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# Online Learning in Mathematics Education: A Review of the Literature

# Sarah DeLeeuw

# George Mason University

# EDCI 857

# Dr. Suh

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Entering the phrase ‘mathematics learning online’ into the Google search engine returns more than four million seven hundred and ninety thousand hits! Several are math help sites – some that include video tutorials, several are courses and textbooks, and several are teacher resources – applets or simulations to use in creating engaging lessons for the classroom or opportunities to take part in professional development, join forums, or get graduate credits to maintain accreditation.

The internet is making knowledge more accessible for both students and teachers. What follows is a review of the literature. The database ERIC was used to search for recent articles (2003 and later) using the keywords “mathematics” and “online learning.” Then, the articles were sorted into categories: frameworks of online learning, using online learning for teacher training and professional development, distance learning and WebCT as a platform, key features of an online learning environment, teacher’s role in teaching online courses and finding & evaluating effectiveness, assessment and achievement of students in online classes, examples of online learning in different courses, student and teacher feedback about online learning, and future directions.

*Frameworks of Online Learning*

Chinnappan writes about the Productive Pedagogies (PP) framework for teaching and learning used in reform of teacher education. PP’s underpinnings stem from social constructivism. Combining online discussion and collaborative learning creates an opportunity for recent graduates of teacher preparation programs to continue professional education while simultaneously practicing in the teaching profession. This is necessary, according to Chinnappan, to address the disconnect between the practice-based learning in conventional undergraduate programs and the actual understanding and expectations of the profession (p. 357). The online forum could also serve as a platform for sharing the dilemmas of practice in the context of real classrooms for beginning teachers (p. 357). This reflective experience relies on learning mathematics and pedagogies through social interactions, meaning negotiation, and shared understandings. As new teachers have new experiences, they critically reflect on their ideas and continue the discussion with those that have more or less experience with the same ideas. Since it involves learning and interacting without the constraints of deadlines, it may be more appealing to those who are under the constraints of working in the field.

The framework of PP, originally developed as part of a research study conducted in Queensland, has generated considerable optimism and excitement within the education community for its potential to provide a solid basis in which to ground and make judgments about good teaching practices (Chinnappan, p. 358). PP consists of a series of indicators that are grouped into four major dimensions: intellectual quality, relevance, supportive classroom environment, and recognition of difference. On page 359 of Chinnappan’s article, a chart breaks down further the more specific facets of each indicator. Questions addressed for each facet are also included. The questions seem to be a good way to assess the teaching and learning within a lesson. For example, the questions include: Are higher order thinking and critical analysis occurring? Is there any attempt to connect with students’ background knowledge? Do students have any say in the pace, direction, or outcome of the lesson? Are deliberate attempts made to increase the participation of all students of different backgrounds?

Kennedy’s framework based on mastery learning seems to parallel with Chinnappan’s dimension of intellectual quality. Paul Kennedy purports that mastery approaches with online internet platforms have been shown to alleviate many students’ deficiencies and open the door to higher mathematics (p. 118). He focuses on an online component of the PACe (Paced Algebra to Calculus *e*lectronically) precalculus mastery program at Colorado State University. The course was developed based on past research, particularly Bransford’s book *How People Learn*, which asserts that learning theory and cognitive science research support four perspectives for creating effective learning environments. Learning environments should be student-centered, knowledge-centered, assessment-centered, and community-centered (Kennedy, p. 121).

The PACe course is based on an assessment-up design. After the course objectives were designed, a problem database was created so that it could generate unique, randomized versions of exams to each student. After the assessment back was designed, instruction was designed. Multiple representations were at the heart of instruction, in hopes that instead of just being able to perform mathematical skills, students would also be able to explain the mathematics and represent their solutions in more than one way. The instruction was made up of videos that resembled a Smart board screen with a calculator view on the left-hand side. These videos included both overview videos with big ideas and calculator instructions and example problems that provide detailed explanations. Both have pdf files that are printable for students. Also, the videos can be paused, rewound, and replayed such that they don’t have to conform to a pace set by a face-to-face instructor. This idea of not being constrained by time is another similarity with Chinnappan’s Productive Pedagogies Framework.

The mastery learning component is ultimately evident in the frequent and repeated assessment in PACe. The course has four units with five objectives each. After each objective, the students must master three randomly generated items. After five objectives or one unit, they take a review and after they get an 80% or better, they go to a proctored testing center to take that unit’s exam. Again, the students are forced to retest until they get an 80% or better. After they get this 80% or better, they can either move to the next unit or still go back and retake assessments in order to keep the highest scores. This eliminates the stress associated with keeping up the pace of a face-to-face course and the repercussions of bad grades; no students get D’s or F’s if complete all units.

Like Chinappan, Maor also focuses on social constructivism in which the ‘four hats’ metaphor of pedagogical, social, managerial, and technical actions serve as a framework. The four hats framework is used to discuss the activities of the instructor and to examine the extent to which she is able to establish and maintain a community or learners and also analyze the pedagogies used by the instructor to promote peer-learning and reflective thinking. Maor includes the necessity that the learning be student-centered, a main component of Kennedy’s PACe program.

Maor used the ‘four hats’ in a qualitative case study to examine the role of the lecturer in facilitating an online unit in higher education with the goal of creating a community of learners engaged in interactions and peer learning through computer mediated communication (p. 129). To promote student leadership, a student was designated each week to facilitate a weekly discussion: present the weekly topic, pose relevant questions, reflect on others’ responses, and provide a synthesis of the discussion (p. 134). Again, this idea of asynchronous learning (not constrained by time) discussion parallels with the frameworks of Chinnappan and Kennedy.

Results showed: The social hat involved affective support, interpersonal communication, setting a positive tone and keeping the communication flowing. The managerial hat involved actions such as designing, coordinating the unit and overseeing tasks and course structure and requirements. The technical hat included actions such as helping and guiding in the use of technology. The pedagogical hat included actions such as providing feedback and instruction, probing, asking questions, stimulating the discussion, synthesizing students’ comments, and referring to outside resources or experts in the field (Maor, p.135). There were implications in facilitating these approaches, to be addressed in a later section of this paper.

Signer’s theoretical framework is also modeled around constructivist learning theory and combines it with situated cognitive theory. Her online in-service course model sets up an online social learning community that contains reflection on readings, one’s own teaching as well as the learning of the teacher’s students. The teachers provide each other both cognitive and affective support through classroom implementation suggestions and expressions of empathy. Her model rests on situated cognitive theory in that new knowledge is based on implementing and observing actual school-based teaching with feedback from other educators within a community of practice.

Signer also considered the best practices of teacher education, instructional technology professional development, and online learning, and aligned components of the model to these best practices. This included opportunities for reflection and collaboration, situated assignments, the Internet as reform-based pedagogy (not serving as object of instruction), and a structure for support and guidance. Like the others discussed above, Signer’s in-service course model also uses asynchronous discussions to support teachers as they experiment with new techniques and discuss student learning and classroom implementation issues (p. 209).

*Using Online Learning for Teacher Training and Professional Development*

Chinnappan’s article in the journal of *Distance Education* focuses in on a framework called Productive Pedagogies (PP) used by a cohort of beginning mathematics teachers. The idea was that this framework would allow the teachers to reflect on, critique, and share views with peers about a lesson on the teaching of multiplication. The ultimate goal of this collaborative activity was to provide opportunities for shared learning.

An online platform is fitting for professional development of teachers for many reasons. They are able to critique their own work while receiving feedback and considering the ideas of their peers. These new ideas and alternate perspectives promote critical reflection and refinement of their own ideas. Ultimately, they are able to develop as teachers by being learners in their own practice.

A discussion online real-life issues initiated by the new teachers themselves lends itself to “independent thinking and reflection about the subject matter they will be teaching and the pedagogies that undergird their teaching practices (Chinappan, p.356).” New teachers often have yet to appreciate the mathematical content of elementary students, and they have to gradually gain experience representing the content in ways that are understandable to young children. By participating in an online discussion, the new graduates learn how to initiate discussions, engage in critical reflections, and analyze authentic contexts for the development of math topic for young children. Hopefully, these new teachers will continue these best practices even after they are not required to take part in the online discussion.

Besides becoming more flexible in teaching the content to elementary students, new teachers are able to participate in an open discussion and ask freely about what their new professions will be like. Chinnappan purports that graduating students tend to have a limited understanding of the expectations of their profession, including tensions that might exist between the knowledge gained in preparation programs in college and the actual application of this knowledge in practice (p. 357). By having access to their peers at any time, they are able to work through all of the questions and anxieties before the first day of teaching.

In Dessoff’s article, International Association for K-12 Online Learning reports that online learning has opened a whole new range of 21st century professional opportunities for teachers. There are several certificates that are attainable online, a conference dedicated to online learning, and a wide array of resources available on the web. For example, he mentions PBS’s TeacherLine- video-based online graduate-level courses. He notes that programs such as these will help administrators find instructors with the “whole new set of strategies and skills” that online teaching requires (p. 26).

Signer writes about an in-service professional development program as a Community of Practice with similar ideas as Chinnappan. She focuses on the duality of both cognitive and affective support exchanged by in-service teachers through online collaborative and social discussions. The teachers-to-be would be able to discuss implementation of ideas in actual classrooms while, simultaneously, building a support network as well. The twist to Signer’s professional development is that new knowledge isn’t just formed through the negotiation of meaning through discussion but also formed by implementing and observing actual school-based teaching.

*Distance Learning and WebCT as a platform*

With respect to using WebCT as a platform for online learning, it is necessary to consider what factors affect student participation. Chan investigates exactly this. Chan collected a sample of 556 students in a pure mathematics course offered online. Demographics were collected and questionnaires containing seven open-ended questions were distributed various ways. 214 were returned and used in a qualitative analysis. Interviews were later set up for deeper understanding of results.

Students’ general reasons for accessing WebCT were: receiving updated information continually and easily, obtaining help in doing the assignments and preparing for the exams, communicating easily, helped in completing the course, learning from each other in a convenient way, and keep up study schedules. On the other hand, those that did not access WebCT did not because WebCT: was not helpful in their studies, assignments, or course completion, was of no interest to them, was duplicated information, was inconvenient to them and they had little time to access it because of other obligations, was not in sync with their personal learning styles, was not user-friendly, or they just preferred hard copies over the computer screen. The students’ reasons are reasonable. They represent the real lives of people; people have more to do than just access WebCT.

Chinappan writes about a specific implication for using WebCT effectively. He contends that online instructors “need to adopt a socio-constructivist approach in facilitating teacher reflections, learning, and mentoring their peers (p.367).” They must allow the students to work out the scaffolding themselves in order to construct meaning instead of scaffolding and demonstrating.

*Key Features of an Online Learning Environment*

Not all online learning or professional development uses WebCT. We talk about best practices in instruction, but when we add the medium of the web, we’d like to know what features should be present to ensure it is the best learning experience possible. Several of the authors from the articles I found talked about at least one essential component.

Chan and Chinappan both emphasize that online learning environments must include shared learning to be most effective. The sample is Chan’s study noted that they liked that when they felt stuck on any assignments, they were able to immediately find a peer also online and talk about it. They noted that if they were in a face-to-face class and wanted to meet to talk about as assignment, distance would be a factor.

Chinnappan discusses further how to achieve this necessary shared learning and activity. He contends that, in order to build a community of learners online, the class must be designed to require online interactions. In other words, the class should be designed that a student cannot be successful without having to communicate with other students. Collaborative activities should be assigned that students (teachers, in this case) are required to reflect on, critique, and share views with peers about a lesson or other particular topic. This will create a community of learners, and they will naturally embrace the interactions.

Jacobs puts an emphasis on making use of interactive tools for the learning of mathematics online. His paper demonstrates that three particular innovative features create an effective online learning environment: graphs which allow the user to interactively vary parameters that are accompanied by ‘walkthroughs’ that break the mathematical content into manageable chunks, a clearly labeled navigational structure that implies a linear order but allows the users to jump forward and backwards, and animations such as an oscillating spring which depicts real-world examples (p. 761). The interactive graphs allow students to discover for themselves what happens when the parameters are modified, and in turn, they form conceptual knowledge (over otherwise procedural knowledge). In the case of the differential equations class in Jacobs’s study, students were given control of sliders that changed parameters. They were able to see immediately if there were real, repeated, or imaginary roots, and begin to analyze patterns. Animations, such as springs and water tanks that fill and empty, were also included to help visual the real-world examples and also keep students’ attention. For example, students were able to see that a pendulum with an angle of exactly pi and velocity of zero would need a push before moving.

Jones, in his article about touring Mars in real-time and 3D, as expected, also emphasizes that using real world examples allows the students to immerse themselves in the context. The explorations lend themselves to increased engagement, and ultimately, students can feel as though they are mathematicians and scientists themselves. Jones doesn’t claim that this learning environment will resonate will all students. Rather, he talks about it as a good option for those who do take to it, and further says that it may generate a spark of interest that could jumpstart lifelong learning in a STEM discipline.

Maor focuses more on the reflection of the interaction than on the activity itself. I really appreciated how she communicated her own journey as an instructor of online learning. Learning how to create a community of learners took time. Her goal was to promote learning through interactions among the students and among the students and herself by reflecting on their experiences in the class. She accomplished this by assigning a student to facilitate the discussion each week, hoping that they would be able to pose relevant questions, reflect on the others’ responses, and provide a synthesis of the discussion. These discussions took place in the Activity Room where asynchronous communication with all others in the class was possible. She admits that she still has not been completely successful in promoting deep reflection.

Signer was the only one that argued that online instruction should be combined with field-based practice. This made sense in her context because she was working with intact groups of in-service teachers. Unlike other models of online education, in Signer’s model, 100% of the grade is determined by discussion postings. Her class is five weeks long, so each post counts for 20% of the final grade, and each post is evaluated with a rubric. To get the maximum points: “Responses integrate multiple views and include other participants’ views and quotes from readings. Postings are evenly distributed during the discussion period. Postings generated further discussion and synthesis (p. 213).” Signer also combined K-12 teachers all in the same course. She felt since the pedagogies for the class were not grade-specific, sharing with teachers of other grade levels would be valuable. Data confirmed that it was a positive experience. The cross grade-level instruction was good for providing insight about their own students and teaching (where they came from and what challenges lie ahead), adapting lessons from other grades to fit their own needs, and creating a support network for similar challenges across the levels.

*Teacher’s Role in Teaching Online Courses and Finding & Evaluating Effectiveness*

Now that we have considered what factors contribute to an effective online learning environment, we must also consider what the teacher’s role is in ensuring this effective learning.

Dessoff expresses concern that there is no way to ensure that online instructors are qualified. Administrators that use online teaching say that they are “generally satisfied that their instructors meet the basic requirements for core academic courses – that they are state-certified or licensed, hold at least a bachelor’s degree, and have demonstrated competency in the subjects they teach (p.23).” But doesn’t it take more than content knowledge to be able to teach online courses? Should there be a standard of how they are trained or certification program? The article notes that districts need to fill needs quickly and are under specific budget constraints. Some districts monitor teacher involvement online, even requiring them to archive all e-mail related to the course, but others do nothing to monitor the teaching. To evaluate find and evaluate effectiveness, schools may decide to ask for feedback from students and parents throughout the course, require training and observation, assign mentors to check in on progress, even offer virtual internships to recruit recent graduates and teach them how to successfully teach online.

Maor, who yearned for student interaction and reflection, felt constrained by time. She ensured learning was taking place by intervening and asking her students questions about their progress. She took on the role as a facilitator of the learning by asking questions such as: Are you helping your peers to improve? How are you continuing/promoting the conversation? Do your postings contain criticalness, scholarship, connection to experiences, and professionalism? (p. 191). She evaluated her progress by asking students for feedback herself.

Reeves, who wrote about free mathematics software resources, was concerned about how the content would change by the presence of technology. Did the teacher have autonomy to decide what content would be most useful for online learning? The digital materials designed to motivate student learning allow student interaction and flexible delivery. Teachers can choose to use the resources to demonstrate in their own classroom or ask students to connect online at home. They can choose the entry-points to meet the needs of individual students, and how the tools fit with their curriculums. Reeves, however, does note that based on about 700 middle school students using these learning objects, there has been an improvement in student learning outcomes in classrooms.

*Assessment and Achievement of Students in Online Classes*

After considering the roles of instructors and how we can monitor them, it is important we also think about how, if at all, monitoring student achievement in online classes is different as well. Hughes’s study focused on the academic achievement in virtual classrooms as compared to traditional classrooms. She studied algebra students and used the Assessment of Algebraic Understanding to quantify her results. She found that online students consistently outperformed traditional students, even despite having lower proportions in a college preparation path.

Jacobs argues that since the online learning environment allows students to explore real-world contexts, assessment should also. With the interactivity possible online, learning is experiential. Formative and summative assessment tasks should test understanding in the same domains. They should test multiple viewpoints within a real world context and automatic feedback should provide students with a challenging basis for measuring their own understanding (p.763). This instantaneous feedback is not possible in traditional classrooms.

Jones asked an interesting question. He investigated whether “gamers” were better online students. In his example of touring Mars online, since the online learning environment in this case reminded him of a video game. He used the Computer Gamer Inventory, an 81 question survey to his sample of 16 students, as a measure of gaming habits before allowing them to participate in the Mars Explorer! activities. After they completed the two lessons, they were asked to fill out another 13-point question survey on their experience with the 3D online learning environment. There were no statistically significant results when the correlation was computed, but it was implied from participants’ feedback that those that were familiar with video games found it easier to transfer their experiences to other game-like environments, like this one.

Kennedy writes about assessment as part of a PACe Precalculus course. He asserts that instruction must not be developed until after the assessment. This assessment-up design ensures that even with the random generation of assessment items, instruction will target the predefined objectives and model what students must know. Each lesson starts with a video, and students are not allowed to skip ahead until after each previous piece is completed. Assessment is frequent, and Kennedy calls it the cornerstone to the PACe Program (p. 124). For each objective students must master the three randomly generated problems, and after the fifth objective is mastered, students can go to a proctored testing center to take module tests. The view is the same as was in the online format, a TI calculator and a screen displaying the problems. When an algebraic (opposed to a graphical) solution is called for, the graphing functions of the calculator are disabled. Students are required to retest until they receive a score of at least 80%, and only their highest score is recorded. Even if they do get an 80%, they can choose to redo a test to opt for a higher score. No students receive D’s or F’s if they complete the course, and rarely receive C’s, but the goal is mastery, so is this a problem?

*Student and Teacher Feedback about Online Learning*

We have looked at examples of using online learning in several different courses: an algebra course, a college differential equations course, a middle school math and science course (as an exploration of Mars), a PACs Precalculus course, and as professional development in a graduate mathematics education course for in-service teachers. And we have looked at details about components about how the course was structured, but we must also consider the thoughts and perceptions of those that were actually a part of the class.

Chan studied the factors affecting student participation in the online learning environment at the Open University of Hong Kong. Through open-ended questions and interviews, she was able to summarize her findings in six headings: reasons for accessing WebCT, reasons for not accessing WebCT, suggested items to be added to WebCT, suggested items to be deleted from WebCT, comments on WebCT (positive and negative), and suggestions for improving WebCT. These are listed in detail in the article but a few highlights follow. Students suggested adding the functions of electronic assignment submission and grade tracking. They also wanted items to help prepare for exams and completing homeworks. Some asked for multimedia to be added to the courses, such as video tutorials and video conferencing. They wanted the Weblinks to be active when listed as references, an alert system to remind them when items were due or whenever the instructor posted a news item, and a software embedded to make it easier to type in math symbols. Students did not find the chat room helpful and didn’t like to have to check a separate email. In the interview portion, students suggested that the design if the interface be reconsidered, again, to also include an equation creator and Chinese characters.

Dessoff was also interested in the feedback from students and instructors. Data reveals that students in online courses are self-motivated and intrigued with the work. About students being so much more responsive at a virtual high school in Michigan, an instructor says, “They took responsibility for their own learning, which I really liked. There weren’t any of the usual classroom battles – discipline problems, kids talking and not paying attention. Online, they are by themselves. They take in more information and they are more personable. I become more a facilitator than a nag. I feel the students really benefit and love it as well (p.25).” A superintendent adds that online learning makes it possible to offer the courses “open doors for self-motivated kids who have a genuine interest in areas that we don’t cover in regular curriculum (p.25).”

Hughes studied the perceptions of the learning environment in virtual and traditional secondary mathematics classrooms. She used the What is Happening in this Class? (WIHIC) classroom perception instrument. Her sample was three virtual schools and three traditional schools in three different states. She found that although tradiational students were more likely to have significantly higher averages on their perceptions of Student Cohesiveness, Involvement, and Cooperation, online students were more likely to perceive higher Teacher Support.

As described earlier, in the professional development model in Signer’s study, having K-12 teachers in the same online class was positive for the teachers. Quantitative and qualitative findings showed that the in-service teachers were positive about the model itself used for online learning, their learning, the quality of interactions with fellow students and the professor, and the impact on their teaching (p.213). Further, data revealed that in-service teachers who had taken previous online courses using the model showed a strong preference for taking more of these courses over face-to-face courses. The analysis revealed that the online students felt part of a learning community that they took ownership in helping create. The students noted: the course promoted higher levels of comfort using technology, they were able to apply what they learned from each other, the resources provided, and their professor in their teaching, interactions with each other reinforced their learning in methods courses, and they hope to continue to interact online.

Something else that is worth including here is that although the mean ratings of the item instructor interaction promoted learning were positive for all the courses, they differed significantly by course. This suggests that, even with the same instructional model, the variables associated with the instructor are significant. Professor interactions, implementation, and interpretations varied by course. (p.214)

Students felt that in general the course provided them with new practical ideas for classroom instruction. They were happy with the direct application to their teaching and the mentoring experience associated with the class. They only things they noted could be improved were more instructor feedback and more professor interaction (p.214).

*Future Directions*

Most of the articles on online learning concluded saying that it is worth continuing to study online learning, especially to address to the issues of assess and equity in mathematics. Hughes closes in saying that her study revealed that virtual students can access quality mathematics content and skilled teaching while also achieving academically, and that increased access to virtual Algebra courses may provide more equitable early access to Algebra I and thus, ultimately, increase mathematics literacy among schoolchildren. Hughes also notes the limitations of her study (voluntary testing, low response rates, difference in sample sizes between the traditional and virtual groups), and calls for future research to use larger samples – especially with the virtual student group. She calls for large-scale research on virtual secondary schools to identify strategies to capture previous achievement data without additional requirements to the schools or students participating. This is necessary in determining gains in instruction.

In Kennedy’s article about Mastery with Meaning in the PACe Program, he calls for next steps in research to concentrate on mastery learning made possible with new technological advances. His conclusions indicated a high need for online tutoring and collaborative groups. He hopes to follow-up by studying the effects of implementing these two new features. He also plans to explore the area of student/teacher discourse in the online environment so that the most effective balance can be uncovered. Last, there will be an effort to tailor the curriculum to be relevant to the students’ culture. There must be alignment with research in other fields to find out what particular examples will be most fitting.

Maor, in her quest to uncover how to develop interaction and reflection in an online learning community, finishes her article with several implications for the future. She emphasizes that changes must take place at the system level. For example, first, the higher education staff responsible for academic decision-making in relation to course implementation should create opportunities and devote resources to assist academic staff in taking on the challenges of teaching online. Second, she calls for professional development for both instructors and students to make them more comfortable and knowledgeable participating in an online environment. These professional development opportunities must include activities to enhance the technical capabilities of the reluctant users among academic staff, and even more so, to get the instructors talking themselves about the pedagogical aspects of online teaching and learning. Professional development is essential if online learning is expected to be successful. They must be taught what there multiple roles are as online instructors, formalize a support system, and provide training for the particular software package used. And, third, students also need indicators on how to work online and also training on new features as they are technologically supported. They need scaffolding in relation to collaborative learning and reflective thinking, which become even more challenging online than in traditional classrooms.

*Conclusion*

We see that there are many advantages to online learning, such as opportunities to grab student interest, provide real-world interactions, allow students to learn from others on their own time, and share ideas for practical applications. But there are also many areas that need more research to ensure that the most effective teaching and learning is taking place. For example, some suggested studies in how to encourage deep reflection, how to evaluate instructors’ readiness to be online instructors, and how to integrate tools into curriculum to promote mastery learning.

*Extension and Relevance to Personal Goals*

 As the electronic content coordinator at NCTM, in an effort to advocate for teachers and allow them both a support network and also a place to share ideas for the classroom, I was particularly interested in Signer’s article, combining K-12 teachers to do lesson studies and reflect on how they could modify them for their own unique needs.

 Each of the past two years at Annual Meetings and Regional Conferences, the pre-service, in-service, and beginning teachers are excited about the relationships that begin at the conference. In an effort to provide them with a way to continue their conversations about having a successful first few years as a teacher, NCTM is considering offering a forum on their Lesssons and Resources Page. I’d like to investigate further the factors that will allow this to be a sustainable and valuable professional development opportunity for these teachers.

 In general, they ask for ready-to-use engaging ideas. This will be a place for them to share their lesson ideas. They also ask for more general advice about classroom management and communicating with parents. There will be a place for them to also share ideas about their own challenges and successes. NCTM has to first come up with a plan to censor the lessons (or at least provide a disclaimer that, although this is a part of NCTM’s website, the lessons are not NCTM materials and are rather submitted by the members themselves) and also a way to make the forum navigable. The navigation of the tool itself will be important for sustaining interest. In order to be valuable to members, the information will have to be organized so that members can find what they are looking for. It may even be an option to rate each other’s posts.

Another article that I didn’t initially find when searching ERIC is called Making Practice Public: Teacher Learning in the 21st Century, by Ann Lieberman and Desiree Pointer Mace, and appeared in the *Journal of Teacher Education*. It isn’t math-specific, but the ideas resonated with my own ideas about implementing such a vehicle for exchanging ideas on NCTM’s website. The authors propose that new media tools and social networking provide a means for professional, networked learning opportunities. They also emphasize that professional development where teachers are students in their own practice is most applicable. They are not being forced to take on initiatives demanded by administrators, and therefore take ownership for their own learning. Further, they take ownership for more than their own learning; as they feel a part of a community of learners, they also begin to take responsibility for the learning of their colleagues. Ultimately, as a group, they learn how to best serve their students.

The network would benefit the teachers participating in providing them support and ideas for practice, the students receiving the instruction, and also teacher educators who could use the network to better understand the needs of these teachers. All it takes is development to get it started and teachers willing to open their doors to feedback and criticism to improve their practice.**References**

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