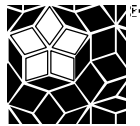


An Investigation of
"Try Science"
Studied On-line and
Face-to-face

Executive Summary

Report by Wynne Harlen and Craig Altobello

**A brief summary of a two-year project
funded by the National Science
Foundation (ESI-9911770) and
conducted at TERC, 2001-2002.**



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Executive summary

1. Aims of the research

The research summarized here was a two-year study, funded by the National Science Foundation (ESI-9911770) of the learning processes and outcomes of *Try Science* studied on-line compared with the same course content studied in a regular face-to-face course. *Try Science* was developed, through collaboration between TERC and Lesley University, as an on-line course. It is the introductory module in a Master's program in science education for elementary and middle school teachers. The whole course has the dual aim of developing teachers' understanding in science and improving their pedagogic skills relating to teaching and learning through inquiry. In the first six sessions of the 13-week course the focus is on learning science. During this time, participants conduct, at home, investigations relating to the properties of ice and water, floating and sinking and dissolving. After a period for reflection on their own learning, the focus turns to thinking about children's learning and to what is required to involve children in learning through inquiry. In the final weeks, the participants apply what they have learned in this model, in designing and teaching a short section of work, which they report and evaluate on-line. After the first week, participants are divided into groups of five to seven and are expected to respond each week to the posts of others in their group. The science and pedagogy sections of the course are facilitated by two different people on-line.

2. Research questions and research design

The purposes of the research was to answer the questions:

- What is the nature of the learning experience on-line and on-campus?
- How do the processes and outcomes of on-line and on-campus compare?
- Are there learning outcomes that are more readily achieved through one form of study than the other?
- What features of on-line or on-campus courses might be incorporated into the other to optimize learning in both situations?

Data were collected about the on-line course in spring 2001 (with 15 participants) and some similar data were also collected about a second on-line course in spring 2002 (with 13 participants). For the purpose of the research a 13-week on-campus course was mounted at Lesley University as an addition to the usual program of professional development courses. Teachers were recruited locally for this course and no attempt was made to assign participants randomly to the on-line or on-campus courses. The on-campus course was taught by one person and ran in the fall of 2001 (with 18 participants). The second on-line course was studied for the purpose of replication and because one of the facilitators was the teacher of the on-campus course, thus giving a little control over the teacher variable.

The extent to which the on-line and on-campus courses were similar in all but mode of delivery is problematic. *Try Science* was "purpose built" for the on-line environment and translating the course material for face-to-face delivery was not straightforward. The weekly course material was spread across the week for the on-line participants while the bulk of the work was concentrated into a three-hour weekly session for the on-campus participants. There were, of course, differences in the mode of interaction (synchronous for the on-campus course and

asynchronous for the on-line course), in the flexibility to adjust the pace of activities to suit participants within a week and between weeks, and also in the role of the facilitator. Thus the research did not deal with a simple independent variable of course mode and is best thought of as illuminating understanding of learning in the two environments.

3. Data collected

Data collected from or about participants in the on-line and on-campus courses related to: their course experience; change in their understanding of the science presented in the course; change in their understanding of the meaning of inquiry in science; change in their view of inquiry teaching; their application of strategies of inquiry teaching and learning in lesson planning and change in classroom practice. Information was also gathered about the experience of the course facilitators.

The methods of data collection made as much use as possible of parts of the course so as to minimize interference with the normal course procedures. Thus "thought experiments," which were part of the course work, were used as evidence of understanding of the science content and the lesson planning embedded in the course were analyzed as evidence of application of the pedagogical ideas introduced. Other data were collected from all participants by pre- and post-questionnaire and by interview after the course. All the posts written by the on-line participants were analyzed and all the sessions of the on-campus course were observed and three sessions were videotaped. In addition, all participants and facilitators kept a log of time spent on the courses and the facilitators were interviewed after the course.

4. Data analysis and findings

This section summarizes the methods of data analysis and the findings for each type of information collected.

4.1. Course experience

The analysis of the posts written by on-line course participants involved categorizing all posts of each participant session-by-session, using a set of categories reflecting the goals of *Try Science*. Comparison of posts in various categories, across participants, for the two on-line courses (spring 2001 and spring 2002) were not significantly different despite having different facilitators. Subsequently, comparisons were only made between the first on-line and the on-campus course, partly because some data for the second on-line course were incomplete. The experience of on-campus course participants was recorded by an observer who was present throughout every session, backed up by the videotape of three entire sessions. Observations were analyzed using the same categories as for the on-line postings so that similarities and differences could be identified.

The results gave evidence that participants in both courses were regularly using science inquiry skills during their science investigations. The main differences in experiences were that on-line participants were involved in reflecting on their learning and on the process of inquiry to a greater extent than the on-campus course participants. There was also greater frequency among on-line participants of application of certain aspects of pedagogy and of recognizing collaborative learning and valuing first-hand inquiry. Records kept by participants of the time

spent on their course work indicated that on-line students spent on average about 7.5 hours per week on the course, about two hours per week more than the on-campus students.

4.2. Change in understanding of the science

In the first half of the course, the focus was on participants themselves conducting investigations of the properties of ice and water, floating and sinking and dissolving. At the end of this section of the course participants were asked to apply their understanding in conducting a "thought experiment," requiring application of scientific concepts that could be developed through the investigations. For the purpose of the research, they were also asked to respond to the "thought experiment" before the start of the course. It was found that the scores of participants on both on-line and on-campus courses improved significantly from pre- to within-course occasions. However, while there was no significant difference between the mean scores for the participants in the two courses at the start, there was a statistically significant difference, in favor of the on-line course, on the second occasion. Thus, while the understanding of the science presented in the course increased for participants of both courses, the change was greater for the on-line course. This difference was also reflected in the participants' perceptions of change in their understanding, which was judged to have been greater by on-line than by on-campus participants.

4.3. Change in understanding of inquiry in science

Change in understanding of the meaning of inquiry was explored through the pre- and post-course questionnaires. The questions asked participants to indicate the extent of their agreement or disagreement with given statements, and to express the meaning of inquiry in their own words. There were few clear differences either from pre- to post-course answers or between courses. However, in questions about their perception of what they had learned, a large majority of participants in both courses recognized that the course had increased their understanding of the meaning of inquiry in science.

4.4 Change in understanding of inquiry teaching

The pre- and post-course questionnaires explored change in participants' view of what is important in inquiry teaching. The change in the responses of the on-line participants were notable in only a few aspects, mainly because of the teachers' initially held views of the importance of key aspects of inquiry teaching. However, changes towards giving less importance to explaining ideas, demonstrating and ensuring correct scientific answers gave some indication of a shift towards giving students more opportunity to work things out for themselves and base their findings on evidence. The changes in these aspects were less marked for the on-campus participants and overall there was considerable consistency between their pre- and post-course views.

4.5 Change in confidence in teaching science

The major change from pre-course to post-course questionnaire responses was found in relation to confidence in teaching science. This change was statistically significant for the on-line participants but not for the on-campus participants. The difference between the pre-course responses for the two groups was not statistically significant while, for the post-course responses, the difference was significant, in favor of the on-line course participants.

4.6 Application of strategies of inquiry teaching in lesson plans and classroom practice

Lesson plans, produced as the culmination of the second part of the *Try Science* course, were analyzed as a measure of application of the ideas about teaching and learning through inquiry. In each course, participants received feedback both from the course facilitator and other participants on their initial plans, which they could then use to revise the plan. Participants then taught the planned lesson to a small group of students and reported on the result. The revised plans and reports of teaching were analyzed using a series of categories relating to the goals of the lesson, the use of the inquiry model, the teacher's questions, and the students' and teachers' actions. Almost all participants in both courses included inquiry skills among their goals and involved students in hands-on activity, in generating data and in making predictions. On the other hand, a minority (less than a quarter) of either course participants involved students in applying the concepts learned or investigating their own questions. A larger proportion of the on-line course participants applied the inquiry learning model and a larger proportion of the on-campus participants asked students questions requiring recall, but overall there were few marked differences between the course groups.

In an attempt to identify change in classroom practice that may have taken place during the course, pre- and post-course lessons were observed for five teachers in the on-line course. Observations were analyzed by applying the same categories used for the lesson plans. It was evident from the results that what could be observed in a single lesson on each occasion did not reliably represent the teacher's intentions and methods and the information gained did not justify the resources needed to visit schools to collect it. Thus classroom observations were not made for the on-campus course or the second on-line course. However, there was some relationship between the aspects frequently included in plans and what was observed in the classroom, both before and after the course.

4.7 The facilitators' experience

Information about the facilitators' experiences was gathered by interview and from records they kept about the time spent. The two facilitators of the first on-line course spent, between them, 16% more time than the on-campus facilitator. The average time spent per week by the on-line facilitators was just over nine hours compared with eight hours for the on-campus facilitator. A great deal of time was spent by the on-campus course facilitator in planning how to organize the content and divide it between the weekly sessions and homework.

The qualitative differences between the experience of an on-line and an on-campus facilitator were investigated by interview of the on-campus facilitator who was also one of the on-line facilitators for the second on-line course. For this facilitator, on-line was thought to be easier and more satisfying, since the course content was already set out week by week and so energy could be focused on helping participants' learning. The on-line course structure was designed to ensure collaborative learning and, perhaps surprisingly, group work on-line was easier to facilitate on-line and was thought more successful than face-to-face. Other on-line *Try Science* facilitators, drawing on their experience of instructing in face-to-face courses, differed in views about some of the relative pros and cons of on-line facilitation compared with on-campus instruction; preference seemed to depend on individual teaching style in this very small sample. The spontaneity and ability to probe individual thinking on the spot, on-campus, was balanced against the opportunity to have more information about the learning of each individual on-line.

Some preferred the more frequent contact with participants afforded by reading their posts, compared with once a week contact in face-to-face courses. Others, however, preferred more direct contact and the opportunity for access to non-verbal signals face-to-face.

5. Implications of the research

To explore implications of the research, the findings were presented and discussed at an invitational conference held on December 10, 2002. The conference brought together 24 researchers, program developers, education technology experts, NSF program directors and professional development providers, from TERC and other institutions. Through group discussions, implications were identified for teachers' learning in science, for professional development through on-line and on-campus courses, and for research. A central focus for discussion was how to change teachers' classroom practice and the difficulties of doing this. Areas needing further research were identified relating to the medium of communication through written language, the role of the facilitator and of participants in on-line courses and issues of change in the seat of power and authority that are raised by an on-line course such as *Try Science*.