

CRITICAL SUCCESS FACTORS IMPLEMENTING MULTIMEDIA CASE-BASED TEACHER PROFESSIONAL DEVELOPMENT

Alvaro H. Galvis*

SUMMARY

This document presents research findings concerning Critical Success Factors (CSF)—those few activity areas that deserve special attention to success—implementing multimedia case-based teacher professional development in school districts where this is an educational innovation. Our findings emerge from data collected during the first pilot implementation of the Seeing Math Telecommunications project. This is an initiative devoted to helping elementary and middle school teachers improve their teaching practices by means of reflecting on and discussing relevant teaching episodes, documented as multimedia information. Four U.S. school districts from different regions of the country and with very different characteristics participated in the experience. Each of them, committed to the idea of implementing video case-based teacher professional development, tried to explore it as an educational innovation. A local facilitator, designated by each school district, led the process of appropriating and customizing the idea, as well as of helping groups of teachers benefit from it. Different levels of success institutionalizing video case-based teacher professional development were obtained by participating school districts, as a result of multiple intervening variables. Its study was our research focus. Our research findings are subsets of these variables, those that may make a difference for the success or failure of an innovation at its different stages.

Literature Review

Teacher professional development (TPD) is an effort that can be approached from many different perspectives, with different strategies and tools, obtaining different levels of accomplishment. Multimedia case-based TPD is a particular and promising way of helping teachers grow professionally, and the core of the

* Alvaro Galvis is a Senior Researcher at the Concord Consortium in Concord, MA where he studies the improvement of educational processes through training and communication technologies. He is also Research Director of the Seeing Math project, which strives to improve the quality of mathematics teaching through the use of interactive video cases. E-mail: alvaro@concord.org

Seeing Math Telecommunications Project.¹ In this study we are focused on determining CSF related to the use of multimedia case-based for TPD, which is an educational innovation in many school districts. The following section will elaborate on what the educational promises of video cases are and how these can be used for math TPD. It will consider the different stages of multimedia case-based TPD as an innovation, each of these with specific indicators of success.

Educational Promise of Video Cases

Discussion of teaching cases can make a significant difference in teacher preparation, by helping teachers reflect on their professional practices and reviewing both other teachers' cases and their own documented experiences (Barnett, 1998). A *good case* is "the vehicle by which a chunk of reality is brought into the classroom to be worked over by the class and the instructor. A good case keeps the class discussion grounded upon some of the stubborn facts that must be faced in real life situations. It is the anchor on academic flights of speculation. It is the record of complex situations that must be literally pulled apart and put together again for the expression of attitudes or ways of thinking brought into the classroom" (Lawrence, 1953).

In the past two decades there have been major efforts for creating, using and learning from teaching cases, most of them presented as written narratives and/or videotaped episodes (Barnett, 1998; Sherin, 2003, in press). New kinds of teaching cases have emerged more recently, with the increasing affordability of digital video cameras and mass storage devices by the educational sector, as well as with the growing existence of powerful and user-friendly software for editing and managing multimedia databases (Georgi & Redmond, 2003; Nemirovsky, Lara-Meloy, Earnest, & Ribeiro, 2001; Sherin, in press). These teaching cases integrate multimedia learning resources by using interactive computer-based environments. The user is able to consult relevant texts, images, audios, or videos, and to explore and conjecture from digital manipulatives. The user can also participate in electronic forums that are focused on discussing the case. In this sense these teaching cases are called interactive multimedia cases studies, not only interactive video case studies. It is common now to talk about different kind of multimedia case studies, some of which are digital portfolios that make use of multimedia documents telling the story of a teaching experience (Clark, Neal, & Goeman, 2003; Kelly, Rankin, & de Freitas, 2003; Reilly, 2003; Royer, 2003); others are videopapers that deliver multimedia case-based papers (Nemirovsky et al., 2001). Multimedia-based cases have become a new way of doing Teacher Professional Development and are an important object of study from multiple perspectives in the educational setting (Barnett, 1998; Dexter & Greenbow, 2002; Joint Venture, 2000; Nathan & Kalmon, 2000; Pfeiffer-Childs et al., 2001).

The evolution of the Internet has also contributed to the educational use of digital video cases. It is increasingly common to have high-bandwidth access at school facilities and many educators have home PCs with access to the Internet. In addition, stream-video technologies and CD ROM media, have helped to deliver digital video cases to be discussed by teachers. In this way, it has become possible to create learning communities of teachers that discuss video cases either online,

onsite, or both, as in fact educators are now doing at a growing number of school districts (Barab, Barnett, & Squire, 2002; Barab, MaKinster, Moore, & Cunningham, 2001; Brown Yoder, 2002; Brownyn, 2002; deCourcy Hinds, 2002; Moore & Barab, 2002; Waddoups, Levin, & Levin, 2000; Wenger, McDermott, & Snyder, 2002). In addition, there is a significant² commercial offering of video-case based TPD opportunities, as well as a rising number of teachers who build their own video cases (Barnett & Friedman, 1997; Nathan & Kalmon, 2000) and of school districts that build local collections of teaching cases to be used with TPD purposes (Edens, 2003).

Case-based Math Teacher Professional Development

Basic beliefs about teaching and learning and different needs and circumstances are behind the different ways of doing TPD. The following are some of the assumptions leading our Seeing Math Telecommunications Project, a multimedia case-based TPD opportunity available for school districts.

Twenty-first century societies need to prepare teachers in a significantly different way from past approaches. Educators must be willing to help students develop their potential, rather than simply filling their heads with proved knowledge (Benne, 1982; Mead & Heyman, 1975). Teachers must think of education as a lifelong process—not a mere preparation for future life (Lineman, 1926). Education and learning must be seen as continuous processes of changing our internal structures based on deep processing of external and internal events that challenge our mental and affective structures (Lyndsay & Norman, 1972; Norman, 1980; Piaget, 1970, 1971; Rummelhart & Norman, 1978; Wertheimer, 1944)—instead of discrete events that occur during schooling.

Teachers must appreciate the value of different kinds of learning experiences as a source of knowledge—expositive, active or interactive experiences (Forté, 1997)—finding educational value in multiple media that are available for learning and recognizing a central role for them in the leadership and orchestration of these learning environments and media (Galvis, 1998a, 1998b; Lampert & Ball, 1998). Professional development in this context, like teaching, is to a large extent about decision making—designing optimal opportunities tailored to the unique situation (Loucks-Horsley, 1998) and, as a consequence, it is audience-based.

Multimedia case-based TPD is potentially a unique way of helping teachers grow professionally. Instead of just listening to or reading about good ideas that may help participating teachers improve their professional practice, case discussants and case creators are invited to reflect about teaching practices in which decision making in real time has happened and in which beliefs supporting these decisions can be pointed at.

The ideas outlined above are behind current reform education efforts reflected in teaching standards for the content and processes of mathematics teaching at different school levels. *Principles and Standards for School Mathematics* (NCTM, 2000), for instance, is a national frame of reference for mathematics teaching. Many school districts have adapted or adopted these standards. The Seeing Math Telecommunications Project considers that the greatest challenge generated by the new standards is that their effective implementation requires

teachers to make fundamental changes in teaching practice, acquire deeper understanding of content, and become familiar with technology (Concord Consortium, 2001). Multimedia case-based math TPD seems to be an appropriate avenue for attending to these challenges, and this is the core strategy encouraged by the Seeing Math Project.

Success Innovating and Implementing Educational Practices

According to researchers in educational innovations, an innovation—an idea, practice or object that is perceived as new—follows different stages:

- *Adoption or rejection*, depending on the perceived attributes of the innovation. Adoption of an innovation depends on the decision-makers' perception of five attributes: (a) the innovation's relative advantage as compared with status quo; (b) its compatibility with the individual existing values, past experiences and needs; (c) its simplicity or complexity; (d) the degree to which it may be experimented with on a limited (and safe) basis; and (e) the degree to which its results are visible to others (Rogers, 1995, p. 15 - 16).
- *Implementation* with different levels of use. Implementation moves the organization from non use of the innovation to being prepared for its use, to mechanical use, to routine use, and to refinement (Hall & Hord, 1987). Movement from one to another implementation stage seems to be governed by learning cycles. According to Charles (1990), at each learning cycle: (a) the organization generates visions of the world that help realize alternative paths in which the innovation may fit or not; (b) leaders of the innovation process conceive and organize the next implementation cycle and generate an action plan; (c) cooperation between participating members puts in place the implementation cycle; this leads to results—partial and cumulative—from which the organization learns; (d) reflection about the results, keeping in mind the expected vision and the planned process, leads to satisfaction—or not—of the stakeholders. This process is repeated through consecutive implementation cycles, as long as the innovation adds value to the system.
- *Institutionalization*, meaning continued or expanded use of the newly implemented change or stabilized use of the innovation (Sherry, 2002, p.214). According to Rogers (1995, p.173), “the implementation stage may continue for a lengthy period of time, depending on the nature of the innovation. But eventually a point is reached at which the idea becomes an institutionalized and regularized part of the adopter's ongoing operation. The innovation finally loses its distinctive quality as the separate identity of the new idea disappears.” When an innovation has been institutionalized, “the change is no longer seen as change, but has become ‘invisible’, and is ‘taken for granted’” (Saxl, Miles, & Lieberman, 1989).

Applying the innovation stages to video case-based TPD in the context of a given school district, it is possible to establish success indicators that help realizing how successful has been a pilot implementation:

- Success indicators at *adoption stage of innovation*: The school district decides to offer video case-based TPD to elementary and middle school math teachers.

- Success indicators at *basic implementation stage of innovation*: Elementary and middle school math teachers decide to participate in video case-based TPD.
- Success indicators at *intermediate implementation stage of innovation*: Elementary and middle school math teachers effectively participate in video case-based TPD activities.
- Success indicators at *advanced implementation stage of innovation*: Teachers change their teaching practices in dimensions that reflect lessons derived from video case-based TPD. Changes in teaching practices may generate gains in students learning.
- Success indicators at *institutionalization stage of innovation*: The school district TPD strategy includes expansion and cares about sustainability of video case-based TPD, beyond the pilot implementation.

Critical Success Factors (CSF) are related to those few activity areas of an organization that deserve special attention to success and those whose failure may make the organization fail (Rockart, 1983). We will also look at the relationships between diverse CSF. Those that belong to only one of the positive or negative dimensions of CSF are *operational*; their attention will help succeeding or avoid failing respectively. Those that are included in both sides, positive and negative, become *strategic*, because taking them into consideration leads to success and not taking them into consideration leads to failure (Galvis, 1997, p.210). *Operational CSF* should be considered necessary to resolve, since they may help success or failure in the process; but *strategic CSF* must be considered crucial, since success or failure depends on them. For example, not having access to computers in online education may lead e-learning experiences to fail; but having computers does not mean that e-learning courses will succeed; computer access is an operational CSF in e-learning. Not having a good online facilitator will make an e-learning course fail, but having a good facilitator will help participants have a good learning experience. The quality of the facilitator is a strategic CSF in e-learning.

With this in mind, and considering that there are different levels—or stages—of an innovation, the focus of this study is to establish those few key elements that may help school districts succeed improving teaching practices with the incorporation of multimedia case-based TPD, or fail in this effort if these factors are not considered.

Context for the Study

Four U.S. public school districts accepted an invitation from the Concord Consortium to participate in the pilot testing of an educational innovation, multimedia case-based teacher professional development. These school districts shared an interest in reformed math education and were technologically ready to benefit from interactive video cases. The math coordinator at each of the participating school districts became the local leader of the innovation process, assuming the role of local facilitator for the Seeing Math (SM) courses. The project offered face-to-face and online seminars on facilitation of multimedia case-based teacher

professional development to local math coordinators and provided continuous support concerning the use of the Seeing Math courses.

The Seeing Math project prepared a portfolio of nine multimedia cases³ dealing with math education topics that are hard to teach or learn at the elementary level (grades 3-6). Each case includes a set of short video episodes that tell a teaching story. Elementary math educators that teach math according to NCTM standards were videotaped in classroom sessions, as a base for creating the stories told as multimedia teaching cases. Video episodes are accompanied by a comprehensive set of surrounding materials that help to understand the context of the case, to dive into the activities in which the students were engaged, as well as to focus on content-, pedagogy- or language-related issues that are behind the case. Reflection and discussion seeds are proposed for each of the video episodes and at the end of the case study. In addition to project-created multimedia cases, the project generated a tool for teachers to create their own video cases.⁴

Local facilitators were encouraged to build their own models for offering Seeing Math courses, attending to their own district's teacher professional development strategies. This allowed the project to explore and learn from several blended (face-to-face and online) implementation models created by the local facilitators. Online discussions were held using Teachscape's interactive platform,⁵ which allows the participants to articulate asynchronous discussions with case reviewing and to organize forums in public or private discussion spaces. Face-to-face discussions were held at each participating pilot site, at each group's convenience. Participating teachers had access to computers and Internet both at their school building and at home; each of them received a set of CD-ROMS that helped properly set up their machines for viewing and discussing the cases. A CD-ROM copy of the videos for all of the cases allowed participants to overcome bandwidth limitations of their Internet connection.

Study Methods

This study's goal is finding those few activity areas that make a difference for success or failure at the different stages of multimedia case-based TPD. In order to solve this question we broke the problem into five subproblems, trying to find for each one of the five stages implementing an educational innovation, what the corresponding CSF were, that is, those few aspects that make a difference in achieving success at the corresponding implementation stage. We collected data from different sources, as follows:

- At *adoption or rejection stage* of SM: oral and written communications with school district superintendents or math coordinators from school districts that were originally part of the SM proposal.
- At *basic implementation stage* (teachers want to participate) of SM: log data from courses offered using Teachscape course delivery platform by school districts to teachers during the pilot experience. Oral and written reports from math coordinators at SD1, SD2, SD3 and SD4 concerning incentives, recruitment strategies, organizational and situational variables, its effects and relevance.

- At *intermediate implementation stage* (teachers effectively participate) of SM: content and statistical analysis of online interactions and final products generated during SM courses offered by the different school districts from January 2002 to June 2003; written documentation of face-to-face interactions during SM courses; oral and written reports from local facilitators concerning the implementation of SM courses at their school districts.
- At *advanced implementation stage* (teachers change their teaching practices according to lessons derived from SM cases; students gain with these changes) of SM: content analysis of online interactions and final course projects, as well as written feedback from teachers and facilitators. Action research was done in cooperation of the external evaluator with volunteer teacher in SD2.
- At *institutionalization stage* of SM: reports from school district facilitators concerning expansion and sustainability of the project at different moments.

In addition, a survey was conducted at the end of the 1½ year pilot experience. We asked the following two questions to each of the four school district onsite coordinators:

- TO DO. What must I, as a local facilitator, or my school district's Teacher Professional Development system as a whole, do extremely well in order to be successful in implementing video case-based TPD programs?
- NOT TO DO. From the reverse side, in which aspects of video case-based TPD can I, or the school district, not fail, because it would lead the innovation to fall flat?

Study Findings

This study is focused on establishing those few aspects that make a crucial difference in implementing multimedia case-based Teacher Professional Development (TPD) as an innovation at a given school district. We are interested in establishing Critical Success Factors (CSF) related to each of the stages of this kind of innovation. They are interdependent: if the innovation is adopted, it can be implemented; if it is properly implemented, there will be powerful reasons for its expansion; if this happens and a critical mass is impacted, the innovation will become institutionalized. Institutionalization leads the innovation to end its "innovative" condition and become part of the normal culture of the institution.

We have organized our findings considering the adoption, implementation and expansion stages of an innovation. We have disaggregated the second stage in three sub-stages, since implementation can be broken into recruitment, participation, and impact on educators and students; any of these sub-stages is determinant for a successful implementation but at different levels.

As mentioned before, CSF are those few activities that deserve special attention for a process to be successful or not to fail. We will look at both dimensions of the concept, the positive and negative: what do I need to do extremely well in order to be successful? and, in which aspects can I not fail because they would lead the process to fall flat? We will also look at the relationships between aspects that belong to only one of the positive or negative dimensions of CSF, these are *operational*, that is, their attention will help succeeding or avoid failing depending on

the side in which they are. On the other hand there are those aspects included in both sides, which we call *strategic*, because taking them into consideration leads to success and not taking them into consideration leads to failure. *Operational CSF* are urgent to care about, their attention may help succeeding or failing in the process; but *strategic CSF* are crucial to consider because success or failure depends on them.

CSF Related to Adoption or Rejection of Multimedia Case-based TPD by School Districts

We found three CSF related to this initial stage. For multimedia case-based TPD to be properly adopted at a given school district there must be organizational readiness, pedagogic alignment and institutional support for TPD opportunities.

- Organizational Readiness

Not all school districts are organizationally ready to implement multimedia case-based TPD. As it was mentioned in the context of the study, from the twenty pre-committed school districts that were initially interested in the SM project, only four signed up as pilot sites. The basic reason was that the project award, its budget being significantly less than expected, did not allow the project to assign resources for technology enhancement or project coordination at the interested school districts. School districts that had appropriate computing and networking capacities at their school buildings, that could afford a math-education leader devoting at least half time doing SM-based TPD, and that could offer the appropriate incentives for teachers to participate in the project, were able to participate. These three conditions were necessary to adopt the project but their accomplishment was not enough to make school district authorities decide to participate in an innovation such as SM.

Organizational readiness is an operational CSF. If there is organizational readiness the project will not necessarily be adopted, however it will be rejected if there is not.

- Pedagogic Alignment

Math coordinators at the school districts were in charge of confirming (or not) the willingness to participate in the project. They and school superintendents got letters of invitation explaining the basic ideas behind the project, its strategy, benefits and participation requirements. Two of the math coordinators requested further information concerning the foundations, philosophy, and pedagogy of the project before proceeding further. In one case this philosophical orientation led the school district not to participate because the math coordinator deemed that they could not afford changing the non-reformed curricula they had in place. On the other hand, SD2 math coordinator found that participating in SM would help her school district succeed in the curriculum adoption process in which they were engaged. SD1 facilitator was the change facilitator of a transformed school in which reformed education had been adopted. SD3 was already implementing

reform-oriented math curricula. SD4 supervisory union had in place three math programs with similar goals and pedagogy, tuned with the project.

Pedagogic alignment between the project and the math education orientation of potentially interested school districts is a strategic CSF. If there is not pedagogic alignment the project is likely to be rejected, if there is pedagogic alignment the project is likely to be adopted.

- Institutional Support for Offering SM TPD Opportunities

The adoption of a project by a school district is more than the administrative act signing in for participation. The adoption of an innovation requires creating conditions needed for a successful implementation. The school district facilitators examined the role of this institutional support as they shared their perceived CSF implementing SM TPD.

SD2 facilitator expressed that “a solid commitment to project success from both the facilitator and the district is the key.” In her words, “the video case-based professional development needs to be regarded as integral part of a cohesive district professional development program, not just ‘one more added thing’ .” SD2 successful participation was due, in part, to the committed adoption of the project; it meant not only that the courses were in the school district catalog but also that appropriate incentives and participation conditions were created.

SD1 facilitator offered a complementary vision of the above idea when she mentioned that “first and foremost, the facilitator must have the capability of getting [the video case-based] course approved on the school system professional development calendar in a timely manner, since it is imperative that the facilitator has the capability of getting the course scheduled or else the course can’t go on.” The lack of commitment of the SD1 math TPD coordination with the SM project not including SM TPD courses in the district catalog was in part the cause of limited participation of teachers in the initial courses, while commitment of the SD1 teacher-union including SM TPD in their catalog was a key factor involving teachers in the final course, since they supported the accreditation that teachers were expecting.

SD3 gave a third view of the required institutional support on the part of the school district. He stated, “It might be necessary to have the video case-based program be the centerpiece of the school district TPD program. When it is an add-on or when it is part of a very full TPD program it can be very tricky to sustain interest. Adding video case-based TPD to a very full TPD schedule could very easily over saturate a district with TPD opportunities. Too many choices in a small school district will likely mean that the overall TPD program could lose its focus”. This explanation helps understand what happened in SD3, in which there was organizational readiness and pedagogic alignment with the project but it did not engage a significant number of participants. Possibly, this was the result of the project not having a higher priority in the school district and of having too many competing projects.

Institutional support for offering SM TPD opportunities becomes a strategic CSF. Without this kind of commitment the TPD project will not be fully adopted.

CSF Related to Teacher Recruitment for Multimedia Case-based TPD

Recruiting teachers for multimedia case-based TPD is a challenging activity. The relative novelty of using multimedia digital resources for TPD, as well as the use of a relatively new format in education (case-based discussions), may help motivate certain groups of teachers, as it was the case of participants in the collegiate course. On the other hand, through the use of blended learning environments it is possible to overcome situational barriers related to time and space for learning, provided that technological barriers do not interfere with online interaction. These reasons are not enough for recruiting teachers. Participation in multimedia case-based TPD is demanding and participants must be conscious that they need to accomplish individual activities (e.g., review and reflect on video episodes and surrounding materials, document and reflect on classroom activities related to the case, develop a final project), as well as group activities both onsite (participation in course meetings) and online (participation in local and public discussions). Motivating people to participate and engage them in these processes require more than access to excellent multimedia educational materials usable in a blended and flexible format.

We found two CSF concerning teacher recruitment for multimedia case-based TPD: Finding the appropriate incentives and configuring a program that sells.

- Finding Appropriate Incentives

Appropriateness of incentives requires knowing the teachers and their personal and professional needs within the context of the external motivators for professional development applicable at the school district.

The first group of teachers, those that took part in the collegiate course, did not require incentives for their participation. They were internally motivated by the possibility of exploring this alternative and trusted the facilitator who invited them to try. Some of these teachers, from SD2, had the possibility of getting graduate credits and seat hours or monetary compensation for the seat hours, but they did not accept it. However these incentives were successfully used in SD2 in the rest of SM courses; teachers paid for the graduate credits with the money they got from seat hours, and they made use of the credits for their professional career. SD4, on the other hand, did not use incentives; according to SD4 facilitator teachers in SD4 are not interested in graduate credits because they are required to gain only seven credits every nine years. However SD4 middle school teachers need to be qualified according to NCBL requirements, which entails passing the Praxis exam or having math as a teaching major. SD4 tried recertification credits, conference attendance, release time, and Yahoo gift certificates, but according to the facilitator only the last two were modestly successful. SD3 offered SM participants the same kind of incentives that other math TPD programs offered, in the context of full support on the part of the school district superintendent, but only a few teachers bought the idea. At the end of the final course of the pilot experience, SD1 teachers got 45 seat hours and three recertification credits given by the teacher union TPD unit. According to SD1 facilitator this was a determining factor in student-teachers taking the course.

Finding appropriate incentives becomes a strategic CSF. If the school district fails to offer them, teachers do not participate in TPD, but if they are available it is possible to obtain a reasonable number of participants.

- Configuring a Program that Sells

Motivating teachers to register for a course requires finding opportunities that fill participants' learning gaps and that match the situational conditions of potential members with the possibilities of the program. As a general principle of adult education this is a rule of thumb. Making it operational brought to the surface two dimensions—course selection and syllabus definition.

- Course selection and sequence

SM has nine cases organized around four NCTM 2000 standards; a course facilitation guide and the corresponding participants' guides accompany each case. Facilitators' initial training includes reviewing the different cases and exchanging ideas concerning their potential value from content and pedagogy perspectives. It is left to the facilitator's initiative to find out what case (or cases) are convenient to a given teaching community, why offer them, to whom, when and how.

Division with Remainders was the SM course most frequently used. Reasons for its selection were of two types: it was important that the teachers felt comfortable with the content of the initial course as well as its offering common problems on the teaching of mathematics at elementary and middle school level. In addition, facilitators felt that questioning strategies were central in this case and that reflecting on their use teachers could change their teaching approach.

Prealgebra: Pan Balance Equations was offered by SD3. TPD at SD3 each year focuses on a certain topic, and Algebra was the topic of the year 2002-03. Middle school teachers were particularly interested in studying pre-algebra and were the predominant group recruited. There was one high school and no elementary teachers participating.

A sequence of three SM courses—*Using Data to Make Predictions*, *Calculating the Area of a Triangle*, and *Pan Balance Equations*—was offered to SD4 teachers through the school year 2002-03, organized in such a way that teachers could be prepared for teaching these topics by discussing the case before teaching the corresponding unit. A small group of teachers were recruited for the three courses.

Making the right selection of SM courses and sequencing them properly may motivate teachers to register for multimedia case-based courses; failing in course selection may lead not to recruit teachers or to recruit only those extrinsically motivated. It is a strategic CSF.

- Syllabus definition

At the beginning of the pilot experience course coordinators defined course syllabi with their own style and with different levels of specificity. However, by the end of the pilot almost all course syllabi adopted SD2 course syllabus model.

Facilitators realized that teachers needed complete specification of goals, duties, requirements and timeline; and all this must be viable. As SD1 pointed out, “The facilitator must develop a course syllabus so that participants are clear on requirement and course guidelines to include assignments and dates of implementation. Just like the students we teach, teachers need clear, concise information as well. . . . Cannot make expectation of coursework unrealistic. Teachers have a busy schedule and must not be made to feel that overwhelmed with assignments.” [SD1]

Making a complete, clear and realistic definition of course syllabus does not make teachers engage in a course; but failing in this definition generates doubts that negatively affect recruitment. The syllabus definition is an operational CSF.

CSF Related to Effective Participation of Teachers in Multimedia Case-based Courses

Participation in SM courses meant more than attending face-to-face meetings, posting online at least twice per week and delivering a final project. These events were valued if there was value added to the discussion with original ideas or comments on other teachers’ postings, if reflections were grounded on the video case or on their own experiences, and if there was transference of concepts and principles from the case to classroom activities. We found the following CSF related to participation: technology readiness, face-to-face meetings, building trust and organizing discussions, and giving support to a community of learners.

- Technology Readiness and Readiness to Technology

Technology readiness was one of the pre-conditions to participate in SM. Teachscape gave check lists and technology assessment tools to local facilitators and was ready to help verify the appropriateness of computers to be used by teachers at the school buildings; in addition, Teachscape sent facilitators as many CD ROM sets as participating teachers, to help them have the required software at home including local copies of the videos, in case the internet bandwidth was not good. Theoretically technology was not a problem. However, at least in one school district that was not the case. SD1 managed to organize the face-to-face meetings at the computer lab of a school building conveniently located for participating teachers. In spite of this, at the first meeting it was evident that not all the machines were ready to use, that there were network security problems to be solved, and that part of the group of teachers did not have email addresses. The course was initiated three weeks later, when the preconditions were achieved; this required solving technical problems and, more importantly, introducing a group of teachers to computers and Internet before reinitiating.

Readiness to use technology was not only an issue from the part of novices in computer use. SD1 facilitator considered that “the facilitator must be computer literate and be able to respond to participants concerns and issues as they arise. Some participants are not computer literate and need guidance from the facilitator” [SD1]. In addition, SD2 facilitator realized that teachers appreciated the “user friendly” qualities of Teachscape site but that it was not enough. She wrote that “participants need a comfort level with technology and computer access both at home and at school” [SD2] and consequently she decided to devote the first face-

to-face session of all her SM courses to help teachers explore and use Teachscape site comprehensively and effectively.

Technology readiness and readiness to technology is an operational CSF. If it is not present it may lead the experience to fall flat, but if present it does not mean that participation is ensured.

- Face-to-face Meetings

When the SM project began we did not have a clear sense of the role of face-to-face meetings for trust building and as a complement to online interactions. Practice showed us that they were crucial for engagement and participation. Teachers who are not used to studying alone or to studying online feel that face-to-face meetings help them manage the process through direct interaction with others in a well-known format. “Failing to provide opportunities for face-to-face conversation between participants in the district will help to diminish interest in the project” [SD3]. We found that in face-to-face meetings teachers felt freer to participate, more spontaneous, and more “themselves.” With the exception of SD4 these meetings stimulated teachers’ online participation because they created a space to share their impressions on what had been said via digital forums. Face-to-face sessions were also a means to “check” with each other before initiating new posts. Another contribution of face-to-face meetings was to articulate links between the local reality of the school and the postings coming from other schools and experiences.

Two major onsite/online blending formats were tried through the first pilot implementation, in order to offer courses with N (N= 5 or 6) teaching examples (video episodes): (1) N+2 face-to-face weekly (or biweekly) 2-hour or 3-hour sessions (one opening session, one closing session, and N discussion sessions) with N weeks with online discussions, as it was the case of SD1, SD2 and SD3 courses; (2) in SD4 they scheduled a one-day face-to-face introductory meeting and individualized meetings at each teacher school building for fostering reflection and participation in online discussions. This last format neither generated the expected results in terms of helping teachers participate in online discussions, nor did it contribute to building a community of learners, since interaction was one-to-one with the facilitator. On the other hand, weekly meetings were found more effective than biweekly meetings, in terms of keeping the pace and the level of participation in the discussions.

Face-to-face meetings are a strategic CSF in multimedia case-based TPD, they make a difference concerning participation both in face-to-face and online discussions. If the facilitator includes them and uses a format that helps interacting and reflecting, making links with online activities, both face-to-face and online discussions may progress. If the facilitator does not organize frequent and efficient face-to-face meetings it is very likely the participation will suffer.

- Building Trust and Organizing Discussions

A course delivery platform such as Teachscape’s offers the possibility of having both local discussions at the school district level and/or public discussions at the project level, this depends on the virtual space that is used for the interaction.

Participation of teachers in online discussions—posting at the different interaction spaces—seems to be related with how comfortable teachers feel expressing their ideas in writing for a virtual space and before a distributed audience as well as with how well organized the discussion is.

Facilitators did many things to build trust, with different results. SD1 facilitator decided to offer her last course at her school district private space and spent three weeks building community while teachers were acquainted with technology. It worked out but the interaction was limited to the school district participants. SD2 facilitator used both private and public spaces in all of her courses, but she changed the organization of discussions from one to another course. At the beginning of the pilot experience she used both spaces to keep mathematical and social discussions, differentiated by the scope of the discussion (local issues at the local space, global ones at the public space). At the end of the pilot she used the private space during the first and the last week of the course, since both discussions were around local practices that initially served to dive into the case, and at the end to build knowledge based on final projects. Discussions during intermediate weeks of the course were held at the public space and nurtured the local group with participation from other school districts. SD4 was not able to motivate their teachers to post online, regardless of the fact that they were following the public discussion and commenting in private with the facilitator. “When I questioned a couple of teachers they expressed a strong inhibition about posting things ‘where anyone can read’. They seemed to feel that they would embarrass themselves with their postings... People are reading what is posted at Teachscape’s discussion area, but they are not posting. Should I consider ‘lurking’ as participation?”

Building trust and organizing online discussion spaces are strategic CSF. If a building trust strategy is implemented with the corresponding organization of online discussion spaces, this may help teachers feel comfortable posting at the local and distributed discussion spaces. Not doing so may make online interaction almost impossible.

- Giving Support to Communities of Learners

A community of learners is healthy when its members feel comfortable and participate actively in the different discussion spaces. We realized that building trust facilitators made a difference by monitoring indicators of participation (onsite and online contributions) and by giving support to teachers when the level of participation was lower than expected. “Facilitators need to address individual teacher needs and concerns through additional assistance via e-mail, telephone, or personal contact. Teachers need to know that if they need help, it’s available” [SD2]. “Supporting teachers who participate by encouraging them to post online and to contribute to the face-to-face discussions will increase the success of the project. A lack of communication between the facilitator and the participants will contribute to the lack of success” [SD3].

Monitoring participation indicators and giving support to learners when needed is a strategic CSF. The closeness of the facilitator to the participating teachers makes a difference.

CSF Related to Learning Gains Attributable to Participation in Multimedia Case-based TPD

A multiplier such as the implementation of SM in participating school districts (the project trains facilitators, they train teachers, teachers teach students), needs to ensure that key actors—facilitators and teachers—are properly prepared to assume their roles. In this sense, the continuing preparation of facilitators and the creation of communities of practices became CSF.

- **Continuing Preparation of Facilitators**

The project offered facilitators two initial seminars, one face-to-face and one online, in order to help them feel comfortable with the multimedia cases produced by the project and with the inquiry-based pedagogy behind them. Through the process we realized that periodic feedback and support on demand made a qualitative difference.

After we found out that grounded discussions were almost absent from initial online dialogues, facilitators and staff members of the project realized that the initial training had missed this topic. SD2 facilitator said “it would have been helpful to have had a discussion at the winter meeting about the level of discussion you were anticipating or “aiming” for. As facilitators, we could have framed questions to support and encourage dialog around connecting specifics of the case with classroom practice.” The topic was discussed in an online forum with facilitators and grounded discussions became the focus of two publications that have served for future work with facilitators (Galvis & Nemirovsky 2003; Nemirovsky & Galvis, 2003). This helped posting discussion seeds that invited to relate case content with classroom practices.

Facilitators felt the need for additional support while moderating online discussions. The project had given them an initiation to online facilitation and a reference book, but some facilitators felt that discussions were not always threaded, that collaborative building of knowledge demanded special moderation skills, and that inquiry-based knowledge construction required more than creating good discussion seeds. SD2 facilitator requested coaching from an experienced facilitator from Concord Consortium; in response, during one semester the coach had access to the content of the discussion and to postings to be proposed by the moderator. A closed dialogue between the facilitation coach and SD2 facilitator helped SD2 facilitator master moderation of online discussions, as it is evident in the data. Based on this positive experience the project has incorporated coaching to new facilitators during the first course they offer on the part of an expert in online moderation.

Periodic face-to-face meetings with facilitators (one per semester) served a very important function concerning building knowledge based on lessons learned. In each of these meetings onsite facilitators shared their experiences, challenges and solutions; project staff members had the opportunity to understand emerging situations and to coordinate support activities from different perspectives, including technology, pedagogy and logistic.

Continuing preparation of facilitators is a strategic CSF. It allows facilitators to appropriately lead those functions that make a difference. When this kind of

ongoing support is not possible, needs felt by facilitators remain unattended and the quality of the process suffers.

- **Creation of Communities of Practice**

In reference to type “H” postings, (remarks related to changes in teaching practices) we note that in a school year in the same school district, through SM courses offered by the same facilitator, the percentage of H-type academic postings (type A.H) increased from 2.41% (SD2-Division with remainders, Fall 2002) to 7.43% (SD2-Division with remainders, early Spring 2003) and to 9.91% (SD2-Fractions, late Spring 2003). Differences between the last two percentages could be attributed to participation of SM-experienced teachers (i.e., 8 out of 20 teachers had taken Division with Remainders), but near 5% of growth cannot be attributed to this cause. It was a result of the active work of the SD2 facilitator for creating communities of practice, in which teachers share and reflect on their teaching experiences, and feel comfortable sharing what happens in their classroom. It is clear that teachers changed their mind and their practices because of the participation in SM courses. They felt comfortable trying in their classroom what they found valuable in the teaching cases, they acutely reflected on their own practices and opened to dialogue with colleagues.

The creation of communities of practice is a strategic CSF. Including creation of communities of practices in the intention and strategy of SM courses can help to make a difference in terms of teacher changes; leaving them out of the academic agenda may result in very low application of ideas and reflection.

CSF Related to TPD by Means of Teacher-created Video Cases

Reviewing the two cycles of TPD at SD3, where teacher-created video cases were the focus of the TPD experience, we realize that two CSF were evident: readiness to technology and building communities of practice.

- **Readiness to Technology**

One of the great differences between the first and second generation of teacher-created video cases was the effort needed on the part of teachers to create multimedia cases. In the first round staff members from the project dealt with the technology aspects while the participating teacher and her coach—SD3 facilitator—worked collaboratively reflecting on her video-taped classroom experiences creating the story and documentation to build the case. Both teacher and SD3 facilitator found this worth doing. In the second round, the project asked participating teachers and facilitator to appropriate VPB2 and to assume also the technical production of video cases. Technology was a hurdle that required support from the part of the project and a lot of effort from participant teachers and SD3 facilitator. Teachers found that VPB2 was an excellent tool for creating a story that synchronizes video, hypertexts and still images, but was not powerful enough for editing the ingredients using a single tool (videos, hypertexts and images need to be prepared with separate tools in VPB2); and teachers struggled with these multiple tools. As a consequence two actions were taken: VPB3 is in design, with

increased functions that will make easier for teachers to create video cases, and SD2, the other group producing video cases in SM, has integrated tech support members to the production of video case.

Readiness to technology on the part of teachers to create video cases is an operational factor. If teachers know how to use the different technologies needed to create a video case, building video cases is less difficult and problematic. But the quality of the video cases does not depend on the technology in use but on the reflective practice generated by their creators.

- Working as a Community of Practice

Three teachers, SD3 facilitator and SD3 math coordinator met periodically to work as a group in the creation of video cases. Working as a group did not mean, however, that participants became a community of practice. The two teachers that completed their video cases felt very isolated in the creation process—it became their personal effort—while group meetings were useful for coordinating ideas, solving problems, and getting feedback; group meetings were not occasions to collectively reflect on their teaching practices and to collaboratively build knowledge from it. This lead teachers to assume the creation process as a personal endeavor. Teachers grew professionally, but the effort on their part was enormous.

Working as a community of practice in the creation of video cases becomes a strategic CSF. If it is present it leads to collaborative creations, if not, to individual creations. Both types of creations are important, but a culture of collaboration makes a difference when teachers use inquiry-based collaborative approach. In the words of SD2 facilitator “districts need to have fostered a value and appreciation for collaborative teacher work environments” [SD2].

CSF Related to Expansion of Multimedia Case-based TPD at the School District Level

A district philosophy and Professional Development plan that emphasizes sustained, on-going teacher learning is key [SD2].

The literature on innovations says that “a successful pilot experience does not ensure by itself a successful institutionalized experience” (Sherry, 2002). In order to survive beyond the limits of a parent project, innovations need to create the means for their autonomous expansion. In our experience school districts have explored three innovative directions:

- Some school districts have expanded their facilitation group with teacher leaders that help with video case-based TPD. Otherwise, it would not possible to scale-up the program. This was the case of SD2, where they created a parallel community of learners, with math teacher leaders from each school building, that explored the value of different ideas behind the nine cases and used selected video examples to help their math teachers with the discussion of specific events. This generates culture of case discussion among teachers. Two of these teacher leaders took two cases and participated in the next facilitators’ training, so SD2 is able now to offer more than one course in parallel.

- A similar phenomenon happened in SD3 concerning the use of classroom videotapes as source for reflection. The math coordinator joined the group that was creating video cases, and math teacher leaders from the different school buildings were invited to presentations about the process and product of the first round. As a result the school district expanded its videotaping capacity and acquired more computers where video editing could be done, as a means of inviting math teachers to become members of communities of practice.
- SD2 has matched a project focused on helping students with math projects, in which teachers videotape every intervention, with the creation of video cases. This synergy helps motivating teachers who see video-based reflections as a normal part of their teaching and video case creation as a value added to it.

Final Remarks

The preparation of this article has been a way to understand the key issues that are behind the implementation of an educational innovation such as Seeing Math multimedia cases. In essence, it is not the innovation itself that makes the difference, but the way CSF that affect different stages of the innovation process are taken into consideration. Seeing Math multimedia cases are resources that can help teachers reflect on other teachers' and on their own practices; however, each math TPD leader in each school district needs to figure out how to create the appropriate conditions for successful implementation. Our findings need to be adapted to the local context and the TPD strategy that each school district has in place. Building on the synergies and on the differences between existing TPD practices and what SM resources offer may generate new avenues of TPD worth exploring.

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RESUMEN

Este documento presenta resultados de investigaciones concernientes a los Factores Críticos de Éxito (Critical Success Factors-CSF)—aquellas pocas áreas que merecen atención especial para el éxito—al usar estudios de caso multimedia para desarrollo profesional docente en escuelas donde esto es una innovación educativa. Nuestras conclusiones o resultados emergen de información recolectada durante la primera implementación del proyecto de telecomunicaciones “Viendo Matemáticas”. Esta es una iniciativa dedicada a ayudar a docentes de escuelas primarias a mejorar sus prácticas de enseñanza a través de la reflexión y la discusión de episodios relevantes de enseñanza, documentados como información multimedia. Cuatro distritos escolares de diferentes regiones de los Estados Unidos y con muy diferentes características participaron en la experiencia. Cada uno de ellos, comprometidos con la idea de implementar video casos para el desarrollo de docentes como una innovación educativa, trató de explorar estas prácticas educativas. Un facilitador local, designado por cada distrito escolar, dirigió el proceso de apropiar y moldear la idea, así como ayudar a que los grupos de docentes se beneficien de ella. Se obtuvieron diferentes niveles de éxito al institucionalizar desarrollo profesional docente con apoyo de video casos. El estudio de las variables intervinientes fue el foco de esta investigación. Los resultados de la investigación son un subconjunto de estas variables, aquellas que pueden hacer diferencia para el éxito o fracaso de una innovación en sus diferentes etapas.

NOTES

1. The *Seeing Math Telecommunications Project* is funded by a grant from the United States Department of Education to Concord Consortium, #R286A00006. The project creates multimedia math teacher professional development case studies and explores the impact they may have on math teaching practices and student learning.
2. See, for example, <http://teachscape.com> or http://www.riverdeep.net/pro_development/index.jhtml or <http://www.intel.com/education>
3. See previews and short explanation of the nice cases at <http://seeingmath.concord.org/screenroom/>
4. Go to the VideoPaper Builder site at <http://vpb.concord.org>
5. To know about Teachscape go to <http://teachscape.com>

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