Review of 2010-2011 Pilot Studies of the HEQCO Research Program in Knowledge Mobilization for Exemplary Teaching and Learning

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for the Higher Education Quality Council of Ontario

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What Have We Learned about Knowledge Mobilization for Exemplary Teaching and Learning?

The HEQCO research program in Knowledge Mobilization for Exemplary Teaching and Learning in higher education was launched with a research project and report1 in 2007-2008. This report introduced the term Faculty Knowledge Exchange Network for the emerging technical and social infrastructures, which enable communities of higher education teachers to access, share, extend, and mobilize knowledge representations and resources to enhance teaching and learning. The report included an analysis of existing models and specific recommendations for research to evaluate new faculty collaborations across Ontario institutions of higher education.

Since then, new evidence has been generated by the HEQCO program and by complementary efforts beyond. The current state of knowledge is reflected in Figure 1, which traces the causal factors from the high level outcome through a set of intermediate drivers to long-term factors which would support lasting change.

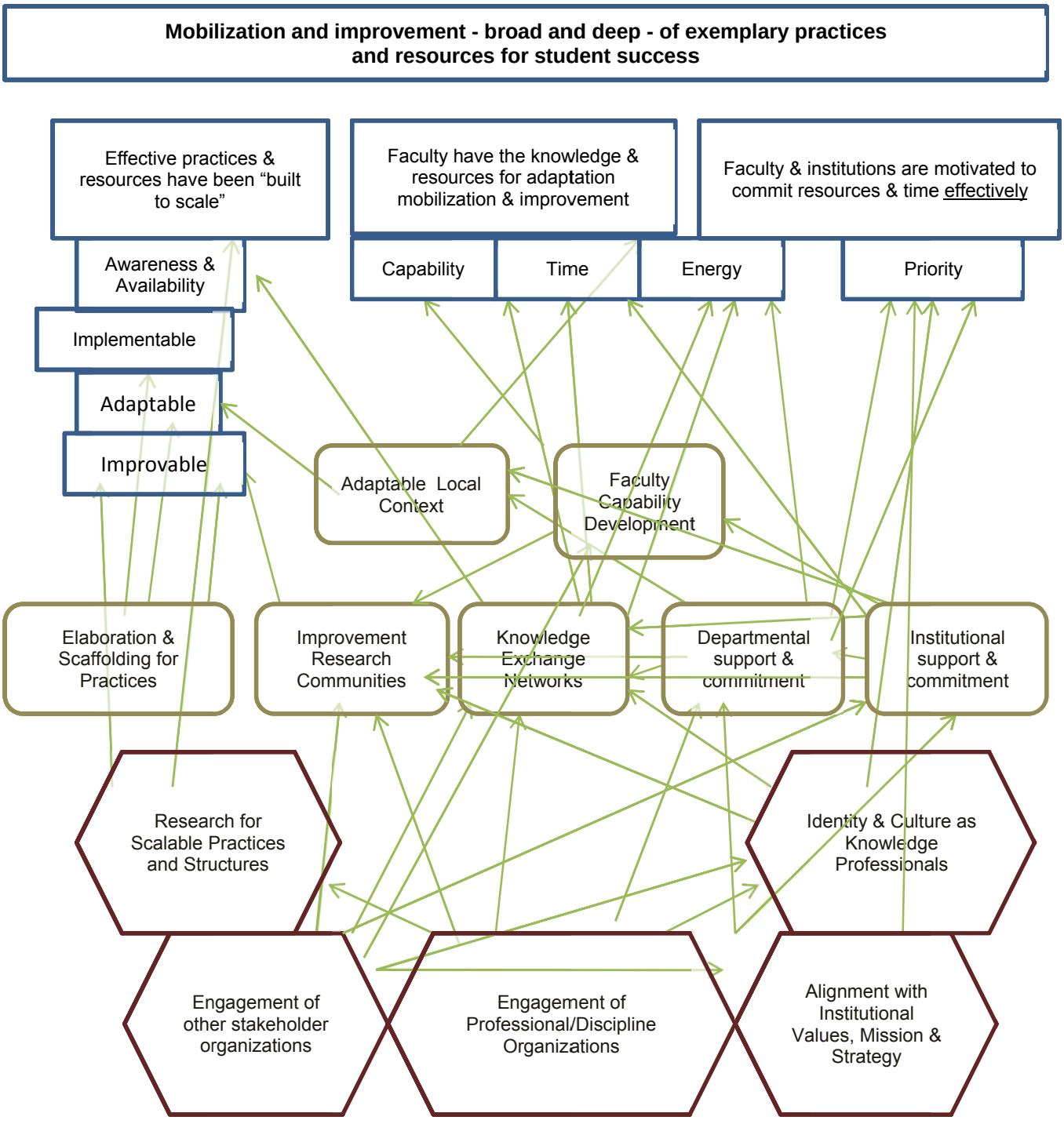
In this initial section we update the content of the 2008 HEQCO report with the issues arising from the pilot studies in the HEQCO research program and from parallel research initiatives elsewhere. In the next section, we outline the particular contribution to addressing these issues made by faculty Knowledge Exchange Networks, the approach taken in the two HEQCO pilot studies for 2010-2011. We next consider what has been learned about the long-term developments required to fully engage faculty in more transformative teaching practices. We then review the HEQCO 2010-2011 research, to analyze how factors in those projects contributed to their outcomes, and how shortcomings from missing elements could be addressed in future initiatives.

Effective Practices and Resources with Built-In Readiness for Scaling

A number of research initiatives in the U.S., in particular several supported by the National Science Foundation,[2] have examined the challenges in scaling up advances in teaching practices and learning resources beyond the institutions involved in their development. The following factors have emerged as key elements for success:

- *Awareness and Availability*: 'getting the word out' on successful innovations and making them available through dissemination of open educational resources are basic elements of any plan to broaden diffusion of educational innovations. However, a focus on resource repositories without the complementary supporting elements has not proven successful, and several large-scale repositories have recently been criticized for failing to deliver the expected changes in practice.[3] The Knowledge Exchange Network approach, discussed below, was developed to address some of the shortcomings of past repository efforts.
- *Implementation Support*: even when an advance in teaching practice is taken up by instructors at a large scale, the results may be disappointing if the implementation does not faithfully follow the educational design rationale underlying the initial success. For example, a recent study of implementation of Physics.

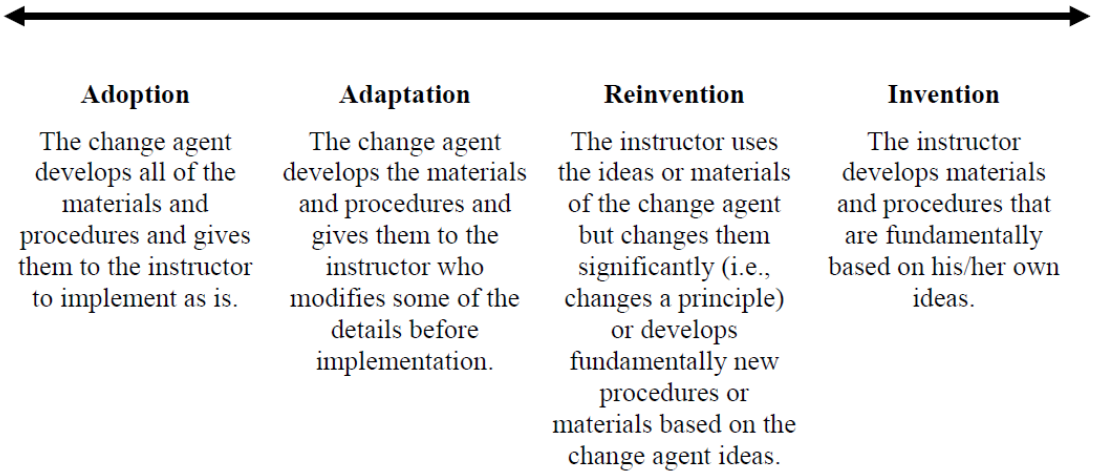
Figure 1: Factors in Knowledge Mobilization for Exemplary Teaching and Learning



Education Research reported the following data for a widely known instructional innovation, Peer Instruction:

- Nearly 30 per cent of physics faculty surveyed reported using Peer Instruction.
- However, nearly 40 per cent of these instructors reported that they had used "some of the ideas but made significant modifications."
- A detailed analysis of the actual practices employed in the classroom revealed that "the majority of Peer Instruction users are not incorporating many of the non-traditional components that the developers argue are important to the success of the method."[4]

- *Adaptability*: Instructors recognize that an instructional package created elsewhere will necessarily have to be reworked to fit in their local environment. The Physics Education researchers cited above, Charles Henderson and Melissa Dancy, have identified four types of interaction between external change agents and instructors in the change process:[5]



"Although change agents typically expect faculty to participate on the adoption/adaptation end of this spectrum, many faculty would prefer to collaborate in some form of reinvention. Faculty should be treated as participants in the development process and be given the opportunity to adopt materials for their own context."[6]

- *Improvability*: amongst the adaptations created by faculty, some will be of significance beyond the local context and should be aggregated to improve the underlying practices, resources and theories. Only in this way can we leverage the network of adaptations to maximal effect. The most recent advance in establishing scalable education adapts the concept of Improvement Research (as applied to support large-scale improvements in healthcare[7]) to provide a disciplined approach to adaptation which leads to improvement in practices and resources and advances educational research and development as a field. Networked ***Improvement Research Communities*** are being implemented in the

Carnegie Foundation Mathematics Pathways initiative as an initial effort to realize this potential in higher education:[8]

> "Effects will vary depending on specific characteristics of students, faculty and the contexts in which they both work. Given that, instead of asking whether an intervention works (e.g., "Is A better than B?" "Is C better than nothing?"), in the Networked Improvement Community we ask, "what works, when, for whom and under what conditions." It is not good enough to know that [a particular innovation] can be made to work in a few places—the point of an improvement-oriented approach to education…is to achieve effective implementation across local contexts, reliably and at scale.

While Ontario institutions will not be participating directly in the Carnegie Networked Improvement Research Communities, the Ontario College Mathematics Association (OCMA) Math Knowledge Exchange Network will be examining the model as part of the plan for professional development activities in 2011-2012.

Faculty Capability, Time, and Energy

Faculty members have consistently expressed to us their interest in improving teaching and learning for student success. They have also consistently cited a lack of knowledge, time and energy to invest in improving teaching and learning. The gaps in knowledge are not just about advanced teaching methods: faculty also may lack knowledge about the process of adaptation and improvement. As a result, when their efforts to implement an innovative instructional strategy or resource consume more time and energy than they had anticipated, the energy available for mobilizing exemplary practices can erode.

Other researchers note similar concerns. For example on the issue of time, "many faculty report that they are interested in improving their instruction… 'time' was the number one reason the faculty gave for not using more research-based strategies… [however] faculty often spend much time preparing detailed lecture notes and presentations…If the faculty are feeling frustrated, confused or unsure about implementing a strategy, they may have a tendency to say 'I don't have the time'."[9]

Faculty collaborations to improve teaching and learning can expand the available knowledge (through a network of ideas contributed by multiple members), time (through a division of labour which allows the team to achieve more than the individuals could achieve on their own) and energy (through the mutual reinforcement of like-minded colleagues). Where the opportunity for collaboration is not available within a department – e.g., where a specific interest is not shared by other local faculty or where local interactions are limited by the lack of a subject area department – the interactions within a distributed faculty network can expand knowledge, time and energy for improvements in teaching and learning.

For example, in a recent evaluation of three regional ***Knowledge Exchange Networks***[10] the community college mathematics faculty involved reported 'some impact' or "quite a bit of impact' from interactions with others in the network in a range of areas: ability to apply knowledge and resources (70%), awareness of relevant teaching knowledge (80%), ability to improve local

instructional designs (65%), ability to evaluate impacts on learning (50%) and engagement with improvements in teaching and learning (67%).

Some of the necessary drivers to address these issues are listed in Figure 1 and outlined further below. Faculty need easily modifiable materials, accompanied by instructional rationale and research evidence, disseminated with an emphasis on personal connections over data presentations, and embedded in a context which aggregates successful local adaptations to promote scalability to diverse settings.

Additional Factors in Successful Knowledge Mobilization for Exemplary Teaching and Learning

i) Elaboration & Scaffolding for Practices: The discussion above raised the twin issues of implementation with efficient effort by faculty and of adaptations which preserve the pedagogical intent of the innovation. These issues have been studied in depth within the K-12 environment,[11] and the results from those studies can be adapted to work in higher education. "Two features of the design of an innovation can affect implementation by influencing practitioners' capability to learn new practices and thus overcome [knowledge gaps]…elaboration and scaffolding."

Elaboration deals with the detail with which an educational reform documents in rich detail what is to be done…Less-elaborated designs tacitly delegate large amounts of invention to implementers, increasing the probability that they will interpret interventions as versions of conventional practice.

Scaffolding deals with the materials and social processes that can support, or scaffold, faculty learning. Innovations can only be implemented as they are comprehended and used by teachers…the more innovations depart from conventional practice, the more new ideas, norms and practices teachers (and students) will have to learn, and the more implementation will depend on that learning.

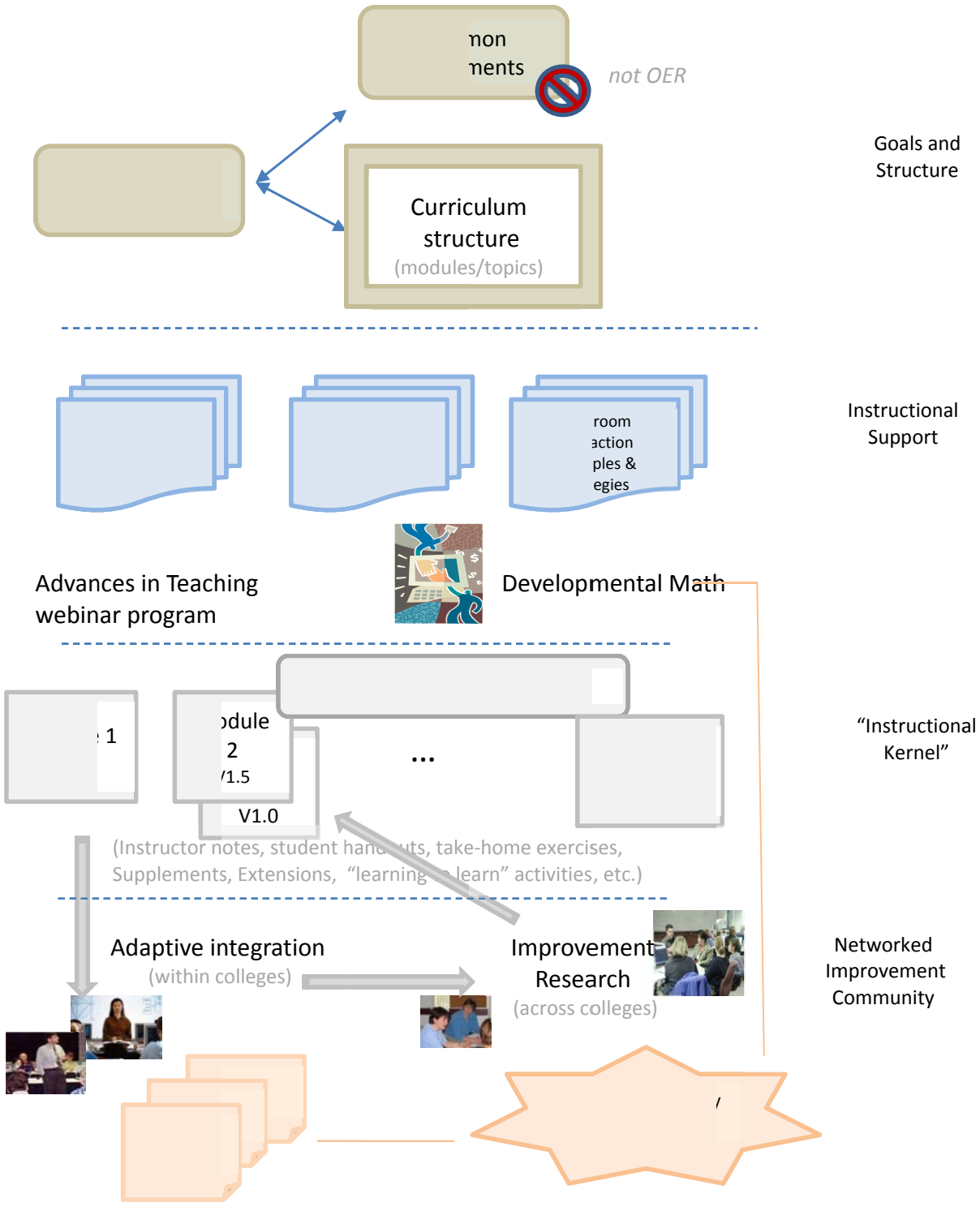
This research from innovations in school reform suggests ways to address the struggles of faculty who find that adapting and implementing an innovation for their own use can be challenging in the time and knowledge required. The Carnegie Statway™ and Quantway™ projects will be providing extensive elaboration and scaffolding resources as part of the open educational resources to be released in August 2011 (see Figure 2), and the Ontario College Mathematics Association Math Knowledge Exchange Network plans to examine these as part of professional development events in Fall 2011.

ii) *Adaptable Local Contexts*: While most of our analysis has focused on the roles and responsibilities of faculty, there are situational factors outside the control of individual faculty which inhibit innovations in instruction. Faculty members have reported that these situational constraints are a prime factor underlying the inconsistencies between their conceptions of exemplary teaching and their self-reported practice. Such factors include expectations of content coverage, departmental norms for instruction, student resistance and the structure of classroom facilities or class schedules. For example, "many of the

instructors indicated that they worked in departments where they were expected to teach large numbers of students in lecture halls with seats bolted to the floor…[which] made it harder to use many research-based methods that focus on interactivity, cooperative learning and formative assessment."

The flexibility of structures like schedules and classrooms can therefore be an important element in the 'absorbtive capacity'[12] of higher education institutions, i.e., the organization's ability to recognize the value of new information, assimilate it and apply it to generate value.

Figure 2: Statway™/Quantway ™ Resources & Processes



iii) *Faculty Capability Development*: many of the areas of capability development for faculty have already been mentioned in the discussion above. While many institutions in Ontario have programs to develop faculty capability in instructional design and teaching practices, there has not been corresponding emphasis on the capabilities required to mobilize, adapt and improve exemplary practices and resources from elsewhere – typical faculty development programs assume an *Invention* or *Re-invention* model as outlined above in (a). This has negative impacts on the faculty's perceived lack of time for instructional improvement, as the 'do-it-all-yourself' model does not leverage the work of others.

The OCMA Math Knowledge Exchange Network held professional development events at its 2010 and 2011 annual meetings to begin to address the need for professional development around an *Adaptation* model, and this will be complemented in 2011-2012 by participation in webinars offered by the Developmental Mathematics Collection of the Mathematics Association of America. We are attempting to arrange participation for OCMA members in the *Advances in Teaching* program of the Carnegie Foundation to build awareness of the open educational resources for Elaboration and Scaffolding being developed as part of the Math Pathways initiatives.

The Aligning and Building Curriculum Knowledge Exchange Network hopes to implement a similar extension to its existing program if their plans for further funding are successful.

iv) *Departmental/Institutional support and commitment:* Many of the above issues require a supportive environment and commitment from departments, divisions/schools and institutions. The most salient of these are the need to provide faculty time, to systematically develop faculty capability and to promote flexibility in local situational factors. To support faculty-led improvements in learning in cost-effective ways, academic leaders will require awareness of the advantages of mobilizing, adapting and improving exemplary teaching practices and resources, and of the recent advances in online resources and networked communities that have made such work feasible without extraordinary external resources.

As will be noted below in section 2, the sustainability model for *Knowledge Exchange Networks* and *Improvement Research Communities* requires a specific, but modest, departmental and institutional commitment of resources for faculty. Department chairs participating in our knowledge exchange networks for college faculty have indicated that they can envision a stage in which the catalyst role of a Faculty Colleague will be similar in effort to assigning a department member to a college-wide committee.

Since the department derives the direct benefit from this activity, the value proposition developed for such initiatives should provide a suitable cost/benefit model at the departmental level. In addition, the institution as a whole can derive significant benefit from the participation of faculty in subject-area collaborations – including coaching for other departments, sharing leadership roles across subject areas with peer institutions, and supporting the institutional strategic position and leadership plans. This suggests

that commitments to shared infrastructure and some departmental startup would be more appropriate at the institutional levels.

In the meantime, there is still a significant learning curve for faculty to mobilize, adapt and improve knowledge and resources for exemplary teaching and learning, and for faculty colleagues to support them locally and to serve in leadership roles regionally.

Knowledge Exchange Networks and Improvement Research Communities

The HEQCO research program on *Knowledge Mobilization for Exemplary Teaching and Learning* (KMETL) has largely focused on the initiation, development and evaluation of the *Knowledge Exchange Networks* component from Figure 1. We describe on the next page the stages of evolution in this endeavour. The overall model that has emerged is shown in Figure 3, using the Ontario College Mathematics Association Math Knowledge Exchange Network (OCMA MathKEN) as a model (in its planned future form as a Learning Improvement Research Network).

2008-2009: Connection and Cooperation

The initial projects in the Knowledge Exchange Networks (summarized in Section 4 below) emphasized building connections between institutions through cooperation and idea sharing. Each institutional team defined a project on which to work for the benefit of their department. Our objective was to demonstrate the value of knowledge exchange across departments by the impact of new knowledge, ideas and resources from outside. A bonus effect in many cases was the increased energy for improving teaching and learning generated by the interactions with like-minded colleagues from outside the immediate institutional context.

2009-2010: Shared Content and Department Catalysts

In the second stage of the Knowledge Exchange Networks, the emphasis expanded with more attention to knowledge and resources available from both within and beyond Ontario. Faculty members were encouraged to share with colleagues the teaching practices and learning resources which they had found to be valuable in their own teaching. This deliberately ‘set the bar low’, i.e. encouraged contributions with only minimal quality control by the local departmental representatives. In tandem, a greater emphasis was placed on mobilizing knowledge from research and on evaluating personal and local advances in teaching practices to support exchange with other colleagues (in line with the notion of Elaboration and Scaffolding described in section 1).

We do not expect faculty to engage in these knowledge exchange activities without ongoing peer support. The evaluation of the initial team work identified a number of catalyst activities which proved to be important for team success. Many of these support roles were initially provided by the Program Leader; over time, more of these have been taken up by team

members themselves. Figure 4 (next page) contains the current description of the key role of these departmental catalysts, designated as “Faculty Colleagues”, who leverage the network effect by serving as local knowledge brokers and network connectors. The strong ties across departments through the Faculty Colleagues and the ties – strong or weak – within departments between the colleagues and department members are critical to achieving a network effect in which the whole is greater than the sum of the parts.

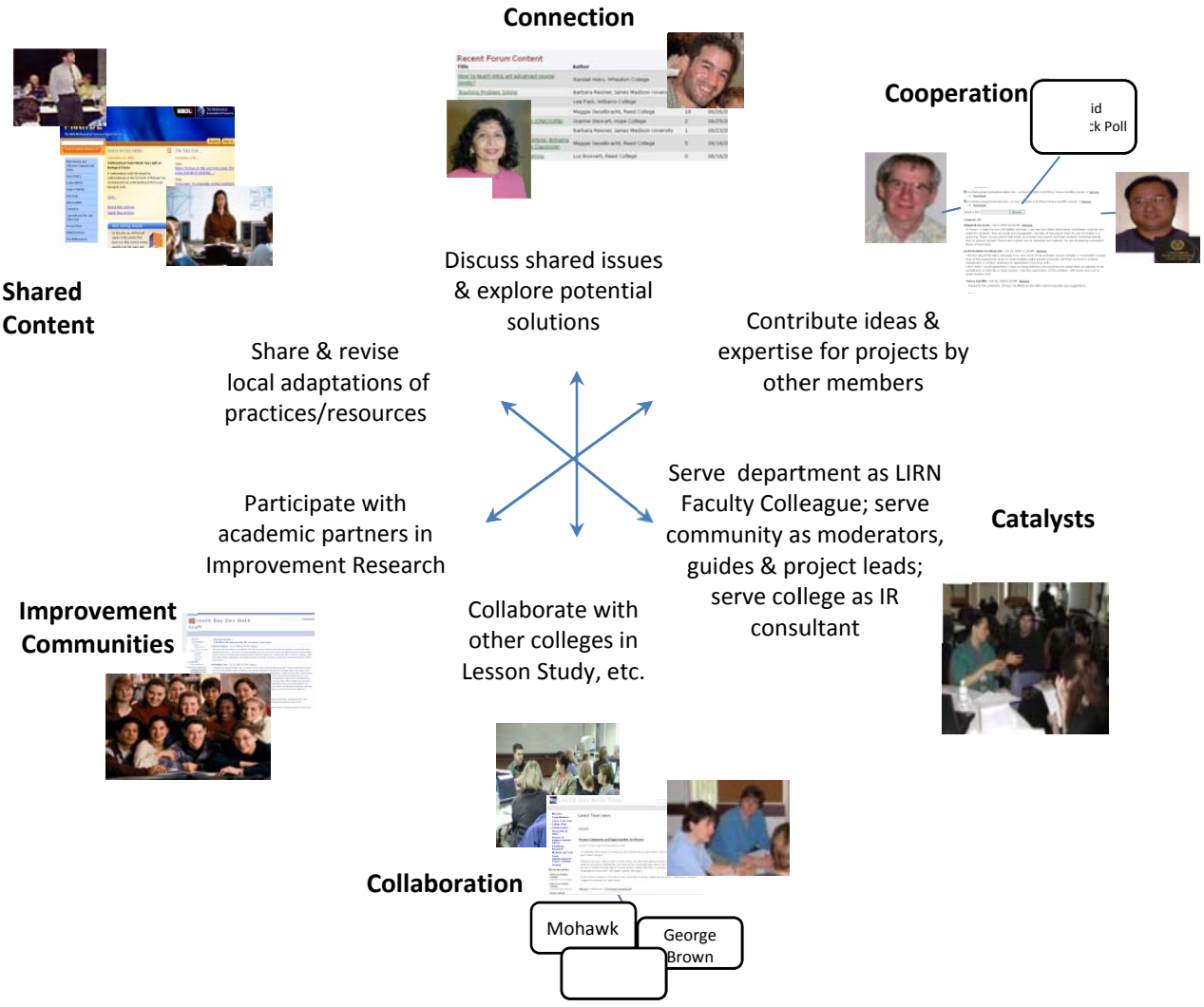
2010-2011: Collaboration and Networking

In the third stage of our Knowledge Exchange Networks initiatives, an increased emphasis emerged on defining collaborative projects across institutions and on networking the knowledge exchange in Ontario with parallel regional developments in the U.S. and with national professional/disciplinary associations. Our increased emphasis on Collaborative Projects incorporated insights from recent research by Anne Morris and Jim Hiebert13 in the U.S., which demonstrated the effectiveness of Creating Shared Instructional Products as a way to advance local teaching practices while also contributing to building up the body of professional knowledge about teaching in the subject area.14

Figure 3: Example Faculty Activities in the OCMA

Learning Improvement Research Network (LIRN)

Faculty are supported in these activities with colleagues in the Network:



They cite three features to enable the construction of shared knowledge products that improve teaching;

- Shared problems across a network of institutions, teachers and researchers;
- Small tests of small changes, aggregated to produce generalizable improvements;
- Multiple sources of innovation and continuing improvement.

Collaborative creation of shared products to improve teaching thus appears to require a critical mass of faculty and institutions around a shared problem, ready to incorporate ideas and resources from others and willing to undertake local tests of change to be shared with a larger network. For the OCMA MathKEN this created a dilemma: advancing the knowledge exchange network seemed to require a larger critical mass in order to provide collaboration partners for the individual interests of the participating faculty and institutions; at the same time, growing the OCMA MathKEN required a stronger value proposition for individual participation, which such larger linkages could provide.

The OCMA MathKEN project leader met with regional counterparts at a meeting of the professional association for community college mathematics faculty in the Fall of 2010, and determined that the OCMA MathKEN efforts would be furthered by an alliance with parallel developments in the U.S. Subsequently, the national association has begun to explore a more official network of regional knowledge exchanges for mathematics faculty, following the model developed for and by the OCMA. The proposed scheme is shown in Figure 5, in which the OCMA MathKEN would be a regional node within a larger network of faculty and institutions working to improve teaching and learning for student success in community college mathematics.

This network structure addresses the need for a critical mass of engaged faculty in order to provide collaborators for local faculty projects to advance teaching and learning. It requires an expanded role for the Knowledge Exchange leaders, who will now both coordinate their regional faculty and link them into the larger developments across the network. A draft role description contains the following elements:

Regional Coordinators *for the Math Knowledge Exchange Network* will be trained and supported to enable knowledge exchange and capability development through the following activities:

- support and coordinate the team of Faculty Colleagues in the region, including identifying perceived gaps in the regional Exchange collection and potential links to other regions;
- moderate the collaboration spaces within the regional Knowledge Exchange;
- lead the team of college facilitators to commission collaborative projects and assign support;
- collaborate with other regional coordinators, to identify project opportunities across regions;

- foster other knowledge exchange activities within the region;
- contribute to the American Mathematical Association of Two-Year Colleges (*AMATYC*) Developmental Math Collection, the Mathematical Association of America (*MAA)* Math Digital Library, etc.

Figure 4: Scenarios for Engaging Department Colleagues in the OCMA MathKEN

The Faculty Colleague role is a key component of our plan for the OCMA MathKEN. The main tasks for Faculty Colleagues involve interacting with faculty in their departments in the following ways (from the Faculty Colleague Role Description):

- *serve as a resource person and catalyst within your department to support faculty in engaging with the project opportunities and activities for collaboration and professional development;*
- *with the support of the program team, advise faculty members on request about sources of knowledge and exemplary learning resources relevant to their teaching;*
- *with the support of the program team, encourage and advise faculty on sharing their knowledge and resources with colleagues, to promote reuse, adaptation and collaboration.*

We continue to add to the Resource Collections in response to requests from faculty and shared resources from other regions. We also now have several active collaborations in which your faculty can participate. Now each of you will want to make your own selections from the following opportunities to engage your department members – or, of course, to invent new ones ☺. Remember to use your college weblog to report back to the team on the results and challenges you experience!

Liaison:

- *Meet with the department chair to bring him/her up to date on the OCMA Math KEN and to explore which of these scenarios are likely to yield the best results – for you and the OCMA Math KEN, and for the department and its faculty. Ask for time in department meetings for an initial overview and then subsequent concise updates on our progress.*
- *If the department has a teaching improvement committee or working group, schedule some time on their next agenda to outline how the OCMA Math KEN can support them (and vice versa). If there is no such group, you might want to chat with other Faculty Colleagues who have successfully initiated such groups as part of their faculty colleague role, e.g., Gretchen Ehlers at West Valley College.*
- *Outline the goals and plans for the OCMA Math KEN to the college professional development and curriculum development teams, and explore how your activities can coordinate with other plans for the college.*

"Export" consultant:

- *With the support of the department chair, identify 1 or 2 faculty who are potential candidates to provide resources or teaching practices which would benefit others in the department and the region. When you meet with the faculty, you will want to show them*

something similar to the contribution that we hope they will make – our support team can help you identify sample resources in one of the other regional Knowledge Exchanges to illustrate what faculty have found useful. E.g., Bob Hasson's description of his use of WeBWorK for the Bay Area Knowledge Exchange shows how a teaching practice can be easily shared with others, and there are good examples of learning activities, topic teaching plans and innovative course designs in the OCMA Math KEN and Bay Area Knowledge Exchange collections.

Of course, it helps if the resource or teaching practice is also one where you have an interest, but if not then we can canvas the OCMA Math KEN Faculty Colleague team or other regional Knowledge Exchanges to provide the names of one or two interested teachers who would welcome the proposed contribution.

*"**Import" consultant:***

- *Recommend resources that you have found to be valuable in your own teaching, to another faculty member who shares your interest in student success and pedagogy. Follow up to see how your colleague's experience matched or differed from your own.*
- *Follow up on expressions of interest from faculty meetings, hallway conversations, etc. re improving student success and the challenges of teaching specific topics in context. The program support team can help you to identify resources and practices in areas where you have become aware of faculty interest.*
- *Ask 1 or 2 faculty colleague to spend 30 minutes with you to scan the current Resource Collection and identify areas where we need to provide resources of interest to them. We already have a list of areas where our program support team is actively searching for high quality content to respond to such requests. Usually when we provide a list of candidate resources back to the requesting faculty member, we also set a date by which we will follow up with them about which of the candidates should be included in the Resource Collections. (This may take place after the teaching term has ended.)*

The selected resources then need to be added to the Knowledge Exchange as contributions recommended by the faculty member, so you will want to help them sign up as Members and walk them through the process of creating the resource and filling in the accompanying information. The San Diego Knowledge Exchange team is creating a set of guidelines for what to put in the Description that users see when they mouse over a resource name: this is the key information a user will want to scan to decide whether to look further, such as the time required for an in-class activity or pedagogical rationale behind a new teaching approach.

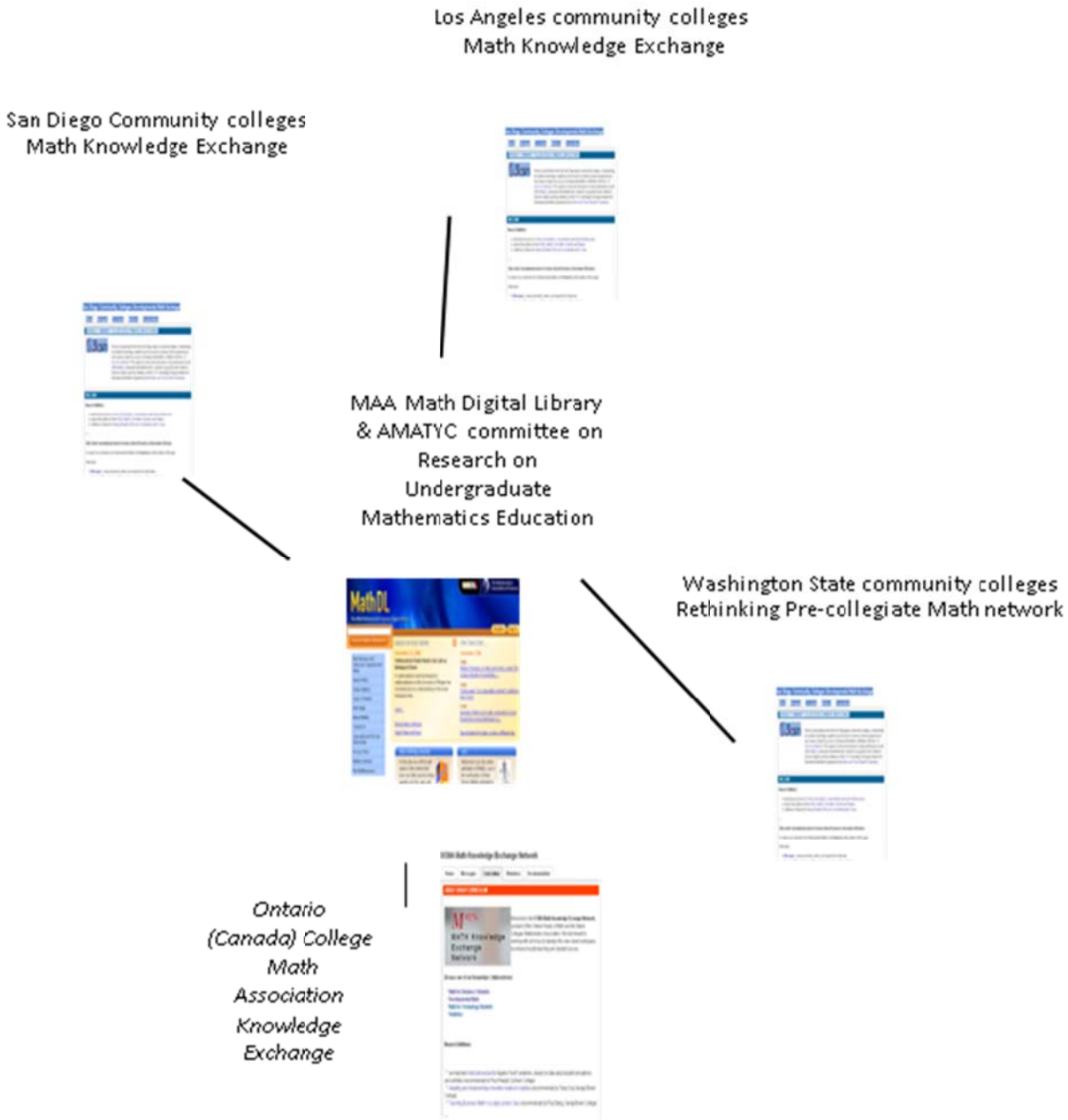
Connect colleagues with opportunities for interaction and collaboration

- *Some of the faculty with whom you interact around Import and Export activities may also be interested in commenting on the innovative work at another college. This could include Comments or questions about a resource, ideas to share related to a current project, or joining a discussion about "how, when, where and why" a particular teaching approach is likely to most successful. You will want to help them join in as members, and*

work with the program support team to ensure they are notified about responses and further ideas from other faculty.

- *There are also collaborative activities underway where faculty can "divide and conquer" a project of mutual interest. Some of your colleagues may be interested in participating actively in the collaboration, others may be content to observe without only occasional contributions – in either case, a lot of learning will take place and even the inactive participants contribute energy by their ongoing interest in future use. The connections may also bear fruit in future projects.*

Figure 5: Proposed AMATYC/MAA[1] Knowledge Exchange Network



[1] MAA: Mathematics Association of America; AMATYC: American Mathematics Association for Two Year Colleges

2011-2012: Improvement Research Communities

The specific plans for the OCMA MathKEN are outlined in the accompanying Project Report by the OCMA Project Leader. One suggested area for exploration in 2011-2012 is the concept of *Improvement Research Communities,* which reflects emerging developments in the U.S. and the particular interests of Ontario college mathematics in a stronger emphasis on research and scholarship. This reflects in part the evolution of the mandate of Ontario colleges to include degree programs, in part the evolving professional identity of many Ontario college faculty toward a more academic role,[15] and in part a growing awareness of the potential for knowledge mobilization partnerships amongst researchers and practitioners to result in significant improvement in teaching and learning.

Networked Improvement Communities emerged from early work by Douglas Engelbart[16] in the 1960's on networking computers in support of high performance organizations (which also resulted in the invention of the computer "mouse", amongst many other innovations). The ideas have been applied in many professional and industrial settings, most recently in combination with the notion of *Improvement Research* from inter-organizational quality improvement efforts in healthcare and elsewhere.[17]

In education, the concept of a network of improvement research communities[18] provides a middle ground between traditional academic research in education and localized action research projects. The former has strengths in rigorous methods and a theoretical base, but has weaknesses in fostering adaptive integration into practice by instructors. Action research, on the other hand, promotes inquiry which is context-dependent and supportive of local improvement but lacks mechanisms for accumulation of knowledge and transfer to new contexts. A network of improvement research communities offers the potential to bridge across these gaps, and leveraging the strengths and minimizing the weaknesses of each approach.

The OCMA MathKEN will include this approach in its future plans. We believe this will provide an opportunity for faculty in Ontario colleges and universities to achieve high-quality research and knowledge mobilization. As noted in the next section, this approach supports some of the longer term changes required to reach the full potential for improvement in teaching and learning through adapting, mobilizing and improving shared teaching knowledge, learning resources and instructional practices.

Long-term Factors to Support Knowledge Mobilization for Exemplary Teaching and Learning

As a final reflection on the general lessons learned from the KMETL research program and related concurrent developments, we summarize here some of the longer term developments from Figure 1, which would support and be supported by knowledge mobilization for exemplary teaching and learning.

Stronger Identity & Culture for Higher Education Teachers as Knowledge Professionals: significant research efforts are in progress to strengthen knowledge mobilization amongst K-12 teachers, focusing on building a stronger professional identity and culture for teaching as a knowledge-rich profession.[19] It is ironic that higher education, with its emphasis on preparing students for a knowledge society, is still reliant on an 'artisan' model of teaching.[20] As noted above, the professional development model in higher education,[21] particularly the induction process for new faculty, has focused more on Invention and Reinvention than on Adaptation, and generally neglects evidence-based practice.

One of the approaches to increasing the use of evidence in teaching practice has been in the direction of the *Scholarship of Teaching and Learning*. However, this approach emphasized the role of teachers as researchers of educational practice, i.e., as 'producers' of evidence about teaching practice not as 'consumers' of such evidence. The research literature on discipline-based scholarship of teaching and learning has not been connected to the complementary research literatures from education research and organizational research on higher education,[22] and the lack of a knowledge mobilization culture amongst faculty as teachers has limited the impact of this form of faculty scholarship. As noted in section 2, the concept of Improvement Research appears to be a promising way to engage faculty in practical enhancements to student success while developing an awareness of evidence from other instructors and a capability to learn from evidence in other contexts.

Alignment with Institutional Values, Mission & Strategy: While institutional leaders in Ontario higher education express a high priority for the quality of teaching and learning, faculty members consistently report a perception that time spent on improving teaching quality and student success is not given appropriate recognition within their institutions. Without judging the extent of any such gap, it is worth comparing the experiences of the Ontario MathKEN team with their counterparts in the U.S. KEN projects. The Math Knowledge Exchange Network projects in the U.S. have enjoyed a higher level of visibility and priority within their respective institutions and systems.

Without going into the many differences in context, the main factor seems to be a high political priority assigned in the U.S. to improving student success in developmental mathematics, which has particular political implications around the success of Latino and African-American students. In contrast, Ontario institutions do not have the same public or political pressure around the quality of teaching and learning (and the low success of under-prepared and under-represented groups such as Aboriginal students is diffused across the system rather than being concentrated in particular institutions as is the case in the U.S.). While the area of

developmental mathematics was identified by Colleges Ontario as a priority, the faculty perception within the colleges about this area lacks the sense of urgency that occurs in the U.S.

There are pressures in Ontario around the costs of the higher education system, but these have not translated into systematic search for transformative approaches which could improve quality and contain costs. In the absence of instructional 'problems' with a high political profile, it appears unlikely that Ontario institutions will be able to focus attention on the quality of teaching and learning around common issues that foster inter-institutional collaborations and faculty knowledge exchange. Rather than searching for common problems to be addressed, there may be more potential in identifying important opportunities[23] for Ontario higher education to support a provincial strategy in new ways. However, any such development would involve experimental pilot studies and institutional commitment to innovation in the teaching and learning process.

Engagement of Professional/Discipline Organizations: many of the disciplinary organizations which influence the scholarly and professional activities of Ontario faculty are U.S-based. Ontario faculty are active participants in many of the subgroups, which focus on teaching and learning, e.g., the Physics Education Research group within the American Association of Physics Teachers, the Research on Undergraduate Mathematics Education group within the American Mathematics Association for Two Year Colleges, and the Special Interest Group on Computer Science Education of the Association for Computing Machinery. Some of the programs of these associations are tied to funding from U.S. federal or state government organizations, which can restrict the participation of Ontario faculty.

Engagement of other stakeholder organizations: Initiatives for improvement of teaching and learning in higher education can be fostered by supportive organizations external to the institutions and faculty who have primary responsibility for instruction. Our Canadian context is particularly challenging: in the U.S., there are three common sources of support that are available to innovative institutions and faculty:

- the federal Department of Education has an Office of Post-Secondary Education with grant programs to support innovation;
- the federal National Science Foundation has a Division of Undergraduate Education with numerous ways to support innovations in instruction (restricted to Science, Technology, Engineering and Mathematics);
- numerous philanthropic foundations, both grant-making and operating, have focus areas in support of higher education. For some, this is a direct part of their mandate; for others, the direct mandate is about equity of opportunity or the needs of specific targeted segments of the population, and the interest in higher education is secondary.

The absence of similar organizations in Canada creates the opportunity for a stronger role by provincial organizations like HEQCO and others (e.g., the BCCampus Learn Together Collaboratory).

Research for Scalable Practices and Structures: as noted above, there is growing research activity in the U.S. and elsewhere[24] about better strategies for scaling up educational innovations to increase the impacts on teaching and learning on a broad scale. HEQCO may

want to consider formal or informal partnerships with some of these initiatives to ensure the lessons learned are applied in Ontario. The challenges of knowledge mobilization for exemplary teaching in higher education are now widely recognized, and Ontario can contribute to – and benefit from – advances in scaling up the use of exemplary practices and resources.

Continued Impacts of HEQCO Projects in Knowledge Mobilization for Exemplary Teaching & Learning

University-based faculty projects

In the initial phase of the HEQCO research program in Knowledge Mobilization for Exemplary Teaching and Learning, two collaborations of university faculty were initiated. Both focused on Undergraduate Degree-Level Expectations (UDLEs), which was a major focus of the Council of Ontario Universities (COU) and was identified by the COU as an important priority area for pilot studies.

1. A collaboration based in the Faculty of Arts and Science (FAS) at the University of Toronto and focused on developing students capabilities in Quantitative Reasoning, to address the Faculty's Learning Outcomes. This work had the strong support of the FAS Vice-Dean for Teaching and Learning, who saw the potential in knowledge mobilization within the Faculty as an important goal. Two departments participated in 2009, Near & Middle Eastern Civilizations and Spanish & Portuguese.

2. A cooperative project across Departments of Languages and Literatures at three universities (Guelph, UT Mississauga and Wilfrid Laurier). Each institution had its own variant of the COU specification of Undergraduate Degree-Level Expectations; each institution also had different priorities to further the development of new student capabilities. The faculty involved were therefore loosely coupled through joint meetings, idea sharing and research into advances in pedagogy, but were not developing shared resources.

Strengths: each of the individual projects was successful in producing a revised course offering which enhanced the student learning experience and the development of the targeted learning outcomes. Each sponsored a symposium to share results with others, one specific to the Faculty of Arts and Sciences at the University of Toronto and one for Departments of Languages and Literatures in the central Ontario area (involving four other departments beyond the original three partners). HEQCO research consultant Dr. Eleanor Pierre provided strong support in instructional design and evaluation, and all the faculty members involved reported significant advances in their own capabilities in these areas.

Weaknesses: For all the faculty members involved this was their first experience of instructional design work informed by research knowledge. This paradigm shift both generated and consumed most of the energy in the project: the additional goal of producing an improvable artefact to be mobilized by others was not adequately addressed. Although the projects were developed in consultation with department chairs, there was only limited involvement of other

departmental faculty. This appears to reflect a lower institutional priority for attention to UDLEs than we had been led to expect.

Also, despite the investment of program staff effort, we were not able to form effective partnerships with the academic support organizations at each of the institutions that were mandated to support teaching and learning. At the University of Toronto, this unit was being reorganized throughout the formative stages of the FAS projects; elsewhere, teaching and learning centres participated in circulating the call for proposals and in preparing proposals, but were otherwise only peripherally connected to the projects. The HEQCO staff on the project noted that considerable effort from these centres was already being put into development of local plans for UDLEs, and the prospect of a larger collaboration at the provincial level came across as a further step, which would distract from the immediate local needs.

Conclusions: Two lessons emerged from this work. One was the importance of pre-existing ties or network infrastructure which could be leveraged to link faculty together. Effort invested in establishing links where none previously existed took energy and time away from the more substantive aspects of the work. We had expected the ties between educational developers to be more useful in the Languages and Literatures project; in the University of Toronto project, the Vice-Dean was instrumental in bringing departments together but when she went on sabbatical much of the momentum was lost.

The second lesson emerging was the importance of a shared, improvable product. In the FAS project, this was initially envisioned as an FAS resource guide to support other faculty and departments in addressing the development of Quantitative Reasoning capabilities. In the Languages and Literature (L & L) project, this was to be a more general guide to developing UDLE capabilities in L & L programs. In the absence of a well-defined audience eager to use such resources – and accountability to them for results – this aspect was trumped by the instructors' natural focus on the needs of their own students.

The absence of existing networks of discipline faculty within the university sector, coupled with the focus of educational developers on building a partnership with COU, led us to conclude that a much more intensive investment would be required to produce significant results in knowledge exchange and mobilization. This was a contrast to the college sector, as described below, and the next phase of the KMETL project focused on work with the colleges. Subsequently, a group of university Biology instructors was formed as the Ontario Consortium of Undergraduate Biology Educators,[25] and some informal contact with this group suggests that they could become the nucleus of a productive project. (However, the group consists mostly of instructors in teaching-intensive positions and members are not all the kind of "flagship faculty" who could be influential with a broader range of faculty.)

Additional impacts: In a spin-off project, four Ontario universities collaborated to create a set of digital media case stories on Academic Integrity. HEQCO staff worked with this team to define the project, secure funding (outside of HEQCO), link to a parallel initiative in the U.S., and post the case stories on the U.S. resource exchange.

Presentations:

- Carey, T.T., and E. Pierre, Emerging Technologies to Support SOTL Collaborations Across Institutions, panel presentation at International Society for the Scholarship of Teaching and Learning, Bloomington IN, October 2009.
- Freeman, W., D. Bell, R. Gorrie, D. Istl, K. Holland and T.T. Carey, Capturing Curriculum Innovation Using Video Case Stories, presentation at the 2010 Annual Meeting of the Society for Teaching and Learning in Higher Education, Toronto ON, June 2010.

College-based faculty projects

The OCMA MathKEN has already been briefly described in section 2 as an illustration of an ongoing faculty Knowledge Exchange Network. As with the University-based faculty projects where the UDLEs priority was originally identified by COU, the priority for a college project in Developmental Math was the recommendation from Colleges Ontario.

The basic elements of this project have already been described:

- An initial phase involving faculty members in Development Mathematics working collaboratively to share teaching knowledge, instructional ideas, learning resources, and research evidence to strengthen projects at their individual colleges.
- A follow on phase with a stronger emphasis on aggregating such resources from within Ontario and beyond, into a Mathematics Knowledge Exchange Network.
- Further work to promote collaborative projects and to link the Ontario MathKEN with parallel developments in the U.S. to provide a critical mass of interested faculty for collaboration.
- *Strengths*: One of the key elements which made this project more successful than the university-based projects was the involvement of the Ontario College Mathematics Association (OCMA). This grassroots faculty association was formed in 1996. Most of the association's current activity is focused around face-to-face meetings, including an annual retreat in May and professional development events at other times in the school year (typically in the Toronto area). Members of the OCMA executive who had participated in the initial HEQCO pilot project saw the potential for an online Knowledge Exchange Network to bridge the gap between face-to-face events, provide more effective outreach to members outside the Toronto area, and link the OCMA faculty with initiatives in the national U.S. organization, the American Mathematical Association for Two Year Colleges.

As the HEQCO KMETL program moved into subsequent phases emphasizing Content, Catalysts and Collaboration, OCMA was able to take leadership in the following ways:

- Appoint Editors for Resource Collections in the OCMA Math Knowledge Exchange Network.

- Appoint local departmental representatives to serve in the role of "Faculty Colleague." Ten colleges were directly involved through appointment of local department representatives; others participated via sessions at the OCMA face-to-face events.

- Work directly with staff at Seneca College who developed the initial software platform (as a customization of an existing platform, see note below under *Additional Impacts*).
- Liaise with parallel initiatives in the U.S., at both national and regional levels.
- Sponsor executive briefing sessions for the Colleges Ontario Committee of Vice-Presidents Academic on the OCMA MathKEN.

Weaknesses: Like many voluntary organizations, OCMA has a limited kernel of committed members and a wider network of peripheral participation. The OCMA members recruited to fill the various roles as Project Leaders, Editors, Moderators and local catalysts took on these responsibilities as additions to their existing OCMA roles and in most cases without reduction in their teaching responsibilities.

In other contexts, leadership roles at the department level would have proceeded in partnership with Mathematics department chairs: in the parallel developments in the U.S., several chairs personally engaged as the departmental Faculty Colleague to signal a strong commitment. In Ontario, many colleges do not have separate Math departments and the faculty members teaching Math are based in application programs. This had two impacts on the organization of the network: a college Faculty Colleague was often isolated from many of the other OCMA members at the college, and chairs/division heads with close ties to OCMA were not available to serve as mentors and supporters.

In retrospect, the speed with which the leadership roles were filled from the ranks of active OCMA members was not matched by the provision of training and resources for their roles. There was also no private workspace within the MathKEN online platform for the leadership team to conduct its affairs, including a place for the team members to raise questions about what was expected of them and to be encouraged – and challenged – by success stories and scenarios from around the network.

The OCMA MathKEN also had to move quickly to a self-reliant enterprise model. Their planned funding for 2010-2011, the second year of operation as the OCMA MathKEN, was significantly reduced and they used this as a spur to move away from the Seneca online platform, which despite its modest support costs would not serve as a platform going forward. The change to a new platform – the Curriki.org curriculum repository/wiki – was technically smooth but still disturbed operations. The net effects of these various factors was that the enthusiasm of team members and the creation of a robust online structure was not followed up with targeted opportunities attracting further engagement of other OCMA members. The network got “all dressed up” but without plans in place for “somewhere to go.”

Conclusions: The leadership team is committed to continuing and improving their activities in 2011-2012 without HEQCO funding support. The issues around leadership roles have been addressed with better resource and success scenarios from the parallel developments in the U.S., and the timetable for future KENs has been adjusted to allow a longer ramp-up time and more capability development within each college. In addition, a new focus for collaboration is being instituted as a Collection in the OCMA MathKEN and a web-based professional development program, as a Learning Improvement Research Network. This will incorporate

emerging ideas from the Carnegie Foundation in the U.S. and provide professional growth opportunities for members interested in scholarly work in teaching and learning.

Additional impacts: The HEQCO research program was instrumental in the design of the Knowledge Exchange Network for the Colleges Ontario Occupation-Specific Languages Training project (with Citizenship and Immigration Canada). In turn, this project provided the software infrastructure for the original OCMA MathKEN site and for the ongoing Knowledge Exchange Network for Aligning and Building Curriculum (although each project separately funded custom developments and user support specific to their initiatives).

Presentations:

- Carey, T.T., V. Lopes and E. Pierre; Building a Knowledge Exchange Network for Educational Development: "Be the Change…", 2009 Winter Conference, Canadian Educational Developers' Caucus, Oshawa ON, February 2009.

Faculty Development projects

The final project in the KMETL program illustrates a successful collaboration with educational developers across colleges. The faculty involved had all been appointed by their colleges to develop new curricula, typically as a team of two to four colleges. In any given year, it is unlikely that there will be many instances of college teams in the same discipline. The envisioned knowledge exchange therefore has different dimensions:

- in the short term, sharing expertise in the processes and tools of curriculum development with future teams assigned to this task (from any discipline);
- in the longer term, sharing expertise and resources specific to a subject area with future teams developing curricula in that area.

Background: A consortium of six colleges in Eastern Ontario have been working together for the past eight years to support faculty as they work to design, review and revise curriculum at both the program and course level. Eight cohorts of faculty from the contributing colleges have participated in a two-part program called Aligning and Building Curriculum (ABC).

In fall 2008 this group launched an ABC Curriculum Resource Project. Phase 1 of the project focused on developing a website to house a variety of curriculum resources, tools and web links that are useful to ABC participants as they engage in curriculum work. The resources are organized to support a conceptual framework for curriculum design (Curriculum Road Map) that was developed by this group to frame curriculum work in college programs. More information about the program can be found on the program website at http://innovation.dc-uoit.ca/abc/.

In 2009-2010, with the support of the HEQCO research program in Knowledge Mobilization for Exemplary Teaching and Learning, the participating colleges were able to build on this past work to engage ABC participants in using a knowledge exchange network (ABC-KEN). ABC-KEN allowed them to share knowledge about curriculum, case studies of curriculum development and new resources for faculty learning the curriculum development process; all of these are now available and in use by subsequent cohorts of ABC participants and to others

working on curriculum in Ontario's colleges. Curriculum information, tools and links to curriculum cases and the ABC-KEN site can be found on the ABC Curriculum Resources website at http://abcresource.loyalistcollege.ca/index.htm.

Based on their initial success, it is the plan of the leadership team that by 2012-2013, a provincial curriculum knowledge exchange will be established and will be used for the ABC-KEN activities and similar efforts by colleges in other Ontario regions. To that end, in 2010-2011 the team undertook the following activities to extend their work from the original six colleges in Eastern Ontario:

- Five additional colleges participated in the ABC activities - George Brown, Lambton, St. Clair, Niagara and Sheridan Colleges - as part of the plan to share resources and effort across Ontario.
- Colleges from outside the Eastern Region were asked to contribute curriculum development resources for use across the province. These are now being incorporated into the ABC-KEN, including a contribution from Centennial College to the case study collection.
- Various planning activities took place to support the design and development of a province-wide Resource Centre and Knowledge Exchange Network for curriculum development:
    - visioning workshops with the Ontario Curriculum Development Advisory Group (CDAG);
    - formation of an Advisory Committee consisting of 12 college representatives (and Tim Klassen from the Ontario College Quality Assurance Service); and
    - A draft set of design principles was subsequently circulated to the Advisory Committee, to the ABC Planning Team and to the CDAG executive.

- During May and June several members of the Curriculum Development Advisory Group approached their academic vice-presidents and reviewed the draft proposal to the Colleges Committee of Vice-Presidents Academic (CCVPA) requesting support for the province-wide KEN project. The positive response from the Vice-Presidents has prompted a request to bring the province-wide KEN proposal to the next CCVPA meeting in November 2011. Durham College has offered to manage financial matters for the province-wide KEN once funding is confirmed.

Strengths: as with the OCMA MathKEN, this project benefited from an existing collaboration, the ABC project team which has been functioning successfully for several years. Unlike the OCMA MathKEN leadership team, the ABC team was using the ABC-KEN in direct support of their primary job responsibilities, and benefited from additional team members with dedicated time for the project.

The team has also been careful to engage other curriculum development leaders across the province through the Curriculum Development Advisory Group, and has produced an effective business case and budget for long-term support. They expect to demonstrate the returns on investment that will come to the colleges from a modest startup expenditure and low ongoing

operating costs. (They have also requested one-time funding from HEQCO for evaluation research to demonstrate the benefits.)

Weaknesses: We have not been able to find additional networks of curriculum development specialists who are sharing resources and promoting the development of shared resources by faculty engaged in curriculum projects. This limits the "network effects" because there is not yet a critical mass of other jurisdictions that have followed Ontario's lead in supporting curriculum development through a knowledge exchange network.

Conclusions: this has been a powerful example of the potential for collaborative efforts with new technologies to enhance teaching quality and student success. We hope the team will be able to share this beyond Ontario to encourage others to follow up and extend the network effects.

Additional impacts: Based on the work in the ABC Knowledge Exchange Network, in Spring 2011 a group of college faculty engaged in a collaborative redesign and resource development project requested assistance in setting up a collaborative knowledge exchange workspace to support their efforts. The project involved extending the Dental Hygiene curriculum across six Ontario colleges from a two-year to a three-year program. While this request could not be accommodated while the HEQCO KMETL program was in the 'wind down' stage, it did reaffirm that other promising opportunities will arise for faculty collaboration across Ontario institutions to advance the quality of teaching and student success.

Moving Forward on Faculty Knowledge Exchange Networks for Exemplary Teaching & Learning

In conclusion, we offer here some further reflections on how the Knowledge Exchange Network model for faculty collaborations within a subject area has evolved as a result of the HEQCO research program and how it can continue to move forward for the benefit of educators and students in Ontario. These are based on what we have learned in Ontario over the duration of the OCMA MathKEN initiative as described above, and what has been learned in parallel projects elsewhere.[2]

The Knowledge Exchange Network model developed and demonstrated in the 2008-2009 and 2009-2010 academic years focused on faculty teams across colleges engaging in cooperative knowledge-sharing to support one another in projects within their individual colleges to enhance student success in their courses in Mathematics. The 2010-2011 work was an intentional step beyond the original model toward effective networks of practice[26] for faculty to share in knowledge mobilization, knowledge exchange and knowledge-building about teaching and learning in their subject area.

[2] The Aligning and Building Curriculum KEN is unique to Ontario so there is not as much evidence from parallel projects to inform further developments within the province.

The future plans for the OCMA MathKEN include the following general directions, reflecting the lessons learned in the HEQCO projects and leading projects elsewhere[3] and applicable in faculty collaborations for other subject areas:

- Frame the program as an ongoing provincial Knowledge Exchange within a larger subject area Network: a social and technological infrastructure to support faculty engagement in cooperative knowledge building, knowledge exchange and knowledge mobilization about exemplary teaching for student success in learning Mathematics and to support faculty scholarship on the teaching of Mathematics.
- Develop the professional social infrastructure through a leadership team of departmental representatives ("Faculty Colleagues") who serve as resource persons and catalysts for engagement of Math faculty at their colleges.
- Provide course release time or stipends for Faculty Colleagues during the startup phase.
    - Revise the expected division of time commitment for faculty receiving such support as new Faculty Colleagues:
        - from a targeted 80/20 split (in the initial MathKEN work) between (i) work on a personal or departmental teaching project and (ii) supporting colleagues on the MathKEN team;
        - to a targeted 40/30/30 split between (i) knowledge exchange to support personal teaching enhancements, (ii) support for colleagues on the regional team and contributions to develop the regional Knowledge Exchange, and (iii) engaging college Math faculty in the Knowledge Exchange activities.
- Develop the technological infrastructure through a public workspace for use by participating faculty (replacing the private group workspace, but including an embedded private workspace for use by the KEN leadership team).
- Move toward the critical mass necessary to provide faculty with connections to colleagues with shared interests:
    - Integrate with other open educational resource activities in subject area, including parallel Canadian programs such as the BCcampus Shareable Learning Resources Repository, and programs outside Canada such as the National STEM Digital Learning Initiative and the MERLOT Network;
    - Connect faculty with other programs by linking the provincial Knowledge Exchange into a larger subject-area Knowledge Exchange Network.
- Develop a new leadership role for provincial Knowledge Exchange Coordinators to support the provincial leadership team, coordinate networking with other regions, and share leadership in securing development from external funders and sustainability support from institutional academic leaders.

[3] E.g., the affiliated Knowledge Exchange Network in California community colleges, supported by grants from the William and Flora Hewlett Foundation and the (U.S.) National Science Foundation.

End Notes

[1] http://www.heqco.ca/en-CA/Research/Research%20Publications/Documents/Knowledge%20Exchange%20Network%20Summary%20(English).pdf

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Characterizing the Impact and Diffusion of Transformative Engineering Education Innovations, National Academy of Engineering, February 7-8, 2011

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