11 University Educators and Disciplinary Specialists Working Together to Enhance Community Outreach and Deepen K–12 Teacher Content Knowledge

Angie Hodge, Cindy S. York, & Janice Rech

University–community partnerships are not a new idea. Partnerships can be based on a number of different concepts, such as service learning, community-based applied research, community-based training programs, authentic learning experiences for university students, as well as others. Community can also be defined in different ways, such as local organizations, institutions, agencies, neighborhoods, individuals, social groups, and so on. Our chapter is about partnerships between university content specialists, university education specialists (discipline-based education researchers), and K–12 teachers. First, we discuss the benefits of university–community partnerships, having a shared vision, discipline-based education and science, technology, engineering, and mathematics (STEM) reform, and how these all tie together. Then we discuss our university–community partnership via the Omaha Area Math Teachers' Circle. This chapter will also connect it all with a discussion on what made our partnership a success, as well as some challenges encountered and how we overcame them. Ideas for future research and ways for other institutions to start similar partnerships in any content area will conclude this chapter.

Benefits of Partnerships

Studies have shown that there are a number of benefits to having effective, meaningful, and significant university–community partnerships (Bouwma-Gearhart et al., 2014; Soska & Butterfield, 2013). Identifying those benefits for everyone involved in the partnership helps to clarify expectations, partnership roles, and intended outcomes. University–community partnerships can enhance university research, teaching, and learning and community recognition and status (Buys & Bursnall, 2007, p. 82). Buys and Bursnall (2007, p. 82) described some of the university–community partnership benefits as:

> . . . additional sources of funding, international research collaboration opportunities, increased publication output, development of "cutting-edge" research projects,

> enhanced research skills and opportunities to inform practice through applied research. Teaching and learning outcomes include enhanced quality and relevance of teaching curriculum, increased student placements, student access to applied projects, increased student enrolments and increased job opportunities for students. These research and teaching outcomes, in turn, enhance university profile and status through national and international recognition and mass media exposure, and raised profile of faculties, schools and research centres.

Specifically, in our case, some benefits for our university partners have been gaining greater knowledge of K–12 teaching and learning, making connections with practicing teachers, informing the university teacher education program, and learning new subject matter. Benefits to K–12 teachers include gaining enhanced content knowledge, making connections with other teachers, making connections with the university, learning new ways to teach, and learning about "new" subject matter and innovative ways to teach this subject matter. Ultimately, well-established models of effective partnerships can "build relationships with the immediate community, improve [university] image and support, and increase funding or recruitment or retention of students" (Holland & Gelmon, 1998, p. 105). This is something we have aimed to do with our Omaha Area Math Teachers' Circle.

Shared Vision

No matter the approach to or benefits from university–community partnerships, a shared vision or goal should be delineated (Pharo et al., 2013). This could include community change, authentic learning experiences for university students, professional learning experiences for community members, building a reciprocal learning relationship, and so on. We aligned our shared goal with the national Math Teachers' Circle Network, which states that, "The mission of the Math Teachers' Circle Network is to support teachers as mathematicians, to connect mathematics professors with K–12 education, and to build a K–20 community of mathematics professionals" (MTCN, 2017). In our case, the shared goal is one that is specific to mathematics; however, this goal could be modified to the needs of any discipline. For example, if history was your subject area focus, you could replace mathematics with history and mathematicians with historians. Essentially, we are connecting university discipline specialists, discipline-based education researchers, and K–12 educators in a way that strengthens each group involved.

Stronger Together

In order to fully understand the value of the players involved in this university–community partnership, it is helpful to understand what discipline-based education research is and the value of including such people in this type of university–community partnership. In the STEM fields, there has been a term coined for researchers who specialize in discipline-based education research, namely

DBER. Due to calls for improving undergraduate STEM education (Ferrini-Mundy & Güçler, 2009), a focus on how students best learn content knowledge at the university level has arisen. Specialists in DBER have gained widespread recognition for their work in all arenas from special journals on undergraduate education to job searches specifically seeking such researchers. These researchers inherently come with a focus on wanting to understand how people best learn content-specific knowledge. Having such people in a university–community partnership helps bridge the gap between K–12 education and university education, as well as puts groups together with a shared vested interest in teaching content knowledge. These specialized university faculty bring a focus on research-based content learning to the partnership, while K–12 teachers bring practical knowledge to the table from being in a K–12 classroom on a regular basis. Together, when learning new content and/or sharing ideas, they can learn from each other. Talanquer (2014) agreed and stated that DBER faculty would benefit from collaborations with others in order to determine how their work fits into the bigger picture and to have their work be impactful on a broader scale. Hence, we stress the value of having these different players interact in university–community partnerships that are similar to our Omaha Area Math Teachers' Circle.

Although the mission of the national Math Teachers' Circle Network is to focus on mathematicians, the Omaha Area Math Teachers' Circle has extended a welcome to other disciplinary specialists in order to enhance the quality of the circle. For example, we have had faculty in instructional technology provide sessions on technology integration in mathematics utilizing free web tools. We also had a session on Bricklayer coding and how it seamlessly integrates with mathematics. Prior to the solar eclipse, we also hosted sessions where specialists in astronomy taught both safety about the eclipse to the audience and STEM lessons related to this unique event. The possibilities are endless for any discipline to make their circles interdisciplinary and open to a wider group of partners. By becoming interdisciplinary, broader applications of education can become more authentic learning experiences for everyone involved.

Disciplinary Outreach Program

Math teachers' circles are one example of interdisciplinary outreach in the STEM fields that can engage a wide audience, including university professors, preservice teachers, and K–12 STEM teachers. We use mathematics/STEM as our content area focus, but such content circles could be created in any discipline. In fact, later in this chapter, we will discuss how a calculus teachers' circle evolved out of our math teachers' circle model. Similar specialization to any content area could occur following this model. This section should be read with an open mind regarding how one could create either a disciplinary circle or an interdisciplinary circle in other fields.

Currently, once a month during the academic year, faculty at the University of Nebraska Omaha (UNO) arrange a Math Teachers' Circle meeting, and although

faculty from the mathematics department lead the event, the individual session leaders have been from various STEM disciplines, including computer science and science education. Some may call this event a problem-solving night or a math club for teachers. The purpose of the events is that everyone who attends can participate in mathematical thinking and mathematical problem-solving at some level. Although the mathematical content is essentially geared toward middle school teachers, the events regularly get attendees from across the gamut of K–12 schools. In fact, many university professors and pre-service teachers also attend the events. We will discuss ways in which this partnership between departments and the community allows for such a diverse audience to interact together at the same events (and for all to get something out of the circle).

Omaha Math Teachers' Circle

In order to more completely provide the reader with the results we have learned over the past eight years, we must describe our own Omaha Math Teachers' Circle context. As you read this chapter, please note that although mathematics is the content area discussed, these circles could be implemented in any content area. These content circles, of which ours is described in detail in the following section, have been successful across the country. However, not all of them have sustained attendance from content specialists, education specialists, and K–12 teachers for years like ours has.

What has made our particular circle so successful and allowed it to withstand the test of time? How have even more groups become engaged over time? Who are these new groups being engaged in the content circle? How has engagement played a role in the success of this circle? In order to help answer these questions, the long-standing success of our content circle in mathematics has been analyzed and outcomes will be shared.

The initial Math Teachers' Circle session held in the area was a result of a partnership with the University of Nebraska – Lincoln (UNL), and specifically through NebraskaMATH. NebraskaMATH is a "statewide partnership that works to educate and support Nebraska's K–12 students and teachers at critical junctures, with an overall goal of improving achievement in mathematics for all students and narrowing gaps of at-risk populations" (UNL, 2017). We used a modified version of a national model called "Math Teachers' Circles" (Donaldson et al., 2014). Faculty from both campuses (UNL and UNO) worked together to bring public school teachers together in an interactive night exploring ropes and knots with UNL mathematics faculty. The fire was lit! From that initial meeting, relationships formed between UNO faculty, UNL faculty, and, most importantly, the public school teachers. The K–12 teachers were eager to continue meeting and being engaged in higher-level mathematics. The mathematics was presented at a very accessible level, and middle school teachers left with the feeling that they could really "do" higher mathematics – more than just being able to memorize formulas and do rote work. The faculty from UNL had successfully launched Math Teachers' Circles in the

Lincoln area. With their assistance, the Omaha Math Teachers' Circles were off to a great beginning. The reins were handed over to the UNO faculty, who further refined the circles and made them truly "their own."

UNO faculty from both teacher education and mathematics were involved in the program's success, but the mathematics faculty were the leaders in terms of organization in this effort. The need to connect with the public school teachers and administrators appeared to be a logical next step. Developmental planning took place, with the mathematics faculty leading the efforts and school personnel providing necessary input. The greater Omaha area simultaneously engages the following three major groups of people: (a) mathematicians, (b) mathematics educators (discipline-based education researchers), and (c) K–12 teachers on a regular basis. The first meetings were held at a local public school, in close proximity to the university. However, numbers quickly dropped (among all three groups of attendees), and we had to problem solve to find a way to bring back that initial excitement for the university–community partnership members.

In the next year, UNO hired a community chair whose job description included outreach to the community, in particular outreach to K–12 teachers. She was involved in Math Teachers' Circles at her former institution and believed strongly in the value of this university–community partnership for everyone involved. However, she heard about the declining attendance at the Omaha Area Math Teachers' Circles and wanted to find out why numbers were dropping. To discuss the future of the Math Teachers' Circles, the new community chair set up a meeting with the mathematics curriculum coordinator, the DBER faculty, and the education faculty who specialized in mathematics at the university to discuss best options for the group.

The attendees of the meeting were able to brainstorm ideas to try to revive the circles. It was determined that the facilities at the university would better meet the needs of the groups. They also decided that having regular meeting times (such as the first Tuesday of each month) would help teachers plan better, as they would know when the meetings were going to be held and save the date. In addition, the possibilities of utilizing local expertise and also national leaders in mathematics education at the circles were discussed. A combination of both resources surfaced as the best option for the future of the group. Local experts were important, as they often provided an immediate connection for teachers throughout the area, and they promoted a level of confidence in the community of teachers. The combination of local and national experts was an excellent choice for the circles. The Math Teachers' Circles clearly represented a coming together of like-minded people who were interested in bettering themselves as mathematicians in order to better serve their students.

There were many details to consider when making final arrangements for the Math Teachers' Circles. Things that had worked well for the circles in Lincoln were not always considered the best option for the Omaha teachers. For example, we abandoned the idea of serving a light dinner to participants, as was standard practice in Lincoln (and many other circles across the country). After consulting with local teachers, we found that the desire was to wrap up the Math Teachers' Circles in time to be home for

dinner with families. Teachers would be more receptive to invitations to participate if there was a demonstrated respect for their time and energy. The Math Teachers' Circles were not only to be well worth their time based on what we did at the events, but the time of day in which we met was also to be best suited for teachers with families at home as well. This is not always the case across the United States, so we recommend surveying your audience members to determine if a meal or light refreshments is best. Most circles meet at around dinnertime and provide a social break mid-meeting or at the beginning of the meeting. This provides time for networking among the groups of attendees. The Omaha area has heavy traffic, and the area is very family focused, so for our attendees, this modification suited their needs best.

With all items under consideration, the time was set for meetings, right after school, yet before family dinner. The location was to be the Alumni House of the university. Excellent facilities were available (rooms with tables and ample space for collaboration), with easy access to the middle of the city and ample parking. Additionally, catering service was available to provide snacks for all participants. The physical setting was excellent (you will have to define what "excellent" means for your particular content group, but we suggest spaces that encourage collaborative learning) and provided a welcoming environment for teachers. The location met the needs of the group and provided a backdrop that was upscale. If teachers were to dedicate time outside of their workday to another learning opportunity, we thought they should be treated exceptionally well.

To provide quality presenters in a first-rate locale required financial support. For years 2 and 3 of the program, we had a small grant from the American Institute of Mathematics to purchase refreshments and supplies, as well as to provide stipends for speakers. After that support was used, we found funding through the Dual Enrollment program with local schools. High school students in local schools that have a Dual Enrollment arrangement with UNO may receive university credit in calculus in the Advanced Placement Calculus course. The university directs a portion of all funds generated directly to the mathematics department. The mathematics department works closely with local schools to discern the best options for fund dispersal, with the ultimate goal of providing assistance to teachers and students. This assistance has taken on many forms, including teacher scholarships and student mathematics competitions. It was a logical extension of the Dual Enrollment program to use funds generated by the schools to benefit more mathematics teachers in those schools. In order to fill the calculus pipeline with highly qualified students, good mathematics teachers were needed at each level that leads up to calculus. Funding Math Teachers' Circles that serve K–12 teachers (often middle school teachers) is an excellent strategy to ensure motivated mathematics students are entering the local high schools.

The Math Teachers' Circles began with dialogues and discussions with local public school teachers and administrators. It was soon obvious that there was a large population of teachers who were not represented in these discussions. The city of Omaha has over 25 Catholic K–8 schools that serve thousands of children throughout the metropolitan area. Efforts were initiated to reach out to the elementary school principals. The students in the Catholic schools and the teachers are often not invited to participate and attend professional development offerings. The Math

Teachers' Circles provide a great opportunity to include these dedicated teachers and bring them together as part of a broader community of mathematics teachers throughout the area.

Over the past eight years, the Math Teachers' Circles have continued to exist, but have experienced growing pains along the way. Attendance has fluctuated, and the university faculty members have at times struggled to attract large numbers to the circles. Tapping into local expertise, particularly teachers who were already well known and well respected within the city, has been a strategy that has piqued interest and brought several new teachers to the circles. Joint planning efforts with the public school administrators has also been helpful in this regard. Attendance was at times counted toward professional development hours for teachers.

The development of the STEM programs within the teacher education department has also provided new directions for the Math Teachers' Circles. Teachers came together to learn about the upcoming solar eclipse and be better prepared to share the experience with students. New programs to help students learn to code and expand their mathematical thinking was introduced to teachers through a Math Teachers' Circle as well. Mathematics has so many connections with the STEM fields that the branching out to these areas became a natural extension.

There were clear benefits being realized by the teachers who participated in the Math Teachers' Circles, but calculus teachers did not always benefit from the circle events. Hence, the structure was copied and utilized in the development of Calculus Teachers' Circles. In many schools, there is only one calculus teacher. That person often works in isolation, with no other teacher to discuss ideas and compare notes with. The Calculus Teachers' Circle was created to address that need. Nationally known experts in the teaching of high school calculus were brought to campus. They shared teaching strategies and concept development with local high school teachers. Teachers were provided opportunities to actually "dig into" the calculus material and have lively discussions about content and the deep conceptual understandings that underlie the calculus course.

The Empirical Study

To kick off the program, we had a teacher quality grant that let us do two one-week workshops for teachers in the summer (one per summer for two years). For one week, these participants engaged in Math Teachers' Circle activities daily. After each week-long program, the survey in Table 11.1 was administered. The survey was given to each participant in pencil/paper form, and the researchers typed up and analyzed the responses as part of a report for the Teacher Quality grant.

From this initial survey, we learned about our area teachers and the needs of theirs that we could attend to in monthly Math Teachers' Circles. The monthly Math Teachers' Circles were extensions of the summer programs, but all were encouraged to attend the circle events. They were also encouraged to bring a friend, and sometimes there were door prizes that they could enter to win if they brought another teacher to the event.

Table 11.1 *Survey provided to Math Teachers' Circle participants*

1. Teaching experience	(a) Student (b) First-year teacher (c) Teacher of 6–10 years (d) Student teacher (e) Second-year teacher (f) Teacher of 11–20 years (g) Para-professional (h) Teacher of 3–5 years (i) Teacher of over 20 years (j) Administrator
2. Gender	(a) Female (b) Male
3. Race/ethnicity	(a) White, non-Hispanic (b) Black, non-Hispanic (c) Native American (d) Hispanic (e) Asian/Pacific Islander (f) Other
4. Grade/s taught (or planning to teach)	(a) Elementary (b) Middle/junior high (c) High school (d) Other
5. Subject/s	(a) Math (b) Science (c) English/Language Arts (d) Geography/History/Social Studies (e) Fine Arts (f) Foreign Language (g) Self-contained class (h) Other
6. Approximate percentages of students who are	(a) White, non-Hispanic (b) Black, non-Hispanic (c) Native American (d) Hispanic (e) Asian/Pacific Islander (f) Other
7. Approximate percentages of students who qualify for free/reduced lunch	(a) 0–24% (b) 25–49% (c) 50–74% (d) 75–100% (e) Don't know
8. School location is	(a) Rural (b) Town/city
9. School is	(a) Public (b) Private

Table 11.1 (*cont.*)

10. School size (number of students)	(a) 1–25 (b) 26–50 (c) 51–100 (d) 101–200 (e) 201–500 (f) 501–1,000 (g) Over 1,000
11. Average number of students taught each year	
	1 = lowest/least often
12. Understanding of core content in my discipline	1 2 3 4 5
13. Effectiveness as a teacher	1 2 3 4 5
14. Enthusiasm about teaching in my subject area	1 2 3 4 5
15. Students work in groups cooperatively	1 2 3 4 5
16. Students learn concepts and processes through hands-on approaches	1 2 3 4 5
17. Material is presented through teacher-led lectures	1 2 3 4 5
18. Student progress is assessed using conventional methods (e.g., paper and pencil exams)	1 2 3 4 5
19. Instructional technology is used in the classroom	1 2 3 4 5
20. Appropriate instructional techniques were used for reaching the objectives	1 2 3 4 5
21. Sufficient time was provided to achieve the objectives	1 2 3 4 5
22. Adequate follow-up was provided	1 2 3 4 5
23. Useful methods were suggested for transferring new knowledge and skills to the classroom	1 2 3 4 5
24. As a result of the Math Teachers' Circle (MTC) activity, I am better prepared to teach	1 2 3 4 5
25. As a result of the MTC activity, the quality of student work and achievement has improved	1 2 3 4 5
26a. Please specify why you do or do not feel better prepared to teach	
26b. Please give any examples of improvements in student learning in your classroom	

Additional surveys were administered at several of the Math Teachers' Circle events to gain a sense of participant satisfaction, both in terms of logistics (e.g., location, time of day, parking, food) and content (e.g., mathematical topics). See Table 11.2 for survey details.

We customized each survey to match up with the activity that was held at that particular Math Teachers' Circle meeting. The one provided here was given during the last ten minutes of the Math Teachers' Circle session on the mathematics behind the game of SET (a card game that has a variety of mathematics in it). This is a card game that can be played solely to practice thinking and pattern-building skills with young kids all the way up to thinking about high-level probability and geometry with university students. Our intent with the surveys was to learn about a the following items: (a) what the teachers liked/disliked about the circle; (b) how they found out

Table 11.2 *Participant satisfaction survey*

Q1: What did you think about today's mathematical activity?	o I really liked the game o It was fun o Terrific o Engaging o Fits in with teaching requirements o Will share with eighth graders/students o Never played o Loved it o Liked it o Great information on how to use it in class o Challenging/critical thinking
Q2: What did you find most enjoyable about the session?	o Playing the game o Learning how to relate it to teaching o Working on the questions with others o Learning the math behind the game o The presentation was engaging o How it could be used to teach math to students
Q3: How do you think we could improve our future presentations and events?	o Nothing o Local teacher who has used the product being present o Put people at the same table who have played the game already to make it more challenging o More people o More time o Can purchase game on site
Q4: What mathematical practices or problem-solving behaviors did you observe?	o Statistics o Critical thinking o Grouping o Elimination o Justifying your answer o Working together o Unwillingness to be wrong
Q5: This presentation was	(a) Very interesting (b) Somewhat interesting (c) Not that interesting
Q6: I found this presentation	(a) Very informative (b) Somewhat informative (c) Not that informative
Q7: I found this presentation	(a) Very fun (b) Somewhat fun (c) Not that fun
Q8: How did you hear about this event?	(a) Email (b) Newsletter from Lincoln (c) Omaha Public School Math Supervisor

Table 11.3 *Email survey example questions*

1. What keeps you coming back to the Omaha Area Math Teachers' Circles?
2. What keeps your colleagues who do not attend the circle events from attending?
3. What has been your favorite circle event and why did you like this event so much?
4. Please comment on the logistics of the events that you have attended (timing, parking, location, food). What can we do to improve upon the logistics of the circles?
5. Did you find the events useful for your classroom teaching? Why/why not?

about the circle; and (c) what we could do to make the circle better for them. We often added an open-ended question or two at the end of the surveys so that they could comment on the circle. We would read, type up, and analyze the results immediately following each event. In this way, we could respond to the teachers' needs as quickly as possible, if meeting these needs was feasible.

In addition, informal surveys (see Table 11.3) and emails were frequently sent to K–12 administrators to continually meet the growing needs of the community in the Omaha area. This community included both public and private schools, as the Omaha area has a large number of private Catholic schools that we determined were not always included in university–community partnerships.

The results of all of these surveys, as well as informal discussions with administrators, informed our decisions about future Math Teachers' Circle topics and logistics. Often, these informal surveys were discussed with the leaders of the Math Teachers' Circle before the next one was planned. We wanted to be as attentive as possible to the needs of our local teachers so they would continue to enjoy the events and gain valuable skills from our circle events.

Outcomes and Successes

One might wonder how a program with so many partners can be sustainable. What is it that made this program one that is still highly attended eight years after its formation? Here, we discuss the main components that can help you create your own successful and sustainable content circle.

The first success is related to the interdisciplinary university–community partnership that UNO has formed with the Omaha area schools. As described above, this partnership was founded on a statewide partnership entitled NebraskaMATH. Beginning on a solid foundation with dedicated team members in the university–community partnership has helped this program last many years.

The second success is related to the planning and the logistics of the Math Teachers' Circle events. This success is also coupled with some lessons learned along the way and being attentive to the constituents of the circle. Being aware that the needs of the constituents may change over time and being willing to try new things along the way has helped with the sustainability of the circle. For example, the circle has seen ebbs and flows over the course of its eight years. Our attendance at circle meetings has been as

high as over 50 people and as low as five people. Any time we noticed a drop in attendance for more than two meetings in a row (or when we could not explain the low attendance due to something like the weather), we examined the reasons for the lows. We had a contact person in the schools (in this case, it was the mathematics curriculum supervisor, but anyone leading professional development is also a good contact person). We would ask this person if there had been a meeting we had missed that teachers were required to attend or if there had been something else going on that we should have been aware of when planning our circles. Some of the items we learned to check for conflicts with on a regular basis were the following: (a) professional development meetings; (b) parent–teacher conferences; (c) state testing times; (d) timely content topics; (e) logistical issues in getting to campus; and (f) teacher suggestions. These suggestions allowed us usually to avoid time conflicts that would prevent large numbers of teachers from attending and have sessions that were meaningful to our local teachers. Thus, communication between vested groups is essential for a successful content circle.

In addition, we regularly surveyed our teachers to determine sessions that they would find engaging. Through these survey data, we learned that teachers really liked the sessions when there was something they could take back with them to their classrooms. They also appreciated it when a K–12 teacher helped with the planning of the events. This helped the community partners (the teachers) to gain buy-in to the circle. This last item recently helped us bring our numbers back up. The teachers felt that when a classroom teacher helped lead the sessions, there were always ideas that they could bring back to also engage their students differently in mathematics.

In summary, we suggest when starting a content circle, have a contact person in the schools who can help you with logistics and also encourage teachers to attend the events. Sometimes, they can even be given professional development credit for their attendance. We also recommend checking in with your audience on a regular basis, as their needs may change over time (both in terms of the time of day to meet up that works for them and topics that are most relevant for them in their classrooms).

Last, what happened at the Math Teachers' Circle events has contributed to the success of the partnership. The following section describes the components of the program that were the most valued and other parts that were modified to improve attendance and satisfaction with the events.

Corollary Successes

Teaching Engagement in Disciplinary Education

Aside from the relationship building that naturally occurs in this environment, perhaps the most valued part of the Math Teachers' Circles for all of the constituents was engagement with the content. Engaging any learner in the topic being taught is a necessary component; this includes K–12 teachers during professional development. We believed that for the success of the program, all of the partners needed to be engaged in the content. For this to occur, engagement with the content in mathematics means

doing mathematics. This means being actively engaged with the materials – solving problems, discussing problems, experimenting, and thinking. This high amount of engagement, we believe, has contributed greatly to the sustainability of our circle. Engagement being a critical piece of the success of the partnership is supported by Buys and Bursnall (2007), who agreed that there can be social engagement as well as content engagement during these partnership events. The feedback from surveys made it clear that all partners involved (especially the teachers) enjoyed sessions when they engaged with both mathematics and with the other attendees of the session. If a session leader, for example, lectured most of the time, there was often a lower attendance for the next circle meeting (sometimes we even noticed the next two circle meetings had lower attendance).

To help ensure active, engaging sessions, we would make the following suggestions: (a) invite the session leaders to attend a session prior to giving one themselves; (b) call these events sessions and not talks; (c) have the session leaders write in his/her abstract how they will engage the audience; and (d) invite people to lead sessions who you have seen engage an audience in the past.

Teaching Technology

Integrating technology into education and educational community outreach is not domain specific. In fact, it has been shown that if more methods teachers (university professors who teach pre-service teachers how to teach their content) integrated technology on a regular basis, the teacher education students would be more apt to do this when they get into the classroom (Inan & Lowther, 2010). Thus, by utilizing technology in the Math Teachers' Circle, more teachers should become comfortable with the ideas and thus effectively integrate technology into their own classrooms. With twenty-first century skills denoting the use of technology, we hope that our circles will entice K–12 teachers to try out more technologies and use them in their classrooms to meet the needs of their students.

The teachers viewed learning about new technology or ways to use technology in a fundamentally different way (often to engage students) as a positive aspect of our Math Teachers' Circles. Over the years, our teachers have learned how to use coding software and mathematics to design art, how to use mathematical computer games to engage students in the classroom, and how to use calculators to teach conceptual understandings of mathematics. These are just some of the examples of ways in which technology can be integrated into a content circle to promote technology-enhanced STEM education, a concept that Wu and Anderson (2015) have said is valuable in today's STEM classrooms.

Moving Forward

The Omaha Area Math Teachers' Circle has not only kept itself going, but has also branched off to form a new community partnership. Two of the

faculty partners in the Omaha Area Math Teachers' Circle leadership group decided to start an additional circle based on specific mathematical content, namely calculus. This partnership is called the Omaha Area Calculus Teachers' Circle. Each semester, UNO now hosts circles focusing specifically on the teaching of calculus at the high school level. Speakers have engaged the teachers in activities to provide them with opportunities to explore calculus further and to expand on their knowledge of calculus content. This "branching out" has created connections and communities that are different from those formed through the original Math Teachers' Circles. This shows how one partnership can lead to other partnerships. In the future, we hope to see other similar partnerships formed in other disciplinary (or interdisciplinary) fields – both in the Omaha area and from our readers of this book chapter.

Starting Your Own Circle

To help you all get started on forming a circle, here is a checklist of items that are helpful when starting your own engaging content circle.

- ☐ Choose a content area.
- ☐ Find a core team.
  - o Include content specialists.
  - o Include discipline-based education research specialists.
  - o Include K–12 partners (e.g., teachers and administrators).
  - o Determine the best way to communicate among team members (phone, email, video conference, in-person).
  - o Clarify the vision, goals, and/or objectives of the circle.
  - o Clarity the benefits to each party involved in the partnership.
- ☐ Meet regularly.
  - o Find a convenient location (consider drive time, school finishing times, and parking).
  - o Find a good space (tables are usually welcoming for collaboration).
  - o Find a good time of the day to meet.
- ☐ Implement your circle.
  - o Find engaging, high-quality session leaders.
  - o Include K–12 teachers in leading the sessions.
  - o Find a way to fund refreshments (or meals).
  - o Find a way to obtain (or purchase) supplies.
  - o Survey your partners regularly to gauge satisfaction.
  - o Revisit your vision, goals, and/or objectives of the circle.

Possibilities for Collaborative Research Endeavors

In addition to creating a circle, research for university faculty can come about from the formation and study of such circles. It can be advantageous to invite the partners to also become involved in the research aspect, as it helps with partner buy-in, and they can see the results of the research being put into action. Cheruvelil et al. (2014) would argue that collaborative research is the best way for scientific work to be conducted. They stated that the best research teams include partners with a common vision – similar to those in university–community partnerships (Cheruvelil et al., 2014). Collaborative research allows for different perspectives to be brought to the table when thinking through a research plan, conducting research, and analyzing data. The next step in our circle's growth is to begin such collaborative research projects.

Conclusion

Ultimately, we hope this chapter has helped you to envision how you can start forming your own university–community partnership in your area, no matter your discipline. We close our chapter by reiterating the following four key issues that led to our program's success: (a) constituent convenience; (b) open resource distribution; (c) linkage to practical payoffs (professional development hours); and (d) progressive outreach to other relevant communities. A summary of the key issues and suggestions for resolving them can be found in Table 11.4.

Table 11.4 *Key issues*

Issue	Meaning	How to implement	Notes
(a) Constituent convenience	Find a location/time that fits the needs of your constituents	Survey constituents and talk to them to find out what these needs are	You cannot make everyone happy, but try to meet the needs of your target audience
(b) Open resource distribution	Make the program free and open to anyone who wants to attend	Advertise with flyers, emails, and through a curriculum supervisor	If the event gets too big, then implement a first come, first served sign up for the event, such as with Eventbright
(c) Linkage to practical payoffs (professional development hours)	Find a way to reward people for attending the event	Connect with a supervisor to determine what the practical payoff is for your constituents	If funds are low, this could be achieved via door prizes donated by local vendors
(d) Progressive outreach to other relevant communities	Make others aware of what you are doing	Invite colleagues and others to your events	You never know what other events could springboard off of your disciplinary circle from others attending your outreach program

We have provided our own experiences with the Omaha Math Teachers' Circle as an example of ways to form interdisciplinary university–community partnerships, along with some suggestions you can "take back" and implement immediately, just as our teachers enjoy taking back new mathematics ideas into their classrooms. Please do not hesitate to email any of the authors with questions if you wish to start your own disciplinary circle. We also offer workshops for a nominal fee for those wishing to get assistance in starting her/his own outreach program that will impact their local community.

References

Appleton, E., Farina, S., Holzer, T., Kotelawala, U., & Trushkowsky, M. (2017). Problem posing and problem solving in a math teacher's circle. *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education*, *6*(1), 33.

Baum, H. S. (2000). Fantasies and realities in university–community partnerships. *Journal of Planning Education and Research*, *20*(2), 234–246.

Bouwma-Gearhart, J., Perry, K. H., & Presley, J. B. (2014). Improving postsecondary STEM education: Strategies for successful interdisciplinary collaborations and brokering engagement with education research and theory. *Journal of College Science Teaching*, *44*(1), 40–47.

Buys, N., & Bursnall, S. (2007). Establishing university–community partnerships: Processes and benefits. *Journal of Higher Education Policy and Management*, *29*(1), 73–86.

Cheruvelil, K. S., Soranno, P. A., Weathers, K. C. et al. (2014). Creating and maintaining high-performing collaborative research teams: The importance of diversity and interpersonal skills. *Frontiers in Ecology and the Environment*, *12*(1), 31–38.

Cooper, J. G., Kotval-K, Z., Kotval, Z., & Mullin, J. (2014). University community partnerships. *Humanities*, *3*(1), 88–101.

Donaldson, B., Nakamaye, M., Umland, K., & White, D. (2014). Math teachers' circles: Partnerships between mathematicians and teachers. *Notices of the AMS*, *61*(11), 1335–1341.

Ferrini-Mundy, J., & Güçler, B. (2009). Discipline-based efforts to enhance undergraduate STEM education. *New Directions for Teaching & Learning*, *2009*(117), 55–67.

Holland, B. A., & Gelmon, S. B. (1998). The state of the "engaged campus": What have we learned about building and sustaining university–community partnerships. *AAHE Bulletin*, *51*(2), 105–108.

Inan, F. A., & Lowther, D.A. (2010). Factors affecting technology integration into the K12 classroom: A path model. *Educational Technology Research and Development*, *58*(2), 137–154.

Math Teachers' Circle Network (MTCN) (2017). *Mission*. American Institute of Mathematics. Retrieved from www.mathteacherscircle.org/about/missionandvision.

Pharo, E., Davison, A., McGregor, H., Warr, K., & Brown, P. (2014). Using communities of practice to enhance interdisciplinary teaching: Lessons from four Australian institutions. *Higher Education Research & Development*, *33*(2), 341–354.

Soska, T., & Butterfield, A. K. J. (2013). *University–community partnerships: Universities in civic engagement*. Abingdon: Routledge.

Talanquer, V. (2014). DBER and STEM education reform: Are we up to the challenge? *Journal of Research in Science Teaching*, *51*(6), 809–819.

University of Nebraska – Lincoln (UNL) (2017). NebraskaMATH. Retrieved from http://scimath.unl.edu/nebraskamath.

Wu, Y. T., & Anderson, O. R. (2015). Technology-enhanced STEM (science, technology, engineering, and mathematics) education. *Journal of Computers in Education 2*(3), 245–249.