Developing a Blended Course for In-Service Science Teachers in India and Its Reception by the Teachers

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Abstract: Interactive Science Teaching is a blended practice-based course for in-service high school teachers offered as part of a large-scale field action project called "Connected Learning Initiative" (CLIx: https://clix.tiss.edu). The course is offered to science teachers from government-run schools from 4 states: Chhattisgarh, Mizoram, Rajasthan, and Telangana. A total of 712 teachers registered for the course. Here we are reporting the process of developing the course and its reception by the teachers. Our main observations are: Of the 2 components of the course, the practice component (implementing exemplary blended pedagogic material) was better received by the teachers. The teachers were enthusiastic during the face-to-face workshop of the blended learning component but did not engage with the online material during the distance period. The reasons given by the teachers for this were lack of time and difficulty in accessing online material. Last, we will document some of the revisions we undertook after the experience of the first run of the course.

Introduction

Continuous professional development is an integral part of any profession. Teachers also need to keep themselves updated throughout their teaching careers in order to perform efficiently. For this purpose, regular teacher-training programs for in-service teachers in the public (government-run) schools are organized by the departments concerned in different countries. These in-service teacher-training programs are expected to respond to the teachers' needs of adapting to changes in curricula, textbooks, or the introduction of new teaching techniques such as educational technology. The programs also help break the monotony of teaching the same content over the years and expose teachers to new ideas. In India, the most commonly used teacher-training model is called *the cascade model*, in which the master teacher educators train the teacher educators who in turn conduct workshops to train the teachers. Every year, the public school teachers in India are provided 20 days of training, which has implications for their job promotion.

This mode of teacher training is not effective. It consists of workshops with teachers that provide sporadic inputs, usually on random topics as opposed to systematic continual support. The training does not focus on helping teachers incorporate useful teaching practices into their regular teaching; rather the workshops concentrate on the discussion of only the theoretical concepts related to teaching science or emphasize the techniques for teaching some specific topics. A detailed critique can be found in (Batra, 2013). This has led to recommendations that online teacher-training courses be developed to increase the engagement period of the teachers and develop an in-depth understanding of particular topics (NCERT, 2016).

In response to such a situation, Tata Institute of Social Sciences, Mumbai (TISS), is in the process of preparing a blended certificate program for in-service training of teachers called Reflective Teaching With ICT (RTICT). This certificate program aims to provide continual input to teachers in a systematic way over two years. The entire program is worth 16 credits and is broken into several courses. In 2017, four courses (of four credits each) were developed and were offered to the teachers in four states of India (Chhattisgarh, Mizoram, Rajasthan, and Telangana) under the field action project the “Connected Learning Initiative” (https://clix.tiss.edu). As with other blended programs, the RTI has both face-to-face and online elements. The program is introduced to the teachers in a face-to-face workshop after which they are supposed to complete the courses in distance mode by accessing the online content. The online content of the program is hosted on a platform called TISSx (www.tissx.tiss.edu), created using the Open Edx. Open Edx is the open-source software platform of the massive open online course (MOOC) platform Edx. Recognizing that teachers teach in their state languages and are more comfortable in communicating in those languages, the program is offered in two languages, that is, Hindi (for Chhattisgarh and Rajasthan) and English (for Mizoram and Telangana). Out of the four courses, one is a foundational course while the other three are subject-specific courses. The foundational course revisits the learning theories and role of teachers in the context of educational technology. It also includes the basics of digital literacy. Interactive Science Teaching is the subject-specific course for science teachers (the other two are subject-specific courses designed for English and mathematics teachers). In this paper, we will present a description of this course, provide the rationale behind its design, and document the experiences after the first run.

Interactive Science Teaching Course

Interactive Science Teaching is a blended practice-based course designed for in-service secondary science teachers. Being a blended course, it has both face-to-face and online components. The course starts with the face-to-face workshop and the teachers are supposed to complete the rest of the course in distance mode in four months’ time. The teachers need to register on the TISSx platform (www.tissx.tiss.edu) to do the course. Teachers can access the platform as a website through their browser or as an app from their Android-based smartphones. The course consists of six units. The first of the five units contain videos, readings, and short activities (e.g., interviewing students or fellow teachers, analyzing certain part of the textbook, etc.) that teachers are expected to do in a sequence. The last unit concerns the student module implementation. A student module is a short pedagogic sequence for teaching a particular topic (usually one chapter of a textbook) and serves as exemplary teaching material for teaching science. All the student modules are blended in nature and hence include both classroom activities as well as digital activities for students. Currently, seven such science modules have been designed. These are hosted on a different platform called the CLIx platform (https://staging-clix.tiss.edu/welcome). Teachers were required to implement only one module to complete the course. Studies about the design and implementation of the student modules are not within the scope of this paper and have been documented separately. The time of engagement expected from the teachers and the corresponding credits are given in Table 1. The structure of the course is schematically shown in Figure 1.

Modality	Unit 1-5 (Blended Learning)		Unit 6 (Student Module Implementation)		Total credits
	# of hours	Credit	# of hours	Credits	
Face to face workshop	21 (3 days)	1.40	0	0	1.40
Online interaction	4	0.13	30	1.00	2.50
Self study	5	011	25	0.56	0.67
Fieldwork	16	0.36	20	0.44	0.80
Total	46	2.00	75	2.00	4.00
Note: 1 credit corresponds to 15 hours of face to face interaction of 30 hours of self study or 30 hours of online interaction or 45 hours of fieldwork.					

Table 1. Time engagement and corresponding credits for the Interactive Science Teaching course.

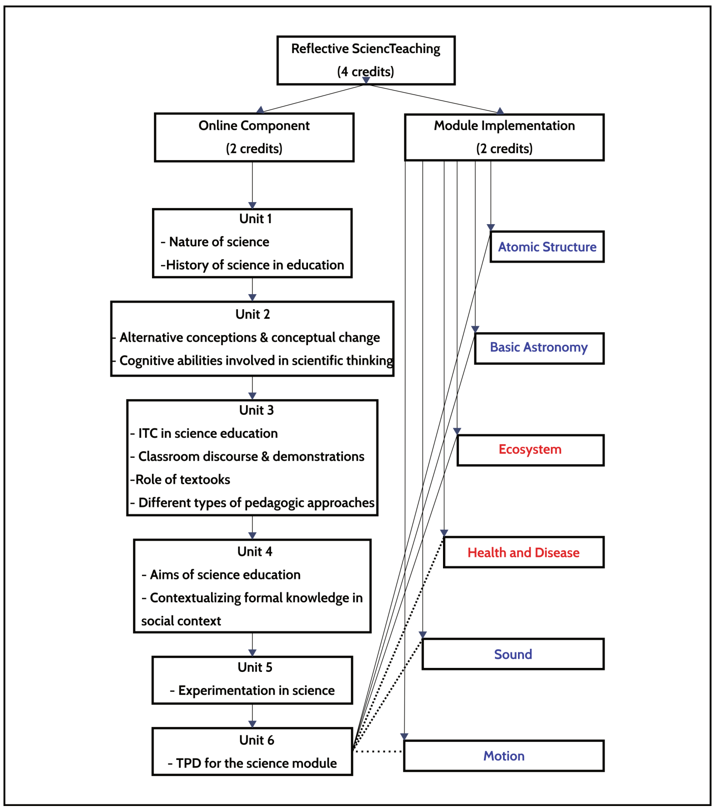

Figure 1. Structure of the Interactive Science Teaching course.
**The dotted blue lines indicate that the support material of these modules for teachers was being prepared at the time of first run of the course.*

The teachers were introduced to the TISSx platform and given a brief overview of the online component during the face-to-face workshop but the main purpose of the workshop was to introduce the student modules to the teachers. Teachers went through the classroom activities and the digital activities of multiple student modules. After the face-to-face workshop teachers were expected to spend another 11 weeks on the course in distance mode. Thus they were expected to spend about nine hours every week during the distance period. The entire course is assessed against 100 points. The assessments included peer evaluation, self-evaluation, and multiple-choice questions (MCQs; see Table 2 for breakdown.)

Participation in the F2F workshop	10 points (self-check)
Implementation of one student module	10 points (self-check)
Responses to MCQs during the course	15 points (15 questions worth 1 point each)
Responses to post-test (MCQs)	15 points (15 questions worth 1 point each)
Peer-reviewed assignments after each online unit	50 points (5 assignments worth 10 points each)

Table 2. Breakdown of assessment.

The Process of Designing the Course

The online component and the student modules were designed in parallel. One of the authors of this paper designed the online component and one of the student modules. The rest of the student modules were designed by experts from different partner organizations. Initially, four units were planned for the online component. The fifth unit was added later by one of the partner organizations to support the student module implementation.

To prepare the online component, we first reviewed some of the science-education courses offered at different institutions. Some of these courses include the course offered to doctoral students at Homi Bhabha Centre for Science Education, Mumbai, and the elective course offered in the MA (Elementary Education) program at TISS (one of the authors of this paper has been teaching the second course). The position paper of the National Focus Group on science education served as a guiding document for designing the course (NCF, 2005). After this review we arrived at the three guiding questions to design this course:

- Why teach science? (aims of science education)
- What do we want to teach when teaching science? (nature of science)
- How to teach science? (pedagogical content knowledge)

The first question was not discussed in the first unit as we reckoned the teachers might not like an abstract topic at the beginning of the course. Rather we decided to start the course with the discussion about the nature of science in the first unit. Teachers' belief about the nature of science influences their teaching practices (Lederman, 1999). It is important to shift teachers' focus from transmitting facts to engaging students in the process of scientific inquiry. This can be achieved by exposing teachers to the history of science (Abd-El-Khalick & Lederman, 2000). Also, the history of science offers stories that help teachers to relate to and look at science as a human endeavor rather than viewing it as a collection of sacred texts. This might help in setting an inclusive tone from the beginning by highlighting the multicultural contributions and contributions from women in science. The unit begins with examples of episodes of development of science. It includes an article about the nature of science. Students' and teachers' beliefs about science are explicitly discussed in this unit.

The second unit is dedicated to the pedagogical content knowledge (Shulman, 1987) of science. It introduces teachers to alternative conceptions, conceptual change, and the importance of different kinds of mental and external representations in science. It also includes an article on some of the key cognitive processes used in science, such as different kinds of reasoning and visuospatial thinking. The third unit is an amalgamation of some of the important pedagogical practices in science education. It includes the use of questioning in an inquiry-based classroom, the role of different tools (e.g., information and communication technologies [ICTs] and textbooks) in science teaching, and introduces project-based learning as an example of innovative pedagogy. In the fourth unit, different aims of science education have been scrutinized. According to the NCF position paper (2005), one of the aims of science education is to relate science to the environment and help students to understand issues in the interface of science, technology, and society. The socioscientific issues are not given much weight in Indian curricula, especially in higher grades (Raveendran & Chunawala, 2013). We discussed the possibility of incorporating socioscientific issues into science lessons through an article. In the fifth unit, the role of experimentation in science has been explored in depth. At the beginning of the course, an introduction has been added that includes a presentation about the course requirements and other course-related details. It also includes the interview of an expert on science education as a keynote. The introduction is not graded. It was covered during the face-to-face workshops.

We invited researchers working in science education to prepare material on the topic of their expertise. Most of them either had a doctoral degree in science education or were in their final stage of doctoral work. Although we had encouraged the experts to use different forms of media, all of them chose to write articles. We printed a handbook consisting of all the articles and gave it to all the teachers, as many of them were unfamiliar with reading from a screen. We mostly relied on the available videos except for one video in the Introduction. Apart from articles and videos, the course consisted of activities such as taking interviews of students or fellow teachers, analyzing students' responses (these were carefully selected or re-created to convey certain points), preparing teaching learning material, and so forth. Teachers were asked to keep a journal to note their observations, opinions, and questions. The breakdown of different kinds of activities is given in Table 3.

Activity Type	Articles	Videos	Other activities	Telegram Activities
Number	11	8	32	13

Table 3. Breakdown of different kinds of activities in the Reflective Science Teaching course.

Role of Community of Practitioners

Communities of practitioners play an important role in professional development (Grossman, 2001). For a large-scale online course, it was essential to create a mechanism through which teachers received support and feedback from their peers. Since the discussion forum on open Edx was not available at the time of course design, and since teachers had better access to smartphones than to computers, we decided to use a cell phone–based app (which also runs on the computer) called Telegram. As Table 3 indicates, many activities in the course required teachers to post on different topics on the Telegram app and they were expected to engage in discussions on those topics. Teachers were encouraged to post messages related to student module implementation as well. Thus the course used connected learning in multiple ways: blended learning, peer assessment, and the community of practice.

Experiences From the First Round of Implementation

The teachers were introduced to the course at the face-to-face workshops. The workshops were conducted starting in July 2017 in Chhattisgarh, Rajasthan, and Mizoram. These were completed by early August. In Telangana, the workshops were conducted in September and October. The courses were expected to be over by December 2017 in Chhattisgarh, Rajasthan, and Mizoram.

Initial Conditions

Teachers were enthusiastic about attending the workshop as they hoped to gain some basic abilities in operating the computers. There was a great degree of variation in their familiarity with the computers. This made guiding the teachers through the student modules at a common pace a great challenge for the resource people. However, when hands-on activities were performed, the teachers could work in teams and each one of them could keep up with the pace of the task.

There were some state-level differences in the teachers' response to the course: In Mizoram, the teachers were interested in implementing student modules but did not want to do the courses under the RTICT program. From the post-workshop feedback, we gathered that the teachers were reluctant to take the courses as the program did not offer guaranteed financial gains or promotion. Also, in Mizoram, the entire teacher group refused to use the Telegram app and instead they insisted upon using their Whatsapp as they were already familiar with the app.

In the other three states, we got mixed responses during the workshop. Some of the teachers were keen on using the student modules as well as doing the course. However, it was noticed that most of the teachers were not motivated to do the course even though they said that they would do it. Only a few teachers from Chhattisgarh and Telangana did the Telegram-related activities and posted comments about the video in Unit 1. But most of the teachers were happy to explore the student modules. Some of them even expressed that more time should be allocated for personal engagement with the student modules.

Changes Made During the Implementation

Initially, we had thought that we would introduce teachers to the TISSx platform and make them take a pretest during the workshop. We expected that they would do the rest of the course on their own. Hence, we kept only one 90-minute session to introduce the TISSx platform while the major chunk of the workshop focused on introducing the student modules. However, as we started interacting with teachers during the workshop, we realized that teachers need more time to understand the navigation on the TISSx platform. Since we introduced both the student and the teacher more or less simultaneously, it was required that the teachers survey both the platforms multiple times to understand the distinctions and connections between them. Thus, after the first four face-to-face workshops (which were held in Raipur, Jaipur, Sirohi, and Aizawl) we significantly increased the time allocated for the introduction of the course during the face-to-face session. We will revise the credit divisions accordingly during the next iteration of the course.

Initially, we had created two different Telegram groups (one for the course-related posts and another for the posts related to the student modules) for Chhattisgarh and Rajasthan. But the introduction of two groups and the two platforms (course and student module) confused the teachers. Hence, the number of posts related to the course was quite low. So we merged the two groups in these two states. We created only one group for Telangana, learning from the mistake in other states.

Teachers did not interact with the course so the time allotted to each unit was increased significantly. As a result the courses did not get completed in the scheduled time.

Challenges

Teachers did not engage with the articles in the course as they found them difficult. They appreciated videos and might appreciate material in other forms, such as audio files, posters, cartoons, and so forth. However, the people designing the material come from academic backgrounds and do not possess the skills required to create such material. Preparing such material with the help of experts in media is time consuming and energy intensive.

Conclusion

During the first round of implementation of the Interactive Science Teaching course, the teachers did not engage much with the online component. The reasons reported are lack of time, difficulty in accessing computers and online connections, and lack of motivation. However, teachers did see the utility in such a kind of course and particularly in implementing student modules. From other sources (not reported in this paper) we know that many teachers implemented modules in the classrooms. From informal interactions with teachers, we realized that the course covers more material as compared to the allotted time and contains many abstract concepts that teachers could not engage with. Hence, for the next round of implementation, we plan to simplify the course by reducing the content and including several concrete examples and practice activities.

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