of the items were rated “moderately significant” to “very significant” ($3.00 \leq M \leq 4.00$). Thirty-four of the items were rated “somewhat significant” to “moderately significant” ($2.00 \leq M \leq 3.00$). And five of the items were rated “not significant” to “somewhat significant.” Mean scores for the barriers ranged from $M=1.45$ to $M=3.48$. Complete descriptives are available in Appendix A.

Another way to look at the data is to do a cross comparison of mean rankings between our three target regions. An analysis of similarity was conducted through a reliability analysis for all of the barrier questions across all regions. A Cronbach’s alpha was run and generated a value of .97. Initially, this seems to indicate an extremely high level of agreement across regions with respect to ICTCPrjBL barriers. However, there are a couple of important points: 1) by nature of the computational formula, Cronbach’s alpha increases as the number of items increases (Kopalle & Lehmann, 1997) (51 in this case), 2) Cronbach’s alpha increases as the inter-item correlations increase. These inter-item correlations are robust in measuring consistency but not necessarily in measuring agreement (Cronbach & Shavelson, 2004). Thus, it’s quite possible for the regions to have similar trends in barriers, but different attitudes about how large the barriers are as a whole. As reflected in Table 2, that is in fact what took place.

Table 2. Round 3, Question 2 - Category Means.

Barrier Categories	Composite Mean (SD) f=44	N. America Mean (SD) f=16	E. Europe Mean (SD) f=16	Africa Mean (SD) f=12
Teacher Training Issues	3.16 (1.05)	2.65 (1.16)	3.26 (0.96)	3.44 (0.85)
Technology/Technical Issues	2.97 (0.92)	2.58 (0.95)	3.00 (0.82)	3.44 (0.85)
Internet Connectivity Issues	2.80 (1.14)	2.31 (1.11)	2.80 (1.13)	3.46 (0.92)
Curriculum/Program Issues	2.69 (0.81)	2.46 (0.91)	2.68 (0.67)	3.00 (0.81)
ICT Support Issues	2.42 (1.18)	2.17 (1.01)	2.33 (1.04)	2.86 (1.51)
Project Related Issues	2.20 (0.85)	2.06 (0.80)	2.09 (0.67)	2.53 (1.09)
Miscellaneous Items	2.03 (0.82)	1.93 (0.42)	1.84 (0.67)	2.40 (1.26)
Note:	1=Not Significant, 2=Somewhat Significant, 3=Moderately Significant, 4=Very Significant, 5=Extremely Significant			

The data shown above are perhaps best represented visually, which is available below in Figure 1. Note that the trend lines, although different for each of the three regions, are largely parallel. For almost every category, North America had the lowest reported barriers, Eastern Europe was in the middle, and Africa reported the highest barriers. The sole exception to this rule was North America reporting slightly higher ($M=1.93$) Miscellaneous barriers than Eastern Europe ($M=1.84$).

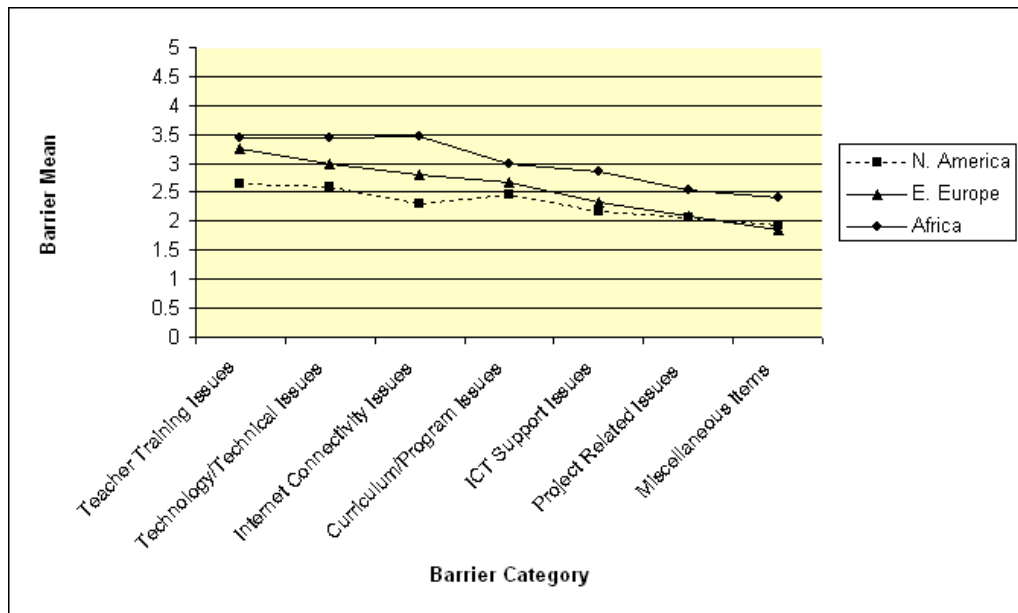


Figure 1 – Barrier means by region

Thus the three regions agreed almost perfectly about the most pressing and least pressing barriers to using ICTCPrjBL, but the impact of each barrier category remains fairly relative. Technology Training, the highest barrier for North America ($M=2.65$) is fairly close to the lowest reported category in Africa, Miscellaneous Items ($M=2.40$).

Discussion

When looking at barriers to ICTCPrjBL, it appears that the situation is complex. An initial examination of the barriers for all participants in the composite group did not show major obstacles for any one category, although some individual items did stand out when individual regions were examined. As expected, the high cost of connectivity is the single strongest factor identified by educators in Africa, only slightly edging out Technology/Technical and Teacher Training, which are both progressively higher in Eastern Europe and North America. Training in ICT use and ICTCPrjBL methodology appears to spike somewhat in Europe, certainly more than the more gradual trend in both

North America and Africa. One item that achieved a significant rating in North America and was supported with respondent commentary concerned inequality of access. Schools in North America appear to find the inability to equally exchange information with schools in other parts of the world to be a factor that limits their ability to do project work. It is worth noting that other barriers that have appeared in previous studies did not achieve high ratings. National examinations are often cited as an obstacle to curriculum change (BECTA, 2004), yet this did not rate as a major obstacle in any region.

Limitations of the Study

Some participants in Africa indicated that in order to answer the survey they had to spend their own personal funds to find a reliable connection to complete the survey. When we were notified of this situation we were able to provide suggestions to the participants on how to gain access to the survey by using a connection through a local university. Nonetheless, it is likely that some potential participants were prevented from completing the survey due to issues regarding their ability to access the survey. If that is the case, then the internet connectivity barrier in Africa may in fact be under-reported here.

We chose to conduct our study in English because we know that it was a language common to all the participants (Schmidt, et al., 2001). English is the primary language used by educators who are associated with iEARN. However, our pilot testing did reveal that relevant terminology does vary in different regions of the world. An example of this is that *school districts* are called *educational agencies* in the United Kingdom. We attempted to address this potential limitation by using descriptive terms that would be recognizable to educators in different parts of the world. An example of this would be

first defining and then consistently using the term ICT, which is more common in Africa and Eastern Europe than it is in the United States. In spite of these limitations we believe that the results of the study have important implications for research and practice.

Conclusions & Future Work

The goal of this study was to research the barriers to the current use of ICTCPrjBL in educational practice. ICTCPrjBL is a practice that has documented benefits in helping students to learn and acquire skills. At the same time, the research suggests that this methodology is one of the least used among educators who regularly use ICT. The barriers identified, whether real or perceived, do limit educators' use of ICTCPrjBL.

Perhaps the most interesting finding of this study is the relatively uniform progression in barriers across three regions that are so socio-cultural diverse, both within each region as well as between the three regions. Future work that verifies this stable progression in the lessening of barriers across regions and over time may help justify the generalization of models to help incorporate ICTCPrjBL in areas that are currently underserved.

Panelist selection is the fundamental basis upon which any Delphi study is built (Andranovich, 1995; Bernard 1998; Delbecq, et al., 1975). We chose to limit our study to the perspectives and opinions of educators associated with ICTCPrjBL. It is likely that a different set of barriers would have emerged if we had included students, administrators, and other individuals associated with ICTCPrjBL. We also used a very specific population (largely iEARN participants) to select our expert panel. There are many other

educators throughout the world who regularly use ICTCPrjBL whose voices may have yielded different responses. Therefore, future work should draw from a larger population than iEARN and include students, administrators, and others who participate in and support ICTCPrjBL.

It appears that technological, training and connectivity barriers present obstacles for schools in Africa to participate in ICTCPrjBL with other regions such as North America and Eastern Europe. Consequently, schools in North America and Eastern Europe are limited in their ability to fully participate in ICTCPrjBL with African schools, narrowing the potential for cross-cultural collaboration and understanding, an oft-cited intended benefit of this educational methodology. One respondent in this study commented: “If you are really interested in project work and your students support you and enjoy communicating with other people online, you’ll overcome difficulties.” In an attempt to bring this sentiment to life, we plan future research on exemplary practices using ICTCPrjBL to investigate strategies that educators have used to overcome barriers for successful implementation. It is our hope that more educators will be motivated to make further use of ICTCPrjBL as they see the benefits that ICTCPrjBL can bring to learning and realize how barriers can be overcome.

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Appendix A. Round 3 – Barrier Categories and Category Means

Please rate the significance of the following barriers as you have experienced them in using Internet and Communication Technology-assisted Collaborative Project-based Learning with students:		Compos ite Mean (SD) f=44	N. Americ a Mean (SD) f=16	E. Europe Mean (SD) f=16	Africa Mean (SD) f=12
Composite Rank - Teacher Training Issues					
1	Teachers are not trained in how to specifically integrate online projects into the classroom	3.48 (1.30)	2.81 (1.33)	3.56 (1.15)	4.25 (1.06)
2	Teachers do not feel they are proficient enough to use ICT and computers for collaborative project work	3.41 (1.28)	2.69 (1.20)	3.38 (1.26)	4.42 (0.67)
3	Teachers have not received adequate training in technology	3.30 (1.13)	2.69 (1.20)	3.38 (1.26)	4.00 (0.85)
4	Teachers simply do not know about this teaching practice	3.18 (1.30)	2.88 (1.45)	3.06 (1.24)	3.75 (1.06)
5	Teachers do not see the value of online collaborative project work	2.98 (1.23)	2.50 (1.26)	3.19 (1.11)	3.33 (1.23)
6	Teachers are resistant to changing the methodologies they use to teach	2.93 (1.13)	2.63 (1.09)	3.06 (1.00)	3.17 (1.34)
7	Teachers have a fear of using technology	2.82 (1.17)	2.38 (1.09)	3.19 (1.05)	2.92 (1.31)
Category Mean		3.16 (1.05)	2.65 (1.16)	3.26 (0.96)	3.44 (0.85)
Composite Rank - Technology/Technical Issues					
1	Students have poor computer related skills	3.48 (1.30)	2.81 (1.33)	3.56 (1.15)	4.25 (1.06)
2	Out-dated computers which cannot support ICT and project work	3.41 (1.28)	2.69 (1.20)	3.38 (1.26)	4.42 (0.67)
3	Unreliable internal network within the school	3.30 (1.13)	2.69 (1.20)	3.06 (1.24)	4.00 (0.85)
4	Lack of technical support for computers and ICT	3.18 (0.97)	2.88 (1.09)	3.31 (0.60)	3.42 (1.16)
5	Quality of access with other schools does not allow schools to equally exchange information or support each other's projects	3.09 (1.36)	2.94 (1.39)	2.81 (1.33)	3.67 (1.30)
6	Project work is difficult to accomplish because computers in different schools have different operating systems and software that are not compatible with each other	3.00 (1.26)	2.69 (1.30)	2.88 (1.26)	3.58 (1.08)
7	Students are not interested in using technology	2.98 (1.23)	2.50 (1.26)	3.19 (1.11)	3.33 (1.23)
8	Education software does not allow students to access project work or research sites	2.98 (1.17)	2.50 (1.26)	3.06 (1.06)	3.50 (1.00)
9	Additional subject oriented classes cannot use computers and ICT because it is strictly reserved for use by computer classes	2.93 (1.13)	2.63 (1.09)	3.06 (1.00)	3.17 (1.34)
10	High cost of technology and equipment needed in schools for participating in online project work	2.82 (1.17)	2.38 (1.09)	3.19 (1.05)	2.92 (1.31)
11	Limited or no access to technology such as computers and ICT connections	2.66 (1.20)	2.63 (1.31)	2.50 (1.03)	2.92 (1.31)
12	Persistent technical difficulties resulting in unreliable equipment and connections	2.52 (1.09)	2.38 (1.09)	2.63 (0.81)	2.58 (1.44)
13	Not enough computers and related equipment to support ICT	2.05	1.69	1.94	2.67

	collaborative project work	(1.10)	(0.79)	(0.93)	(1.44)
Composite Rank - Internet Connectivity Issues					
1	Poor, slow, and unreliable connectivity makes it difficult to download and access information	3.09 (1.36)	2.56 (1.26)	3.00 (1.41)	3.92 (1.08)
2	Low bandwidth or congested lines makes it difficult to download and access information	2.93 (1.42)	2.44 (1.36)	2.81 (1.42)	3.75 (1.22)
3	Persistent lack of access – Computers not connected - Lack of electricity to run computers	2.82 (1.42)	2.31 (1.25)	3.00 (1.41)	3.25 (1.54)
4	High cost of connectivity	2.36 (1.10)	1.94 (0.93)	2.38 (0.89)	2.92 (1.38)
Category Mean		2.80 (1.14)	2.31 (1.11)	2.80 (1.13)	3.46 (0.92)
Composite Rank - Curriculum/Program Issues					
1	Projects take too much time to complete given the limited amount of time in the school day and an already full school curriculum	2.98 (1.13)	2.81 (1.22)	3.13 (0.81)	3.00 (1.41)
2	Cultural misunderstandings among the students – Students cannot understand views and perspectives of students in other parts of the world	2.93 (1.09)	2.63 (1.20)	3.19 (0.83)	3.00 (1.21)
3	Preparation for local or national examinations takes precedence in the allocation of time leaving little time for computer related project work	2.93 (0.97)	2.88 (1.09)	2.88 (0.72)	3.08 (1.16)
4	ICT teachers have a workload that is too heavy and do not have enough time to devote to online collaborative project work	2.89 (1.35)	2.50 (1.26)	2.81 (1.17)	3.50 (1.57)
5	Local education agencies (school districts) emphasize traditional textbook learning and has a curriculum that has limited or no emphasis on the use of ICT skills or related projects	2.89 (1.28)	2.75 (1.48)	2.94 (0.93)	3.00 (1.48)
6	Teachers and students simply lose interest over time on projects that take a long time to accomplish	2.86 (1.17)	2.56 (1.31)	2.94 (1.00)	3.17 (1.19)
7	Negative experiences, such as low interaction or no responses from other schools, with past project work	2.84 (1.16)	2.88 (1.26)	2.88 (1.02)	2.75 (1.29)
8	No time for teachers to plan with others teachers involved in projects	2.73 (1.30)	2.13 (1.20)	2.69 (1.08)	3.58 (1.31)
9	Little or no time for individual classroom teachers to plan and initiate ICT projects	2.39 (1.30)	2.38 (1.09)	2.00 (1.10)	2.92 (1.68)
10	Students have too much traditional classroom work – Computer related project work is seen as an extra and has low priority	1.45 (0.87)	1.13 (0.34)	1.38 (0.62)	2.00 (1.35)
Composite Rank - ICT Support Issues					
1	Lack of support for educational technology and ICT on an local educational agency (school district) wide, institutional, or state level	2.75 (1.35)	2.50 (1.15)	2.69 (1.40)	3.17 (1.53)
2	There is little or no administrative support on a local level because administrators do not understand the value of ICT project work	2.43 (1.42)	2.00 (1.26)	2.44 (1.09)	3.00 (1.86)
3	Lack of support by others teachers needed to complete project work	2.07 (1.19)	2.00 (0.89)	1.88 (1.02)	2.42 (1.68)
Category Mean		2.42 (1.18)	2.17 (1.01)	2.33 (1.04)	2.86 (1.51)
Composite Rank – Project Related Issues					

1	Language barriers – Students have difficulty communicating with other students online because they have difficulty communicating in non-native languages	2.57 (1.04)	2.38 (0.96)	2.44 (0.96)	3.00 (1.21)
2	Differences in school schedules influenced by exams and holidays that do not allow for continued participation or support of projects	2.34 (1.10)	2.44 (1.26)	2.13 (0.72)	2.50 (1.31)
3	Time difference between schools in different geographic regions prevent them from having synchronous communication	2.30 (1.27)	2.38 (1.45)	1.88 (0.81)	2.75 (1.42)
4	Available projects are difficult to integrate into the curriculum because they do not fit into the subject matter or structure of the curriculum	2.02 (1.02)	1.69 (0.79)	2.06 (0.93)	2.42 (1.31)
5	Actual projects are not well organized or poorly planned and have no support for schools attempting to work together	2.00 (0.94)	1.81 (0.83)	1.94 (0.77)	2.33 (1.23)
6	Available projects do not have any perceived educational value	1.98 (1.07)	1.69 (0.60)	2.13 (1.20)	2.17 (1.34)
Category Mean		2.20 (0.85)	2.06 (0.80)	2.09 (0.67)	2.53 (1.09)
Composite Rank - Miscellaneous Items					
1	Technology use is dominated by male students leaving few or little opportunities for females to learn skills and participate in online projects	2.59 (1.19)	2.81 (1.28)	2.31 (1.08)	2.67 (1.23)
2	Students will not stay on task to complete project work	2.18 (1.26)	2.25 (1.13)	2.06 (0.85)	2.42 (1.73)
3	Students lack cooperative learning skills and are unable to work together on project work	2.14 (1.17)	1.81 (1.17)	2.19 (0.91)	2.50 (1.45)
4	structure of the school day does not allow the flexibility needed to participate in online collaborative project work	2.11 (1.04)	1.88 (0.89)	2.06 (0.85)	2.50 (1.38)
5	Parents of students have a fear of their children using ICT and are not supportive of online project work	1.82 (1.11)	1.44 (0.63)	1.69 (0.79)	2.50 (1.62)
6	Communication online and in forums is too impersonal for meaningful work	1.73 (1.04)	1.88 (0.96)	1.38 (0.81)	2.00 (1.35)
7	Lack of participation and interaction specifically by teachers within the United States	1.61 (1.10)	1.44 (0.63)	1.31 (0.87)	2.25 (1.60)
Category Mean		2.03 (0.82)	1.93 (0.42)	1.84 (0.67)	2.40 (1.26)
All Barriers		2.67 (0.79)	2.37 (0.77)	2.65 (0.67)	3.10 (0.83)
Note: 1=Not Significant, 2=Somewhat Significant, 3=Moderately Significant, 4=Very Significant, 5=Extremely Significant					