

Pre-Post Workshop Outcomes for
ARG Fundamentals Workshop
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Executive Summary

The Affinity Research Group (ARG) model, developed at the University of Texas, El Paso (UTEP), is a comprehensive model for the creation and maintenance of dynamic, productive, and inclusive research groups (Gates et al., 1999; Kephart et al., 2008). UTEP is currently focusing on widespread adoption of the ARG model in STEM fields by creating mentoring and collaboration structures to support faculty in diverse institutions and across a variety of disciplines to adopt and disseminate the model. One of the first steps in supporting faculty to adopt and disseminate ARGs is to offer a “Fundamentals” workshop to increase faculty understanding of the model, enhance their ability to implement ARGs, and create a community of practice among ARG adopters.

Methodology

This mixed-methods evaluation study was designed to provide formative feedback to ARG developers on the ARG Fundamentals workshop design and activities, and to gather information on participant outcomes. The study focuses on changes in participants’ conceptual understanding of the ARG model, their beliefs about its effectiveness, and their strategies for adopting and implementing the model. The study was conducted through the use of pre- and post-workshop surveys. Participant observation during the workshop and informal conversations with attendees also provided feedback about workshop design, activities, and outcomes. Surveys were delivered electronically to all faculty participants one week prior and one week after the workshop. Overall, thirteen matched pre- and post-surveys were collected.

Results

Changes in participants’ understanding of the ARG model

Most faculty had little prior knowledge of the ARG model. In fact, faculty rated their knowledge of the model prior to the workshop as a 2.83 on a 5.0 scale (between “a little” and “some” knowledge). Five participants had some prior experience with ARGs and the rest had no prior experience. In written responses, faculty offered vague definitions of the model as “group work” or “working in teams,” but they did not demonstrate a deep or nuanced understanding of ARGs or cooperative learning. Prior to the workshop, many attendees did not use or seem to understand the terminology associated with ARGs or the theory underlying the model.

Faculty reported substantial gains in knowledge of the ARG model from the workshop. After the workshop, participants rated their understanding of the model as a 4.25 on a 5.0 scale (between “good” and “a lot” of understanding). Participants’ written responses

demonstrated deeper understanding of the model as they began to adopt the language and ideology of ARGs. Faculty also began to identify essential elements of ARGs that they would like to incorporate into their own practice, such as annual orientations, individual and group accountability, skill development, and cultural diversity.

Effective elements of the workshop

The majority of faculty reported that the most effective aspect of the workshop was the opportunity to engage in guided, reflective practice of the ARG model. The activity of planning and implementing a workshop or training with ARG elements, coupled with constructive reflection and feedback, deepened participants' conceptual understanding of the model and increased their confidence that they could effectively incorporate the model into their own groups. Faculty reported that they had intuitively known that cooperative learning is the ideal way to learn, but now they understood *why* these strategies are effective. One participant reported that she would no longer be “winging it,” but now had a systematic strategy to work with her research group.

The progression of adopters' understanding of the model

Overall, participants demonstrated a progression of learning and understanding, from basic conceptual understanding of the ARG model, to understanding the way the model works in practice, to mastering the nuances or more challenging aspects of the model. Survey responses and participant observation suggest that most faculty progressed beyond the first stage of ARG learning. After the workshop, most participants were in the process of mastering the second stage of gaining a deeper understanding and fluency with the model in everyday practice. A few more experienced practitioners had advanced to the final stage of fine-tuning the model and mastering the nuances of group dynamics. Assessment—both of student learning and model implementation--was another area of uncertainty for some ARG adopters.

Ongoing needs for support

Adopters gained confidence and knowledge from the workshop, yet some still expressed uncertainty about some of the more challenging aspects of cooperative learning, such as conflict management, developing group and personal social skills, and group processing. All participants expressed a need for check-ins with ARG developers throughout the year to discuss progress and trouble-shoot day-to-day implementation challenges and group processing issues. A few adopters also wanted feedback from ARG developers on their actual implementation of the model. A final challenge for faculty was assessing student learning from ARGs and the efficacy of their own ARG implementation.

Introduction

The ARG model

The Affinity Research Group (ARG) model, developed at the University of Texas, El Paso (UTEP), is a comprehensive model for the creation and maintenance of dynamic, productive, and inclusive research groups (Gates et al., 1999; Kephart et al., 2008). While traditional research groups often focus on recruiting the “best and the brightest” into research, ARGs focus on expanding opportunity to students who show promise but lack confidence or may not have excelled in traditional classrooms. The model involves the *deliberate design* of research groups whose members share a common purpose – an *affinity* – and it emphasizes the conscious development of students’ disciplinary knowledge, research abilities, and team skills, as well as their sense of professional identity and belonging. The ARG model is founded on two important research-based practices: the interaction among students and faculty outside the classroom to increase the likelihood of students persisting to graduation (Astin, 1985; Rodriguez, 1994; Tinto et al., 1994); and the use of cooperative learning techniques—*positive interdependence, face-to-face promotive interaction, individual and group accountability, group and professional skills, and group processing*—into the routine functioning of the group, which fosters group cohesion and increases the likelihood that members will be able to transfer skills to other situations. (Johnson & Johnson, 1989).

Dissemination of the ARG model

The ARG model has been disseminated through a handbook, multiple publications and presentations, and workshops. Evaluations of ARG workshops indicated that adopting the ARG model is challenging and more support and guided instruction are needed early in the process. Thus UTEP is currently focusing on supporting faculty in widespread adoption of the ARG model in STEM fields by creating intensive, collaborative support structures centered on ARG Hubs. An ARG hub is defined in the ARG CCLI proposal as a collection of three or more faculty who 1) use the ARG model to cultivate a climate where research skills and other ARG attributes are deliberately and intentionally practiced; 2) provide a support structure for faculty adopting the ARG model; and 3) document effective activities and practices.

The goals of the current funded project are:

- Goal 1: Develop faculty expertise by creating a self-sustaining support structure through which ARG adopters can learn, practice, and critically reflect on ARG core components.
- Goal 2: Improve the ARG model by reinforcing (addressing) the factors that enable (hinder) the adoption of the ARG model at geographically diverse institutions and across a variety of disciplines.

- Goal 3: Determine the impact and success of ARG in those settings.

The ARG fundamentals workshop

The data presented in this report are derived from pre- and post-workshop surveys and participant observation of the ARG fundamentals workshop delivered in El Paso on May 25-27, 2010. This workshop was the first of a professional development series of summer workshops. According to the CCLI proposal, the workshop series is designed to provide faculty with the opportunity to gain the knowledge, skills, beliefs, and attitudes of an ARG faculty mentor. The workshops are designed to engage participants in active, cooperative learning that simulates the ARG model itself and allows time for guided, critically reflective practice of the ARG model. The workshop series is also designed to meet individuals' varied levels of understanding and experience with the model. Faculty mentors were encouraged to bring students to the workshop to more effectively simulate an actual ARG environment.

The first workshop in the series is a "Fundamentals" workshop in which adopters learn about the essential elements of an ARG, including how cooperative teams function and how to plan activities and workshops that incorporate ARG elements. The guided instruction activities within the workshop allow attendees to critically reflect and give and receive feedback on their implementation of ARG activities. Thus the "objective of the Fundamentals program is to move adopters from an ad hoc model of research groups to a model with a reproducible process and systematic evaluation." According to the proposal, the expected faculty outcomes from the workshop are that participants will be able to:

- plan an ARG activity that structures cooperative elements;
- explain the differences between an ARG and traditional research groups;
- synthesize the feedback from the facilitator on their practice of ARG activities and improve based on the feedback;
- use the ARG Handbook as a resource;
- create a realistic plan for implementing ARG components throughout the year.

Research and evaluation design

This mixed-methods evaluation study was designed to provide formative feedback to program organizers on the workshop design and activities, and to gather information on participant outcomes. The study focuses on changes in participants' conceptual understanding of the ARG model, their beliefs about its effectiveness, and their strategies for adopting and implementing the model.

This study was conducted through the use of pre-post workshop surveys. Participant observation during the workshop and informal conversations with attendees also provided feedback about workshop design, activities, and outcomes. Videotapes of ARG implementation by hub leaders and follow-up surveys will provide future data. This report focuses solely on data collected from pre-post surveys of the 2010 ARG workshop and participant observation during the workshop itself.

This study may be of interest not only to ARG developers for improving and assessing their dissemination of the model, but of broader interest given the high numbers of undergraduates engaging in research in STEM fields and the importance of these experiences in diversifying the scientific and technical workforce. The ARG model captures promising practices in the professional development of student researchers and documenting and monitoring its adoption at other sites will provide insight into the transferability of the model to other contexts. Research and evaluation of the dissemination of the ARG model will help to determine which factors support or impede its adoption and success. This study should also provide insight into effective ways to disseminate the model and to train others in its implementation.

Therefore, the broader research questions—as defined within the proposal—guiding research and evaluation efforts are:

1. Which aspects of the model are essential to its implementation in order to achieve the goals of enhancing student retention, increasing undergraduates' enrollment in graduate school, and developing participants' research and professional skills and abilities?
2. What types of activities and forms of interaction are essential for preparing mentors and students to be able to implement the model?
3. What types of attitudes, predispositions, and ideologies toward cooperative learning and leadership do successful mentors display?
4. What types of institutional factors would support implementation, and conversely, what types of institutional obstacles might impede implementation?

The evaluation questions specifically addressing the ARG Fundamentals workshop hosted by UTEP in May, 2010 are:

1. What do attendees learn from their participation in the ARG workshop? What are the short- and long-term outcomes to faculty from their participation in the workshop?

2. How do participants' beliefs about the ARG model specifically, and cooperative learning and research mentoring more generally, change as a result of the workshop? What activities and interactions in the workshop fostered these changes?
3. What support do ARG adopters need to implement and disseminate the model?
4. How does implementation of the model vary in different contexts? Which aspects of the model are readily transferred to new contexts and which, if any, are challenging to adopt?

Data collection procedures

All faculty were invited to complete pre- and post-workshops surveys. The pre-workshop survey was sent electronically ten days prior to the start of the workshop. Two survey reminders were sent at four day intervals. Fifteen participants completed the pre-workshop survey. A post-workshop survey was sent electronically one week after the workshop. Two survey reminders were sent at one week intervals. Thirteen participants completed the post-workshop survey; therefore, there were thirteen pre-post matched surveys. All four hub leaders completed both pre- and post-workshop surveys.

Analysis methods

The quantitative data were entered into the statistical software package SPSS where descriptive statistics were computed. Frequencies are reported for most of the ratings items, and means for some of the multiple-choice items. Items are rated on a 5-point Likert scale. Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted because the small sample sizes for the surveys precluded meaningful statistical analyses of group differences.

Write-in responses to the open-ended questions were entered into *N'Vivo* qualitative analysis software and coded using procedures developed by Spradley (1980). Each new idea raised in a written response was given a unique code name. As these same ideas were raised by later respondents, each segment was added to an existing code reflecting that idea. At times the write-in answers were brief and represented a single category, but more frequently, responses contained ideas that fit under multiple categories, and these were coded separately. Codes were organized into larger, descriptive categories, or "domains." Domains were generated deductively, from the research and evaluation questions and theoretical concepts guiding this study, and inductively, from the data itself. The coding framework was organized into taxonomies linked by a semantic relationship, such as "a is a kind of b," or "a is a result of b." Componential analysis allowed for examination of outcomes and differences among groups, such as gender, ethnicity, prior experiences with research mentoring, etc.

Demographics of the survey sample

The data addressed in this report come from the matched set of thirteen pre-post survey respondents. Eight (62%) of the respondents were men and five (38%) were women. Workshop participants also reflected a range of career positions: six (46%) were assistant professors, 3 (23%) were associate professors, two (15%) held administrative positions, and one (8%) was a doctoral student. One participant did not respond to the career rank question. Workshop attendees were diverse: five (38%) identified themselves as Hispanic, five (38%) identified as Caucasian, and three (23%) identified as African-American.

Findings

Participants learned about ARGs from networking

Faculty were evenly split as to how they first heard about Affinity Research Groups. Five (38%) heard about ARGs from Ann Gates, five (38%) at a conference or meeting, and five (38%) from a colleague in their own department or another department. Participants mentioned a variety of meetings in which they first heard of ARGs: NSF BPC meetings, CAHSI annual meetings, NSF CCLI meetings, and the Grace Hopper conference.

Diversity, cooperative learning approach are attractive elements of ARGs

In an open-ended question, participants were asked why they were interested in Affinity Research Groups. ARG adopters cited a variety of reasons for their interest in the model and their desire to learn more about it:

- Desire to broaden participation in research for underserved groups (3 responses)
- Cooperative learning approach (3)
- To personally gain mentoring skills (2)
- Emphasis on student skill development (2)
- Desire to improve student outcomes (2)
- Addresses many of the challenges of mentoring undergraduate researchers (2)

A few participants felt that the cooperative approach found within the ARG model not only helps to broaden participation in research, but also reflects the interdisciplinary nature of contemporary scientific research and the skill sets required in scientific and technical careers. These skills and values are typically not taught in undergraduate STEM courses and the ARG model can be a valuable way to convey these essential aptitudes. An adopter with prior experience with the ARG model noted:

I wanted to work on enhancing the participation of minorities in research, particularly Hispanics, but realized computing is becoming more interdisciplinary in nature and the skills sets required are not taught in the classroom. I believe the ARG model is one means to achieve this. The more I participated in the ARG workshops, I realized that research can be done in a group that can create a culture towards the value of research. Interesting and complex research problems may have an interdisciplinary component, which creates a challenge. ARG was a means for me to learn how to work and form a research group.

Most ARG adopters have prior research mentoring experience

Most workshop attendees had previous experience in mentoring undergraduate researchers. Eight participants reported that they had previously mentored undergraduate research students, while four had not. One participant did not respond the question. Most faculty with prior experience had extensive experience in mentoring undergraduate researchers, often ten years or more. Two participants had less than five years experience.

Traditional research groups are most common model

Almost all of the workshop attendees had not yet begun to adopt the ARG model. In fact, nine participants (69%) had not yet implemented the model in their own practice. Three participants had just begun to integrate the ARG model into their research groups and one of the hub leaders had already begun to disseminate the model.

In an open-ended question, participants described the current operation of their research groups. Four attendees responded that they do not currently have a research group. The remaining participants described the practices and processes that they currently use in their research groups. For the most part, faculty utilized traditional modes of operating research groups and did not seem to have a systematic or structured approach to group interactions or activities. Faculty mentioned the following features of their current research groups:

- Regular communication and meetings (7 participants)
- Select projects based on student interest and skills (4)
- Students work individually (4)
- Irregular communication and meetings (2)

The rest of the responses to this question were individual responses, including: assessment of student progress, assigning roles and responsibilities, cooperative learning techniques, holding an orientation, offering skill development workshops, setting expectations, student presentation of work, and peer mentoring.

The frequently mentioned practices, such as regular meetings, projects based on students' interest, and individual work are commonplace elements in typical research groups. The

practices mentioned by only a single respondent, such as assigning roles, cooperative learning, orientations, skill development workshops, and peer mentoring, constitute more “ARG-ified” practices. These responses indicate that most participants had implemented the model only to a limited extent, if at all. A few attendees had obviously integrated quite a few elements of the ARG model into their regular practices, but this was not the norm among workshop participants.

Prior beliefs about undergraduate research

Though most attendees either did not currently have a research group or had not yet adopted ARG practices in their group, participants strongly believed in the value of undergraduate research in students’ intellectual and professional development.

Undergraduates gain intellectual, career skills from research

In an open-ended question, attendees were asked to describe the benefits of undergraduate research. ARG adopters emphasized the intellectual growth, career and skill development, and personal benefits of undergraduate participation in research. Faculty without research mentoring experience did not respond to the question. Eight participants (100% of faculty with prior research mentoring experience) mentioned that students develop critical thinking and problem-solving skills, increase their understanding of research design and methodology, and develop other cognitive abilities from participating in research.

As professionals of the field, they become more knowledgeable and experts in the subfield they become interested in. Additionally, they improve their critical, computational, mathematical and research skills.

Seven ARG adopters (88% of those with prior research mentoring experience) noted the range of skills that students gain from research: communication and presentation abilities, research skills, collaborative, and leadership skills. One faculty member noted that she had also personally gained teaching skills from mentoring student researchers.

For the students: Access to information, develop skills that are needed for their profession, networking opportunities, and increased knowledge. For me (faculty): I have been able to complete research work with undergraduate students that were a significant part of a graduate project. I learn how to teach. In the personal sense, it is rewarding.

Seven participants (88%) mentioned the career and professional benefits of undergraduate research, such as preparation for graduate school and a research career, or increased interest in pursuing terminal degrees. Students gain an understanding of the life and work of scientists from participating in a research community of practice.

The primary benefits are having the students engage in research with various positive outcomes: - a window into the life of a (computer) scientist - research experiences that will benefit them

should they decide to go to graduate school - boost to students' academic profile including potential publications - increased confidence to pursue advanced work and studies.

Four participants (50%) commented that participating in research boosts students' confidence and interest in the field. The comment below from a participant who has already adopted several ARG elements stresses the importance of broadening research participation to students who are capable, but not yet confident in their abilities to do research.

There are multiple benefits, the first is that they build confidence, and alleviates the lack of self-esteem, allows student to understand that research is within their reach (most student think only the top students can do research, they have a stereotype of a researcher as a lonely and isolated individual).

Lack of student preparation and motivation are most common challenges

In an open-ended question, participants were also asked about the challenges associated with mentoring undergraduate researchers. Participants without research mentoring experience did not respond the question. Faculty cited a lack of understanding and preparation as the primary challenges of working with novice researchers. ARG adopters cited the following challenges of engaging students in research:

- Student understanding of research and lack of preparation to engage in research (4)
- Student motivation (3)
- Providing the appropriate amount of guidance and support (3)
- Time to mentor students (2)
- Lack of student confidence (2)
- Student obligations outside research (2)
- Accountability (2)

Other challenges mentioned only by individual participants included: conveying expectations to students, securing funding for students, an institutional culture that does not support undergraduate research, lack of student maturity, and taking care in their work.

As noted, the most common response was that students are not always prepared to participate in research. In the comment below, the respondent also mentioned that students lack confidence in their abilities to perform research and have many external obligations, such as work and family.

They are not well prepared academically, they do not understand what doing research is, they think they are not smart enough, they have many commitments (work, family).

Setting realistic goals and providing the appropriate amount of support were other challenges listed by workshop participants. Mentors struggled to find appropriate tasks and

projects for students. Some mentors also struggled to provide the right balance of support that allows students to grow and develop as researchers without “doing the work for them.”

starting at their level - especially if they have no experience and being realistic about what can be accomplished in a set period of time; not doing the work for them; role clarification; accountability

Student motivation was another challenge faced by research mentors.

1- Getting them excited about the research problem. 2- Getting them up to speed with the research problem and what have been done in the area. 3- To be meticulous about their work.

Adopters’ understanding of the ARG model

Prior knowledge of the model is limited

Most participants entered the workshop with limited understanding of the ARG model or the theory underlying it. Prior to the workshop, participants rated their understanding of the ARG model a 2.83 on a 5-point scale (1=no understanding, 2=a little understanding, 3=some understanding, 4=good understanding, 5=a lot of understanding). Therefore, most participants felt that they had “a little” or “some” understanding of the model prior to the workshop. However, a few participants were more familiar with the model. Five faculty had a “good” understanding of the model prior to the workshop. Therefore, the majority of adopters had limited familiarity with the ARG model, while a few had a greater understanding of the model and its application.

In an open-ended question on the pre-workshop survey, adopters were asked how they would describe the ARG model to someone who is unfamiliar with it. Five participants, including one hub leader, reported that they had little or no prior knowledge of the model. Faculty with some knowledge of the model were able to highlight a few of the key aspects of the model, yet most of the responses lacked sophistication and depth of understanding. Respondents mentioned the following as essential aspects of the ARG model:

- Focus on teamwork or collaboration (7 participants)
- No knowledge of the model (5)
- Has a good reputation, is effective (3)
- Focus on deliberate skill development (2)

Individual respondents also noted that the ARG model is non-hierarchical and involves shared goals and objectives.

Participants with a little or some prior knowledge of ARGs seemed to have a basic understanding that the model involves groups or teams. For example, the comment below was a typical explanation of the model prior to the workshop.

Don't know much about the model other than it seems to be a model designed around team concepts and interaction rather than individualism.

In contrast, hub leaders demonstrated a stronger prior understanding of the model than other participants. Hub leaders seemed to have a more sophisticated understanding of the concepts underlying the model (e.g., cooperative learning) and the way the different components of the model fit together. The two comments below are both from hub leaders. It should be noted that these two answers were the most nuanced and detailed responses to the question; all other responses resembled the more general response above.

It is a method to develop the skills of undergraduates working on research based on the cooperative learning model. It focuses on deliberately developing students skills.

The deliberate, thoughtful integration of activities specifically aimed at developing student skills necessary for their effective contribution to a highly functioning team with clear, shared goals and objectives

Participants gained deeper understanding of the model

Participants substantially enhanced their understanding of the ARG model during the workshop. While attendees rated their pre-workshop understanding of the model a 2.83 on a 5-point scale, they rated their understanding after the workshop a 4.25. In fact, 100% of attendees reported that they had a “good” understanding or “a lot of” understanding of the model after the workshop. In contrast, only 38% of participants entered the workshop with this level of understanding. Tests of statistical significance to compare pre- and post-workshop means were not possible given the small sample.

Participants also had a chance to expand on their understanding of the model in written comments. Cooperative learning was clearly the most common answer. Almost all attendees mentioned it as the most important idea from the workshop:

- Cooperative learning (9 participants)

All other responses were only cited by individual participants. These responses included: the importance of orientation; individual and group accountability; insight on diversity in groups and cultural barriers to participation in research; the structure of an ARG; deliberate skill development; and the effectiveness of the model.

Participants began to frame their answers within the concepts and theory underpinning the ARG model. For example, rather than vaguely referring to “groups” or “teams,” responses

after the workshop more often referred to “cooperative learning” or the “five elements of cooperative learning.” Faculty transformed their understanding of ARGs from having a general notion of the importance of “groups” or “teams” to understanding each of the five elements of cooperative learning and the role they play in fostering learning. For instance, one participant noted that she learned that all five elements of cooperative learning have to be present to maximize student learning.

That all five elements of cooperative learning need to be present in order to be more effective teaching undergraduate research.

Participants also gained a better understanding of how to implement cooperative learning in their research groups, as evidenced by the survey response below:

[I gained] 1) Best practices to implement cooperative research groups that build the capacity of students. 2) Implementing interventions based on the ARG model. Extensive handouts and materials were provided. 3) How to organize and plan your research for the group, describe research objective, research goals, and many other practices that allow engaging students in active cooperation.

Adopters also gained a sense of the importance of planning and developing deliberate strategies based on the elements of cooperative learning. Participants began to realize that they needed to plan ahead and intentionally incorporate elements, such as accountability, into their research group in order for the group to function effectively. Participants also began to realize that learning and skill development may not occur unless cooperative learning elements are deliberately integrated into group practices. Thus adopters began to transition from an unplanned, ad hoc research process to a more systematic method of planning, organizing and running a research group. In the comment below, the participant has come to realize the benefit of proactively and deliberately incorporating elements of cooperative learning into the research group from the beginning rather than simply reacting to issues as they arise.

Setting and establishing an accountability system became a very significant idea in the course of the workshop. Understanding how important is the individual and group accountability in a research group has been a valuable benefit. Before the workshop I used to see accountability in retrospect, looking back to see what went wrong, seeking to find the human causative factors. Now, I can see accountability in prospect.

The most important concept I learned was that of "deliberate actions to achieve desired outcomes" -- essentially that skill training and skill set development should be explicit and not happenstance.

Finally, one participant mentioned that he gained a greater understanding that some students face cultural barriers to their participation in research. ARGs can address some of

these challenges, such as lack of student self-confidence or lack of preparation to engage in research.

Undergraduate students don't possess the skills or self-confidence to do research. Skills that are taught in some families are not taught in all. There is a cultural barrier to some students being effective participants.

Participant observation during the workshop also confirmed transformations in attendees' understanding and implementation of the ARG model. For example, faculty demonstrated more leadership and ownership over the model on the last day of the workshop compared to the first day. Faculty behavior on the first day of the workshop more closely resembled that found from participants in a traditional workshop. Workshop leaders presented information in an interactive manner that engaged participants, yet the participants did not demonstrate *ownership* of the model early in the workshop. Many of the questions and comments from adopters on the first day did not display strong understanding of the model. Audience comments were not often framed within the language of ARGs and workshop presenters often re-framed participants' comments in the terminology of ARGs (e.g., comment: "The students are owning what they're doing." Presenter: "Yes, the goal is to create positive interdependence"). On the first day, many of the questions and comments focused on the logistics or small details of what was happening in the ARG examples (e.g. "how did you select students for the group?", response: the group was selected to have a mix of graduates and undergraduates. "what if someone hasn't read the paper?" response: the individual accountability built into the ARG will lead them to start preparing). Again, workshop developers' often re-framed participants' ideas and questions within the language and concepts of ARGs and cooperative learning.

On the second day of the workshop, hub leaders implemented an activity or workshop with ARG elements. After the activity, participants were able to de-brief and provide feedback on each hub leaders' activity. After engaging in this guided practice of ARG activities, participants began to adopt the language and tools of ARGs. For instance, in the de-briefing session for one of the hub leaders' ARG presentations, participants critiqued the extent to which the activity had incorporated elements of ARG using the language of cooperative learning. These same participants had not used this language to the same extent the day before. One participant noted that she did not observe group accountability in the activity. Other participants discussed the level of group processing that had occurred and offered suggestions for how the group processing element might be improved. The group also modeled elements of constructive and productive critique and feedback by highlighting positive aspects of the presentation and thoughtfully addressing areas of improvement with concrete suggestions that focused on the workshop content, activities or behavior, and not the individual.

Likewise, on the last day of the workshop, participant observation field notes described greater participant leadership and burgeoning ownership of the model. Participants themselves began to introduce ideas and occasionally decided amongst themselves, “let’s do this.” In a process emulating the cooperative learning found in ARGs, workshop organizers designed the workshop to incorporate the five elements of cooperative learning. Thus participants modeled the learning that occurs in cooperative learning environments by developing greater responsibility, initiative, and ownership of the ARG model over the course of the workshop.

Most importantly, participants’ knowledge and understanding of ARGs had increased because participants gained a framework through which to understand their practices. They had begun to understand not only that certain practices work to enhance student learning, but also *why* those practices or approaches work. During the second and third days of the workshop, multiple participants commented on their learning to workshop organizers or the evaluator. One participant mentioned to the evaluator that she is “new to education” and hadn’t thought much about teaching and learning in her own work. She said that she was “excited and energized” to start thinking about teaching and mentoring. She was also excited to incorporate elements of cooperative learning into her own classes and now she has a better idea of how to do this. She concluded that she had always “intuitively known that certain things worked better than others but now I know *WHY* they work.” The evaluator also observed several participants describing their learning to workshop organizers. One participant commented, “I will definitely use this model in my research group. I was just winging it before but now I know that there is a model that is out there.” Another participant told a workshop organizer that in the past she had given her class an overview of the syllabus on the first day of the course. Now she was considering asking the class what they hope to get out of the course and use their responses to come up with topics. Finally, a hub leader mentioned that everything had “clicked” for him during the hands-on activity of the second day. He said that he finally understood *HOW* the ARG model worked. He said that planning his own workshop had helped him to finally understand how the model works in practice and he now knows how to implement it at his own institution. In conclusion, the workshop helped the ARG model to “come to life” for participants. Through guided instruction and active, cooperative learning strategies, ARG adopters began to gain a greater understanding of *why* the model works and *how* it works.

Strong beliefs in the value of the ARG model prior to and after the workshop

Faculty entered the workshop with a strong belief in the effectiveness of the ARG model, rating their beliefs about the effectiveness of the model as a 4.2 on a 5-point scale (1=not effective, 2=a little effective, 3=somewhat effective, 4=mostly effective, 5=highly effective). Eighty percent of pre-workshop survey respondents rated the model as “mostly” or “highly” effective. It should be noted that five participants did not respond to this item on the pre-

workshop survey. These participants had little or no knowledge of the model. After the workshop, participants rated the effectiveness of the model as 4.67, with 89% of participants rating the model as “mostly” or “highly” effective after the workshop. Participants’ beliefs about the effectiveness of ARGs were not radically transformed from the workshop only because many entered the workshop with strong beliefs about the value of ARGs and their efficacy in practice.

Changes in confidence and knowledge in adopting the model

Attendees described the extent to which they had adopted and implemented the ARG model in open-ended survey questions. Prior to the workshop, the vast majority of participants reported that they had not yet begun to implement the model or had only done so to a limited extent. Indeed, 69% of participants had not implemented the model at all and 15% had implemented it to a “limited extent.” The remaining 15% of attendees had implemented the model to a “great extent.” Just as there was a range of pre-workshop understanding of the model, there was also a broad range of current adoption and implementation.

Participants entered the workshop with little confidence to adopt the model

In an open-ended question on the pre-workshop survey, participants were asked what aspects of ARGs that they felt confident in implementing. Participants expressed little confidence in their ability to implement the model. Respondents’ answers were as follows:

- Don’t know/nothing (9 participants)

The remaining responses were only mentioned by individual participants who felt confident in: creating a cooperative learning environment, leading a meeting, conducting trainings and workshops, interacting with undergraduates, and understanding the model.

Prior to the workshop, participants also answered an open-ended question about what aspects of ARGs they felt unsure about implementing in their own research groups.

- How to apply or implement the model (3 participants)
- All of it (2)
- Conflict management (2)
- Don’t know (2)

The other responses were all listed by individual participants: accountability, group processing, non-hierarchical structure, skills trainings and workshops, and teaching others how to implement the model.

While the majority of responses simply stated they felt unsure about “implementing the model” or “I don’t know,” a few participants with greater prior experience with the ARG

model had more sophisticated responses. For instance, a participant who had implemented ARG to a “great extent” had the following response about areas in which she was still uncertain:

1) Creating individual and group accountability 2) Individual and group conflict management 3) Research sustainability (keeping students active and finding the resources to keep their research active) 4) How to achieve the support from administration 5) How to apply ARG to a faculty group 6) How to sell the benefits of ARG to upper administration (provost, president) and other faculty with a traditional approach

It is unsurprising that most attendees had such vague answers to these questions prior to the workshop; one must demonstrate understanding of the model before determining which aspects of the model may be easy or difficult to implement. Only participants with a reasonable amount of prior experience with the model were able to respond to these questions. Adopters with prior knowledge felt confident in leading meetings and running workshops or trainings, yet still felt uncertain about institutional and structural support for research on their campuses, and some of the more difficult aspects of group dynamics and group processing.

Guided practice increased adopters' confidence

Participants dramatically increased their confidence in adopting the ARG model during the course of the model. On the pre-workshop survey, 69% of participants did not have a single aspect of the model that they felt confident about. On the post-workshop survey, every respondent had at least one, if not multiple, aspects of the model that s/he felt confident about adopting. After the workshop, participants felt confident in adopting the following:

- Accountability (2 participants)
- Applying the model (2)
- Assigning roles (2)
- Conceptual understanding of the model (2)
- Creating a cooperative environment (2)
- Conducting an orientation (2)
- Conducting skills workshops or trainings (2)

Other responses were from individual participants: identifying core purpose and values, facilitating students in constructive critique, team meetings, writing research goals and objectives, and face-to-face interaction.

Overall, participants expressed confidence after the workshop that they understood the model and could apply it effectively in their own groups. The comments below demonstrate that some of the concepts underlying the ARG model had crystallized in participants' minds, increasing their confidence in their ability to effectively implement ARGs.

I am confident in knowing how to execute the high-level concepts of the model.

I'm very confident about the conceptual model of PIG's Face. I can implement task-oriented activities that would better engage undergraduates and graduates.

I feel confident I can start an ARG model. The collaborative aspects of the model are much more clear in my mind now.

Therefore, prior to the workshop, participants expressed little to no confidence in their abilities to adopt the model. In contrast, after the workshop, all participants felt confident in their basic understanding of the ARG model and their ability to adopt at least a few elements of the model.

Some still uncertain about group processing and conflict management

Adopters' thoughts about the aspects of ARGs that they still needed to work on or felt unsure about changed in the post-workshop survey. In contrast to the pre-workshop survey where many participants did not have enough prior knowledge to be able to answer the question, all respondents after the workshop were able to identify elements that may require more work. Thus faculty had gained enough understanding of the model and its implementation to more effectively self-assess their own strengths and weaknesses as ARG mentors. The elements that adopters still felt uncertain about after the workshop are as follows:

- Group processing (3 participants)
- Securing funding for student researchers (2)
- Don't know (2)
- Setting goals and objectives (1)
- Defining core values (1)
- Evaluation of ARGs (1)
- Improving students' communication skills (1)
- Project management (1)

During the workshop, participants realized that cooperative learning environments had to be carefully established and facilitated. A few participants expressed concern with their ability to facilitate group processing.

I learned that I need to include group processing which I had not been doing and also more development of social skills to aid the group's learning process.

Progression of ARG adoption

Attendees' survey responses and participant observation during the workshop itself demonstrate that ARG adopters progress through a developmental sequence of learning

gains. Participants must first gain an understanding of the theoretical and conceptual framework underpinning the ARG model, particularly the elements of cooperative learning. A few adopters had this understanding prior to the workshop, while the rest of attendees increased their understanding from the workshop. Participants then begin to gain an understanding of the structure of an ARG and the nature of day-to-day implementation of the model. More straightforward elements of the everyday practices of the model, such as annual orientation or assigning roles and responsibilities, seem to be more readily understood and adoptable than more complex components of cooperative learning. In fact, the final hurdle to mastery of the ARG model appears to be the adoption of some of the more challenging elements of cooperative learning, such as group processing, interpersonal and small group skills, and conflict management. Additional challenges include assessment of student learning and self-assessment of implementation of the model.

Guided practice is the most effective aspect of workshop

In an open-ended question, participants also reflected on the aspects of the workshop that helped to foster their learning and understanding of the ARG model and its implementation. Overwhelmingly, participants identified the hands-on activities of the workshop, particularly the workshop planning and presentation by the hub leaders, as integral to their learning. Participants also mentioned that the workshop itself incorporated all five elements of cooperative learning and served as a model of effective practice.

- Guided practice workshop design (9 participants)
- Workshop modeled cooperative learning (5)
- Networking opportunities (2)
- Self-evaluation and reflection (2)
- Materials and resources provided (1)
- Planning document (1)
- Learning about the needs of students (1)

Overwhelmingly, participants cited the hub leaders' workshop presentation activity as the most effective element of the workshop. This activity not only modeled the ARG process, it also inspired confidence that ARG adopters could implement the model at their own institutions.

In every way, the workshop met my expectations. After working through the model with the break-out sessions I gained a great deal of knowledge about the model, its various components, implementation process and evaluation procedures. Conversation with and evaluation from our proposed implementation of the ARG model was very helpful and assisted us in moving forward with new and better ideas. Overall, it was an incredible experience.

Participants also gained confidence from implementing and receiving feedback on ARG activities during the workshop.

The two biggest things I came away with were confidence and experience. The 'doing' part is just what I hoped for.

It was excellent - the design, the facilitation, the supporting materials - all are things that have given me the confidence to go out and do this with my groups.

Participants appreciated that the workshop itself was designed to model the very practices that organizers hoped to teach participants. A participant cited the following as the most effective aspects of the workshop:

1) Not only the lectures but the actually modeling of the behavior of cooperation between the instructors. 2) Participants were engaged in activities in which we had to apply the ideas of the ARG model. I was a participant and not a spectator; it was very intense.

Finally, the design of the workshop and the modeling of cooperative learning also helped to solidify participants' understanding of the model.

The interactive nature of the workshop solidified the key elements of ARG and I learn how to apply to research teams. The task-oriented activities gave easy to implement examples of how to engage both students and faculty members.

Adopters had few suggestions for workshop improvement

Faculty were asked in an open-ended question if they had any suggestions for improving the workshop. Attendees had few suggestions for improvement and there was little consensus among their responses. Two participants requested more materials and resources to help them implement ARG principles in their own research groups. Two participants also mentioned the planning document as needing improvement, but unfortunately did not specify how to improve this activity in their responses.

- Planning document (2)
- Provide more pre-packaged materials and resources (2)

The other responses were mentioned by a single individual: Hold a longer workshop, hold a shorter workshop, more discussion of implementing ARGs in small research groups, and better time management.

Adopters need regular check-ins and feedback

ARG adopters reflected on the type of support from ARG developers that they might need in the coming year. Participants seemed to want individual check-ins or meetings as needed

to assess their progress and trouble-shoot difficulties in implementing ARGs. A few participants also desired more prepared workshops or materials, and feedback from ARG developers on their actual implementation of the model. A single participant requested review or feedback of materials created for their ARG, and another individual requested support in assessing the effectiveness of ARGs. Adopters' requests for support were as follows:

- E-mail check-ins or phone meetings with ARG developers as needed (6)
- Provide more prepared materials and resources (3)
- Provide feedback on implementation (2)
- Review materials that participant has created (1)
- Support in evaluating ARGs (1)

Conclusion

The ARG Fundamentals workshop engaged ARG adopters in guided, critically reflective practice of the model. Most of the ARG adopters had little to no knowledge of the model prior to the workshop. A few hub leaders had already begun to implement ARG practices in their own work, yet most attendees had little or no practical experience with or understanding of ARGs. Through guided activities that allowed participants to plan and implement cooperative learning strategies in a safe, supportive environment, participants deepened their understanding of the model. Faculty noted that they finally understood *why* certain teaching and learning strategies are more effective. Faculty also held strong beliefs in the value of ARGs and their effectiveness prior to the workshop, although, for the most part, these beliefs were not informed by practical experience with the model. The workshop itself emulated the ARG model and reinforced the value of cooperative learning to participants. The design of the workshop and its emphasis on guided, reflective instruction, cooperative learning strategies, and constructive critique and feedback, allowed participants to practice and reflect on the model. While the workshop did not necessarily transform participants' beliefs about the value of cooperative learning—they already held it in high regard—ARG adopters did gain a deeper and more nuanced understanding of the ARG model and cooperative learning theory and techniques, and gained confidence in their abilities to implement the ARG model at their own institutions.

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