Introducing Agility into Research Teams

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Abstract— In this paper, we propose an innovative practice based on agile software development methods. This research approach introduces agility into learning of research in an academic environment, resulting in an Agile Research Team. Such a research team follows an agile approach, based on modifications to the Scrum approach, to collaboratively learn about research, and to manage research projects and the researchers involved. Success in research requires self-motivation, collaboration, and knowledge exchange. Traditional research occurs in top-down research groups that are led by a leading researcher, who oversees postdoctoral researchers and Ph.D. students, who in turn manage graduate and undergraduate level students. It is up to individual researchers to stay motivated, to acquire the necessary skills to conduct research, and, oftentimes, to decide what the following steps are. Much like effective research groups, agile software development approaches rely on individuals to form self-organizing and motivated teams to deliver technical excellence. Agile software development teams also require an environment of sharing knowledge between senior and junior developers. Agile approaches can facilitate the efficient exchange of knowledge due to a strong dependency on face-to-face communication and teamwork. With the emerging adoption of agile methods for software development in industry and its ability to expedite projects' delivery, we argue that such approaches can potentially provide similar benefits for researchers and students in academia. The advantages that agile methods provide are twofold: the ability to respond faster to change, and a shorter feedback loop, which facilitates the learning of how to conduct research. This paper explores the impactful benefits of using an agile approach to manage research team projects to keep researchers motivated, enhance the learning of knowledge and research skills, increase scalability, and foster inclusivity. This paper will also present the roles, responsibilities, and processes defined for managing an Agile Research Team to support adoption of the approach with other research teams. In addition, results and lessons learned are presented following our experience with using the approach as described in this work.

Keywords—Agile Research Team; Scrum; Improving Research Skills

I. INTRODUCTION

Successful research requires self-motivation, collaboration, and knowledge exchange. Traditional research in academia occurs in top-down research groups that are led by a principal researcher who oversees postdoctoral researchers and Ph.D. students, who in turn manage graduate and undergraduate level students. It is up to individual researchers to stay motivated, acquire the necessary skills to conduct research and oftentimes to decide what the following steps are. Often, students struggle to learn the appropriate research techniques and getting up to speed on cutting-edge research topics, all while balancing the rest of their educational experience. Much like research groups, agile software development approaches rely on individuals to form self-organizing and motivated teams to deliver technical excellence. Software development teams require an environment of sharing knowledge between senior and junior developers. Agile approaches can facilitate the exchange of knowledge efficiently by their strong dependency on face-to-face communication and teamwork. With the emerging adoption of agile methods for software development in industry and its ability to expedite projects' delivery, this paper posits that such approaches can potentially provide the same benefits for researchers. The benefits that agile methods provide are twofold: the ability to respond faster to changing needs and a shorter feedback loop. This paper explores the benefits of using an agile approach to manage research team projects to keep researchers motivated, increase the exchange of knowledge and skills, and increase the team's scalability and inclusivity.

The paper is organized as follows: Section II gives a brief background on agile methods. Section III describes related work that utilize agile methods to perform research. Section IV proposes an approach and process for using agile methods within research teams. Section V presents the goals of this approach. Section VI presents a survey used to assess the goals of the approach. Section VII presents the results of the survey. Sections VIII, IX, and X present the conclusions and future direction for this research.

II. BACKGROUND

Agile approaches to software development are lightweight methods that are people-oriented, adaptable to change and characterized by short incremental iterations. To better develop software, the agile manifesto was created by a group of experienced individuals that value customer interactions over following a plan [1]. All agile methods follow the twelve principles backing the agile manifesto, which involves continuous delivery of working software, a high level of customer involvement, flexibility to change, face-to-face communication and improvements to the process [2]. These methods are only six of the twelve, but they are core attributes to the altered agile approach. The benefits of these methods are software of higher quality, improved productivity, frequent delivery and improved customer satisfaction [3].

Scrum is an agile approach that manages software development in iterations called *sprints* [3]. Requirements for the system to be built are drawn from the *product backlog*, which is managed by a Product Owner representing the customer. Each *sprint* involves a *sprint backlog* and *daily scrum meetings*. *Sprint backlogs* are populated by drawing from the

product backlog. Less emphasis is placed on a process driven framework. Instead, the focus is on daily progress and process improvement through retrospective meetings after each sprint and planning before the next sprint [4].

III. Related Work

The Scrum agile approach has been adapted widely in industry. This popularity has led to the adaption of Scrum practices in university classroom settings. Many studies have been done and the published results show that Scrum practices are successful additions to the classroom experience, and while these publications differ slightly in implementation technique, they all draw a positive conclusion to the inclusion of Scrum in the academic classroom [5][6][7]. Due to this success in the classroom, a logical expansion of this research is to use it in other academic contexts, such as research groups.

The Scrum agile approach has been used to manage research projects through an approach called Scrum for Research (SCORE) [8]. It was found that the method assisted in breaking research projects down into attainable steps and allowed for project feedback and timeline to be more flexible, thereby reducing stress. Contrary to the proposed approach in this paper, SCORE relies on meetings between students and their advisors to remove obstacles in their work. This can be prohibitive in transferring knowledge because it is a one-on-one meeting instead of involving the whole group. Another effort to adapt Scrum into a research environment found positive results but one problem that arose was the lack of proactivity of some individuals, and the authors suggest excluding these individuals from the teams [9]. Contrastingly, the approach proposed here aims to increase recruitment and foster more inclusivity. More recently, a study on the use of agile methods in a scientific context found that it necessitates coordination by a research facilitator or manager [10]. This aligns very well with the goals of the proposed approach, where the PI acts more as a facilitator instead of the traditional PI role.

IV. Approach

The proposed approach will draw from the Scrum approach, modifying it to be applicable in an academic research setting, to implement an Agile Research Team (ART).

A. Sprints

Under ART, the durations of the *sprints* are defined to be one week. This amount of time provides enough days for each member of the research team to gain insights into the research area and enough time to develop some research artifacts. Furthermore, having short sprints provides opportunity for frequent meetings to allow the researchers to update the team on their progress, no matter how small, and give members of the overall research team the opportunity to share their knowledge to help others overcome research hurdles and provide valuable feedback and validation.

B. Roles

The roles within ART are defined as follows: the Research Lead (RL), the Research Mentor (RM) and the Researcher. A person can have multiple roles in the ART, i.e., the RM can be a RL or a Researcher. Any Researcher can become a RL for one project while being a Researcher for other projects under another RL.

The RL role parallels the Product Owner role in Scrum. The RL is the manager of the research that is being conducted into a topic and centers on a research idea. Any Researcher can become a RL by proposing a new research idea to the larger team, called the *pitch*. Pitches can occur at the end of any *sprint* meeting. Pitching research ideas allows interested members of the team to volunteer to join the proposed research sub-team and provide research or technical contributions.

The RM role parallels the Scrum Master role in which the RM facilitates the work of the RL and Researchers and works closely with the RL to provide guidance and direction on the overarching goals of research for the team. Additionally, the RM helps the members of the research team as well as the different research teams in their research journey, providing technical advice, mentorship, and training. The RM also leads the *sprint* meetings, aids in disseminating the research work and acquires funding for the research team.

The Researcher is any other member of the research team and parallels the Developer role within a software development team. Researchers can work on one or more of the projects simultaneously depending on their interests and schedules. The Researchers work with the RM and RL to contribute to research. In return, Researchers gain experience in research and technical skills.

C. ART Process

After each sprint, a research meeting is held for one hour but no more than two hours. In this meeting, the RL of the team gives an update on the progress of the research, give any demos if necessary, discuss any hurdles, and explain goals for the upcoming *sprint*. Once a presentation is complete, the RL answers any questions posed by other Researchers and considers their inputs as related to the research presented. The presentations at the end of each sprint are not limited to the current research work, researchers can *pitch* new ideas to the team to gauge the viability of starting that research effort. If an idea pitched by a researcher has been accepted by the team and other Researchers have volunteered to contribute to the research, the Researcher who pitched the idea becomes a RL and research sub-teams can be formed around it.

D. Process and Artifacts

Many development methods require the use of artifacts to document and track work progress. The ART intends to use a lightweight approach to managing and documenting progress. This lightweight approach to research artifacts was selected to avoid hindrances to research. Managing logs takes time away from performing research since the *sprints* are relatively short. Task estimation activities in agile methods do not translate well, as the nature of research is that the idea is largely unknown by the team and hence making estimates non-trivial. Instead of putting emphasis on the artifacts like a log or in task estimations, the focus is on a set of research questions proposed by the RL which must be answered by the end of the research. Once a sub-team has been established, a further task decomposition is needed, and Researchers can work closely with RL and the RM to establish tasks. This allows the research to be guided by overarching goals and to have a metric to mark the progress of a research effort.

E. Potential Drawbacks

As with any experimental process, there will exist potential drawbacks and pitfalls, with the ART process being no exception. The ART process aims to have pitches to formulate a sub-team, however, if a researcher is too shy or feel as if they are inexperienced to pitch an idea, they might avoid pitching altogether. To alleviate this pitfall, the researcher could present to a single peer or speak to the RM outside of the weekly meetings about the pitch idea. The goal is to slowly give the researcher confidence about the idea so they can pitch it during the weekly meeting. An alternative option would be to find a researcher with a similar research agenda and joint pitch the idea. This option allows for the idea to have already garnered support and lead to a successful pitch.

V. ART Goals

The proposed approach aims to keep researchers motivated, increase the exchange of knowledge and skills, and provide a framework with increased scalability and inclusivity. Though these skills are qualitative metrics, rather than quantitative measurements such as number of publications, they are more appropriate for a research group with large levels of student involvement. The goal for student Researchers should be to learn how to conduct research in an effective manner. While the end result is ideally publications, increasing the motivation, exchange of knowledge, and inclusivity of a group will create Researchers who are capable of quality publications.

A. Increase Motivation

The approach increases the motivation of the Researchers by two main mechanisms. First is the notion of volunteering to join sub-teams if the pitch is of interest to the researcher, as researchers willingly join the work solely because of interest in the topic. The second mechanism is that if a Researcher is passionate about a topic, he or she can pitch an idea and try to convince others to work on this.

B. Expedite Knowledge and Skill Transfer

The approach includes many opportunities for knowledge and skill transfer. The weekly *sprint* presentations will teach critical-thinking skills, presentation skills and acquisition of new knowledge. Likewise, the flexibility of joining sub-teams allows the acquisition of new skills by working with different people in different projects.

Knowledge and skill transfer is one of the most important goals of the ART process. Given that undergraduate and masters students may only spend one to four years in a research group, it is important to encourage the acquisition of not only research skills, but enough contextual knowledge to move the individual from novice to proficient on one or more cutting-edge research topics. This speed of knowledge transfer required in a research group mimics the challenge of a classroom, but in a mostly self-guided arena.

C. Enhance Scalability and Inclusivity

The approach is more scalable because the management of research is led by RLs, who gain the expertise through observing and participating in other sub-teams. Likewise, the approach fosters inclusivity because anyone can volunteer to work on a research project or propose their own. This allows a greater number of students to benefit from the academic advantages of a research group.

This inclusivity has a positive effect on the research group itself, as a wide variety of perspectives can be beneficial to idea generation. Additionally, individuals who become engaged in research at an early stage in their education may be more likely to pursue advanced academic degrees. Therefore, having larger and more inclusive research groups can lead to potential side-effects such as encouraging a larger candidate pool to remain in academia.

VI. Survey

To assess how students function in and perceive their experience in both traditionally structured and ART research groups, a survey was developed and conducted to assess their achievements, expectations and feelings towards their research group. The survey was comprised of multiple choice and ranked choice questions. The goal of the survey was to have questions that address all facets of the expectations of an ART research group.

The survey was given to students in two different research groups. One of these groups was employing the experimental ART approach, while the other group was not and acted as a control, for comparison. In addition to the questions addressing the students' experience, demographic information was collected, so that the results could be interpreted based on the demographic experience of the participants.

The survey consisted of the following seven questions. Each question is followed by a description of the reasoning behind the selection of the question.

Q1. Which of the following research activities have you participated in?

1) *Conducting a literature review*
2) *Summarizing a research paper*
3) *Writing a conference paper*
4) *Writing a journal paper*
5) *Preparing and presenting research work to the group*
6) *Reading a research paper*
7) *Writing an abstract to submit to a conference*
8) *Explaining the work of others in the research group*

Question 1 works to establish the experience level of the group as a whole. Having group members with varied experiences is essential for knowledge and skill transfer to occur. It is also important to know the current experience level of the researchers, so that questions about future work can be interpreted accordingly.

Q2. Approximately how many hours a week do you expect to spend on research?

1) *1-5*
2) *5-10*
3) *10-20*
4) *20+*

Question 2 can be interpreted to show the motivation in the group. It is important to note that time spent on research can be limited by factors outside of motivation, such as other academic

obligations. Nevertheless, having researchers spend time on their work is essential for the success of the group.

Q3. What point are you at in your college career?

1) *Undergraduate student*
2) *Masters' student*
3) *PhD student*

Question 3 gives insight into the academic level of the research group, which is important to the success of the ART process. Having a wide range of experience levels allows for ongoing knowledge and skill transfer. Ph.D. students, by nature of their position, have more research experience than undergraduate students and can be expected to transfer that knowledge within the ART process. Additionally, having graduate and undergraduate researchers working side by side is a sign of enhanced scalability and inclusivity.

Q4. How comfortable are you with the following options? (Give a score from 1 to 5, where 1 is not comfortable and 5 is very comfortable)

1) *Conducting a literature review*
2) *Summarizing a research paper*
3) *Writing a conference paper*
4) *Writing a journal paper*
5) *Preparing and presenting research work to the group*
6) *Reading a research paper*
7) *Writing an abstract to submit to a conference*
8) *Explaining the work of others in the research group*

Question 4 analyzes the level of comfort a researcher has with various research activities as a means of determining the level of knowledge transfer. Previously, we determined the representative research activities that a researcher could have performed. If the survey participants indicate they are comfortable with activities that they have not had the chance to experience, that is an indication that they observed and learned from other members of the group.

This question also helps to reveal the individual's level of confidence. If a researcher is comfortable and confident in their ability to perform a research task, it is easier for them to find the motivation to do so. That motivation, in turn, will create a more prolific research group, as researchers will be more willing to try new things.

Q5. What projects can you see yourself participating in over the next year?

1) *Conducting a literature review*
2) *Summarizing a research paper*
3) *Writing a conference paper*
4) *Writing a journal paper*
5) *Preparing and presenting research work to the group*
6) *Reading a research paper*
7) *Writing an abstract to submit to a conference*
8) *Explaining the work of others in the research group*

Question 5 aims to expand upon the outcome of question 4. That is, it tracks how motivation translates to research production. In doing so, it gives a more realistic depiction of the scalability and maturity of the research group. While question 4 allows the researcher to show their ability and willingness to do a task, question 5 shows the likelihood that they will do that task within the next year. While question 4 approaches the issue from a perspective of knowledge transfer, question 5 approaches the same scenario with the purpose of determining the motivation of the researcher.

Q6. Please mark your level of agreement with each of the following statements. (1- Completely Disagree, 2-Somewhat Disagree, 3- Neither Agree nor Disagree, 4- Somewhat Agree, 5- Completely Agree).

1) *I feel a sense of belonging in this group*
2) *I feel comfortable asking others for help with my projects.*
3) *I feel comfortable asking to join other projects.*
4) *I feel like I have plenty of opportunities to contribute.*
5) *I have the support I need to succeed in the projects I'm passionate about.*
6) *I have had opportunities to learn from my peers.*
7) *I feel like I have grown in my research capabilities as a member of this group.*

Question 6 is designed to uncover the level of inclusivity found within the research group. Ideally, all researchers should feel like they belong in the group, feel comfortable interacting in the group, and feel as though they benefit from being a member of the group.

Q7. How long have you been involved in this research group?

1) *<1 semester*
2) *1 semester*
3) *1-2 years*
4) *2-4 years*
5) *4+ years*

Question 7 gives an overview of how invested the members of the group are. Having researchers that participate over a long period (multiple years) is important to ensure the growth and development of skills. It also shows a level of investment in the group that suggests that the group is inclusive. However, given that scalability is a goal of the ART process, it is also important to have new members within the university research setting. Since a researcher is expected to leave the group after graduation, a constant stream of new members is important as it not only gives more individuals research opportunities, but it also ensures the longevity of the group as there are always people to learn and advance within the process.

VII. RESULTS

The following results were collected from two different research groups. The ART group consisted of 13 participants. All these participants are part of a research group that has followed ART principles for multiple semesters. The control group is comprised of 8 participants. Participants in the control group are members of research groups that followed the more traditional research approach described earlier in the paper. The authors realize the sample is too small to make definitive conclusions, however the analysis of the results shows potential trends and differences within the two groups that merit further study.

Fig. 1 shows that both the ART group and the control group have a widely varied set of experiences. Both groups have the potential for successful knowledge transfer, as there are areas

where group members lack experience, but there is at least one group member who has experienced every item on the list. Both groups have different areas of strength and weakness, but these differences average out in the long run.

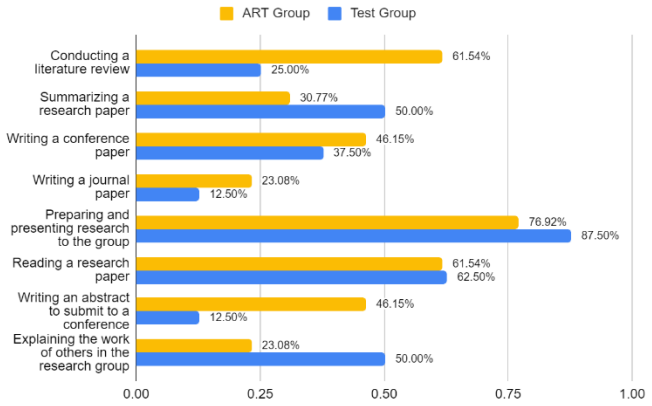

Figure 1: *Which of the following research activities have you participated in?*

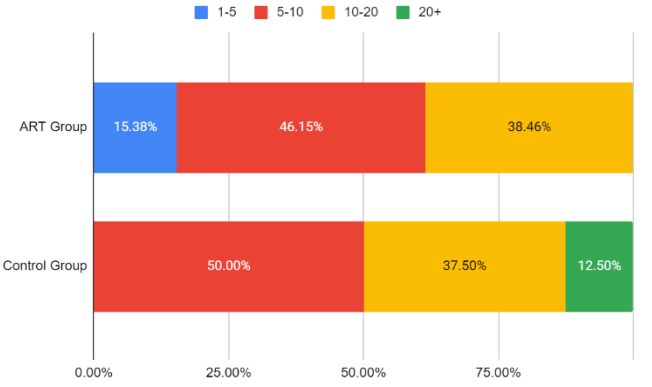

Figure 2: *Approximately how many hours a week do you expect to spend on research?*

Fig. 2 shows the difference between the ART group and the control group on time spent varies only slightly. For both groups, almost all members are putting in 5-20 hours a week, which is a good range for student researchers.

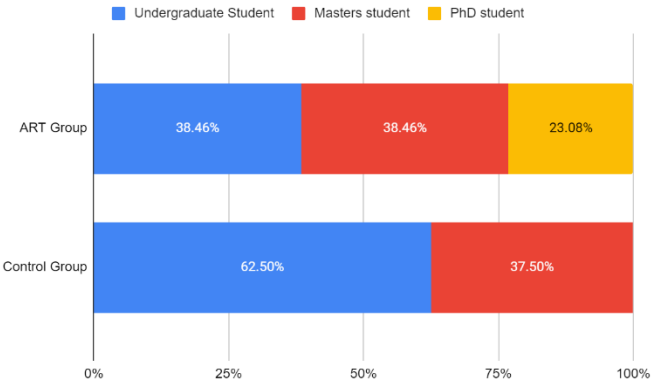

Figure 3: *What point are you at in your college career?*

Fig. 3 illustrates the academic diversity of the ART group compared to the traditional research group is shown here. Both groups have both undergraduate and graduate students, but the ART group benefits from having researchers at the PhD level as well. It takes effort to maintain a research group that caters to all levels of students; having a balanced number of students at each level shows that the ART structure can be correctly upheld.

Fig. 4 shows that the ART group overall is more comfortable with literature reviews than the control group. A majority of ART members rate themselves as comfortable, while a majority of the control group are in the neutral section. This is a task that is labor intensive, but necessary foundational work for successful research.

Fig. 5 shows the results that both the ART group and the control group show similar results of being comfortable with summarizing research papers. This task is important to the research process as it is the foundational block to conducting literature reviews.

Writing a conference paper is a more advanced research task, yet Fig. 6 illustrates that over 70% of the ART group would be comfortable doing so while less than half of the control group feels comfortable.

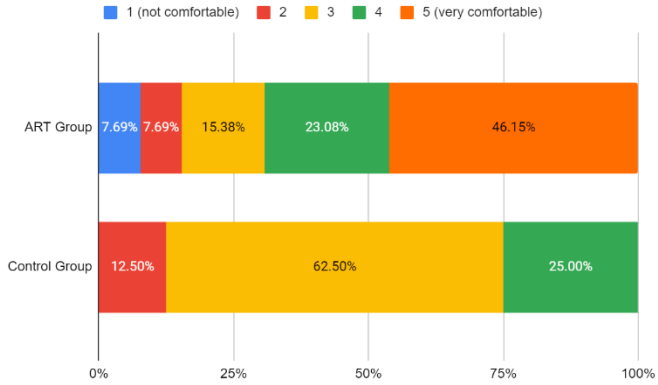

Figure 4: *How comfortable are you conducting a literature review?*

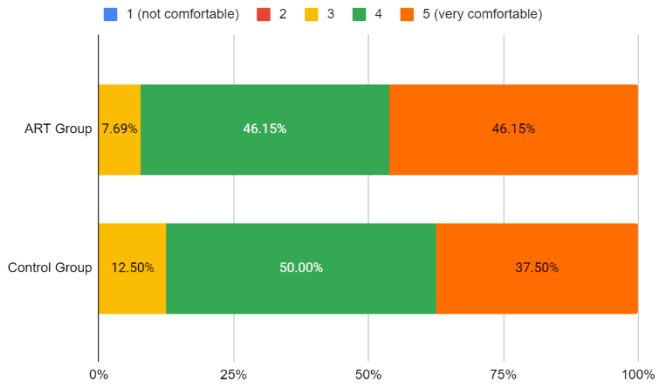

Figure 5: *How comfortable are you summarizing a research paper?*

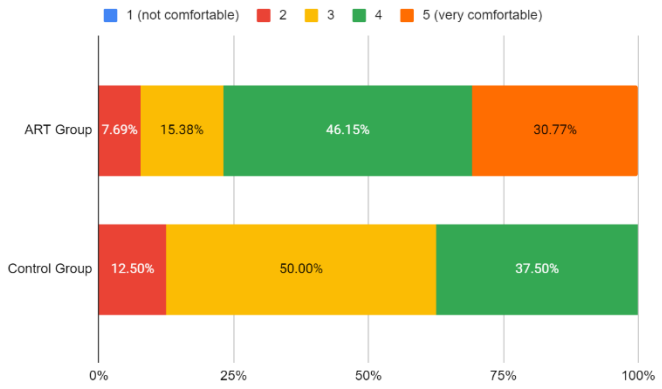

Figure 6: *How comfortable are you with writing a conference paper?*

Likewise, writing a journal paper is much more advanced research task. As journal papers are longer and more involved with conference papers, this task is incredibly advanced for undergraduate researchers. Similarly, Fig. 7 shows that almost all of the ART group feels some level of comfort with that task. Contrastingly, there is a lot of discomfort with that task among the control group, which is expected of a group of primarily undergraduate researchers.

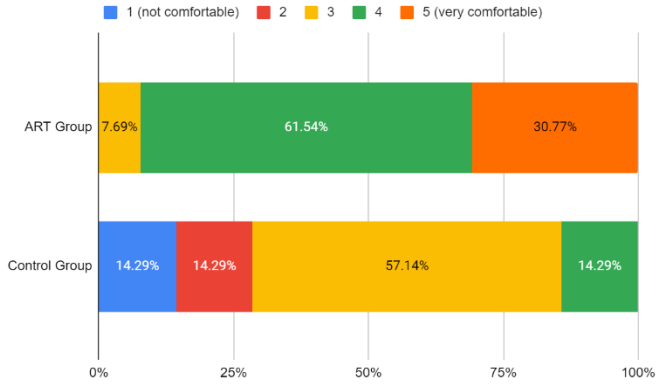

Figure 7: *How comfortable are you with writing a journal paper?*

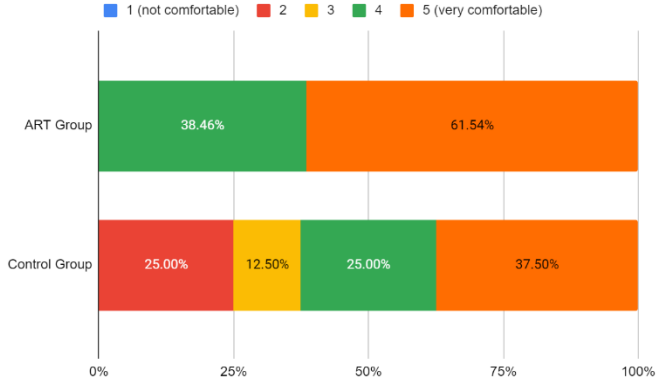

Figure 8: *How comfortable are you with preparing and presenting research work to the group?*

Preparing and presenting research work to a group is an important part of knowledge transfer among group members, and a valuable communication skill to master. It is also a practice that helps prepare researchers for more formal research presentations. As Fig. 8 conveys, all members of the ART group feel comfortable with this task. A majority of the control group also feels comfortable, yet a quarter of them feel a higher level of discomfort, which is entirely expected from a group of new researchers.

Fig. 9 Shows that both groups have very similar levels of comfort around reading research papers. The ART group has a small percentage of participants who feel neutral, while everyone else feels some level of comfort.

On the other hand, Fig. 10 shows that a majority of the ART group feels comfortable writing an abstract to submit to a conference, while most of the control group feel neutral about the process. As this is a relatively intimidating task for student researchers, the response from the ART group is impressive.

Explaining the work of others in the research group is an important skill that not only shows the effectiveness of knowledge transfer within the group, but also highlights how interconnected a member is with the work of other group members. This level of awareness is important, as it allows members to contribute to multiple projects, which is another factor in expediting the learning process.

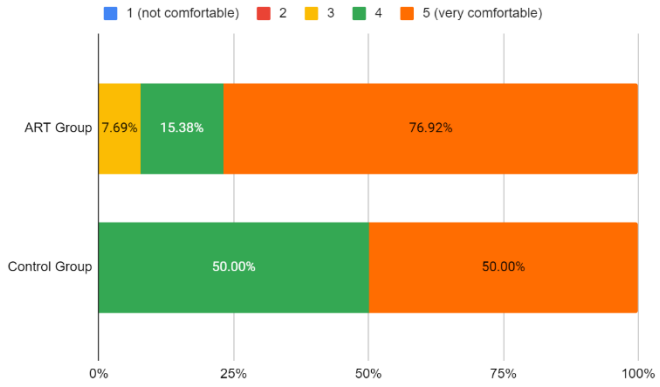

Figure 9: *How comfortable are you reading a research paper?*

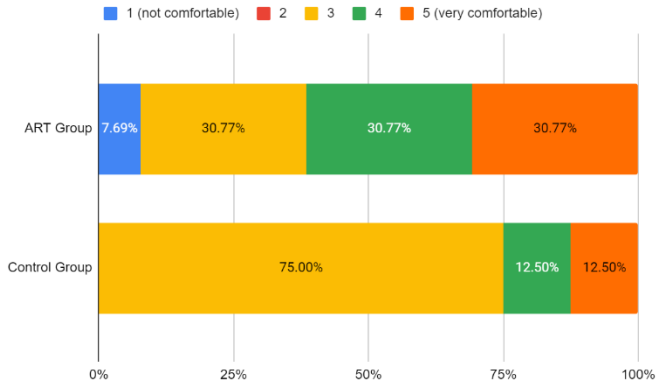

Figure 10: *How comfortable are you writing an abstract to submit to a conference?*

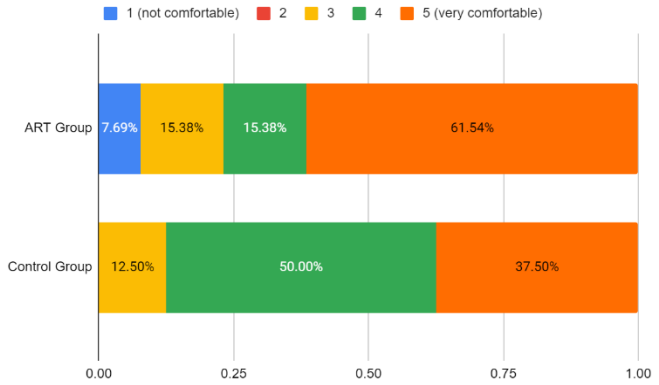

Figure 11: *How comfortable are you explaining the work of others in the research group?*

Fig. 11 shows that both groups rate their level of comfort as similarly high for this task. While the ART group has a small percentage of members who are not comfortable at all with explaining the work of others, this is a reasonable expectation as some of the members are new to this group and some undergraduate students may be uncomfortable explaining the work of PhD students. Given these constraints, it can be assumed that both groups have a high level of familiarity with other work of other researchers within their group.

It is important to note that in all the above activities, the ART group has an equal or greater level of comfort performing research tasks when compared with the control group. Considering that both groups were well matched in terms of previous experience performing these tasks, the consistently higher levels of the ART group suggest that knowledge and skill transfer is happening at an expedited rate.

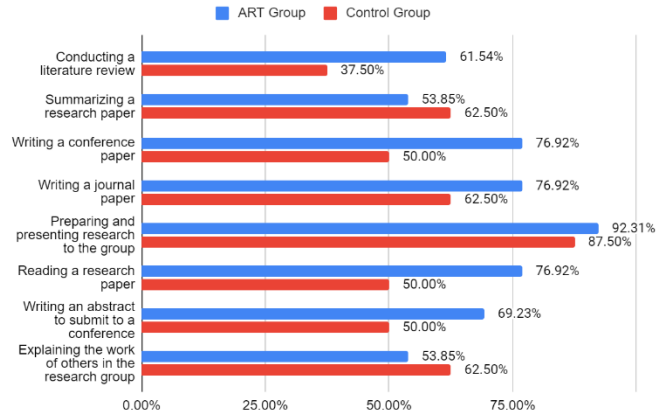

Figure 12: *What projects can you see yourself participating in over the next year?*

Fig. 12 shows that the expected future performance of these groups further supports the hypothesis that ART groups function more effectively. As seen in the last set of questions, the ART group members are more likely to be comfortable performing basic research tasks compared to their traditional research counterparts. This question shows that the level of comfort will correspond with larger volumes of research that are produced. This provides insight that not only has skill transfer been successful within the group, but that successful skill transfer has led to increased motivation.

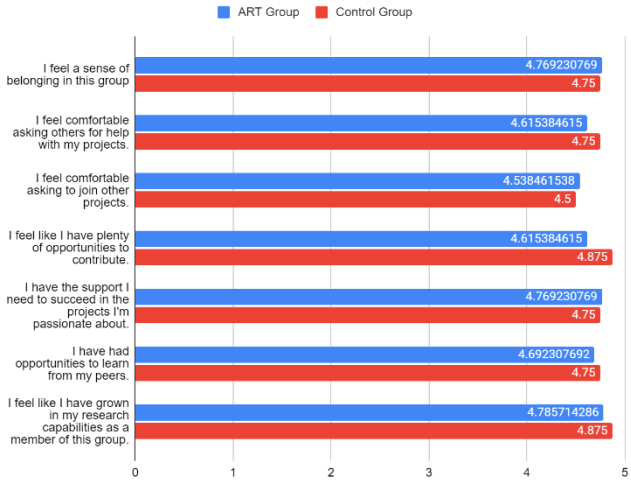

Figure 13: *Comfort level of agreement with each of the following statements. (From 1- Completely Disagree to 5- Completely Agree).*

As Fig. 13 shows, both groups have responses to this question that suggest a high level of inclusivity. There is always room for improvement, but the differences between the groups are both negligible.

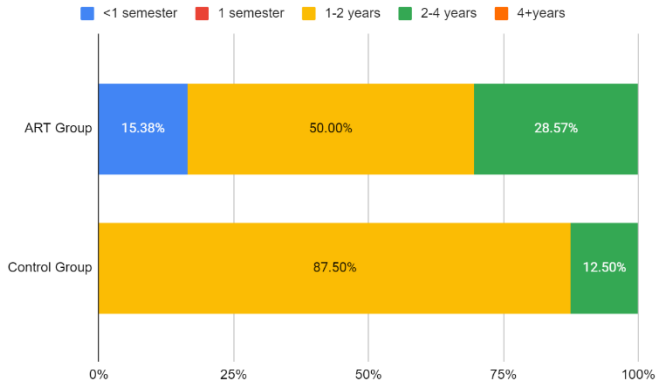

Figure 14: *How long have you been involved in this research group?*

This question shows that the ART group has the necessary influx of researchers to maintain the knowledge transfer process. Fig. 14 shows that there are a considerable number of researchers who have been a part of the group for 1-2 years, combined with those who have been working for 2-4 years and those who just joined this semester. While the makeup of the control group is entirely appropriate for a traditional research setting, the makeup of the ART group is encouraging for not only the ART process but for the continuity needed for success.

The first question, shown in Fig. 1, demonstrates that the ART group has more experience writing conference and journal papers, as well as submitting applications to conferences compared to the control group. Figs. 4-11 reflect that currently, the ART group is more comfortable with research related

activities, from writing papers to understanding current research. Fig. 12 shows that the ART group is more likely to produce published research within the next academic year. Therefore, the metrics that ART strives to achieve (increased motivation, transfer of skills, and increased inclusivity) are supported by these questions, but also correlate with a higher number of publications and increased performance. These metrics will be continuously monitored to gain an accurate depiction of research metrics.

VIII. Further Experimentation

After the initial data collection process, the study was expanded to examine the results of introducing the ART process to a new research team. This team was given training in the ART approach. These individuals were led through the process by an RM who was familiar with ART approach but was not involved in the research activities. This semester long experiment was tracked by the participants having two reflective discussions (at the halfway mark and at the end of the experience) where participants were allowed to share their thoughts on the process.

The participants overall responded favorably to the process. The strengths were especially pronounced in those new to research. The added level of organization and process transparency provided by ART allowed individuals to make more rapid progress. This increased productivity correlated with a desire to take on more responsibility within the group.

Despite the noted strengths, the participants were also able to highlight potential challenges of the process. During the duration of this experience, those who were already familiar with the research process did not experience as much from the increased transparency. The nature of the project made it difficult to discuss challenges candidly during the stand-up meetings, as the research was of a sensitive nature and could not be shared with the RM who was guiding the process.

Overall, this experience was successful and benefitted the research group, on both an individual and a holistic level. The key takeaway to explore as this process matures is that the wider the experience types among participants, the more likely it is that everyone can experience increased knowledge gain. Further, it is potentially important that the person who is guiding the process is also an invested member of the team, as that will help them to best calibrate the ART process for team performance.

IX. Conclusions

Since this project is in its early stages, it was difficult to gather data as the current sample size is small. Because of this, it is important to note that trends could be misleading, and the given results must be treated critically. Despite this, the consistency of results gathered from the survey lends credibility to our conclusion and encourages to further investigate the approach.

For the data gathered so far, the results align in a promising way with the expectations of an ART. There were clear signs that there was increased motivation in an ART group when compared to the traditional control group. Additionally, it seems that the ART group has enhanced scalability, and with that is more productive with their research tasks. The evidence also supports that, with a properly structured ART group, knowledge and skill transfer happens at a faster rate than with traditional research groups. The results suggest that the expectations and goals of ART also correlates with increased performance in relation to number of publications within a group.

It appears that forming an ART group has a net positive on the efficacy of academic research. Even considering the possibility that some of the results may be misleadingly positive, there are absolutely no indications that adapting an ART would be worse off than a traditional research group. If anything, this could provide further experience in following agile approaches that could benefit future employment in industry. This means that the process is safe to adapt traditional research groups to follow an ART process without fear of negative outcomes.

Academic research, and thus academic research groups, are some of the most important activities that occur on a college campus. Finding methods, such as ART, to improve the structure and performance of these groups is an essential area of research. Increasing educational opportunities and encouraging learning outside of the classroom experience is beneficial to the individual students and the culture of the university.

X. Future Work

ART is an approach which can be used by research teams to keep researchers motivated, increase the exchange of knowledge and skills, and increase scalability and inclusivity. Future work is planned to expand the pilot study to two universities using the presented approach, with the goal of involving more than 50 researchers and gather more quality data. Results of using the approach will be disseminated in future publications.

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