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Technology accountability groups: A novel form of technology learning and support for graduate students and faculty in STEM

Feather Ives[1] | Vijayvardhan Kamalumpundi[2] | Celestine Wanjalla[3] | Jazmine I. Benjamin[3] | Kit Neikirk[4] | Sulema Perales[4] | Annet Kirabo[3] | Debra D. Murray[5] | Anthonya Cooper[6] | Edith M. Williams[7] | Antentor Hinton[4] | Sandra A. Murray[6]

[1]Molecular Imaging Center, University of California Berkeley, Berkeley, California, USA

[2]Department of Medicine, Mayo Clinic, Rochester, Minnesota, USA

[3]Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA

[4]Department of Molecular Physiology and Biophysics, Vanderbilt University, Nashville, Tennessee, USA

[5]Department of Molecular and Human Genetics, Baylor College of Medicine, Houston, Texas, USA

[6]Department of Cell Biology, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

[7]Department of Public Health Sciences (SMD), University of Rochester, Rochester, New York, USA

Correspondence

Antentor Hinton, Department of Molecular Physiology and Biophysics, Vanderbilt School of Medicine Basic Sciences, The Vanderbilt Diabetes Research and Training Center, 750 Robinson Research Bldg, 2200 Pierce Ave, Nashville, TN 37232-0615, USA.
Email: antentor.o.hinton.jr@vanderbilt.edu

Sandra A. Murray, Department of Cell Biology, University of Pittsburgh, Pittsburgh, PA 15261, USA.
Email: smurray@pitt.edu

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Abstract

In academia, particularly in science, technology, engineering, and mathematics (STEM), writing accountability groups have emerged as an effective technique to enhance writing productivity by offering structure, increasing the commitment to write, and fostering social commitment. The rapid development of technology has introduced a new challenge across STEM fields: technostress, where individuals face heightened stress due to novel applications of technology. To address this, we introduce Technology Accountability Groups (TAGs), a novel form of community support for graduate students and faculty. TAGs are tailored to help individuals navigate technological innovations, alleviate technostress, acquire new skills, motivate, and connect with leaders in the field. This paper presents a framework for establishing, implementing, and sustaining TAGs in STEM.

KEYWORDS

inclusion, STEM, technology, Technology Accountability Group, technostress

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1 | INTRODUCTION

Accountability groups have been used in academia for decades to boost productivity and foster innovation (Neikirk et al., 2023; Thorpe et al., 2020). Accountability groups are small communities where individuals work together to set goals, share progress, collaborate, and hold each other accountable for achieving goals. Accountability groups are built on mutual learning, allowing individuals at every career level to learn from one another (Chen, 2013; De Lora et al., 2022; Spencer et al., 2022). One example of a successful deployment of an accountability group is the writing accountability group (WAGs). WAGs are structured writing groups that aim to increase writing productivity by improving time management, organization, writing frequency, and overcoming procrastination. They can also improve writing outcomes among new, underrepresented faculty within STEM (Spencer et al., 2022). The usage of accountability groups for uses outside of writing warrant further research on their efficacy.

In addition to the pressures placed on students and faculty to write grants and manuscripts, another pressure is to stay current with technology to innovate and discover. Indeed, the rapid growth of technology has led to revolutionary advancements across STEM. For example, in the cell biological imaging field, revolutionary technological advancements such as transmission electron microscopy, have made it possible for scientists to visualize organelle structures and dynamic relationships in minute detail. However, these rapid technologic developments force end-users to expend significant mental energy and time to stay current and troubleshoot the latest technology in the field. The necessity for frequent technological multitasking and the constant influx of novel technologies are both factors that contribute to technostress, a condition resulting from an inability to effectively cope with the demands imposed by new technologies (Murray et al., 2022). Inadequately treated technostress may cause students and faculty to leave the STEM pipeline and lead to further avoidance of cutting-edge technology in the future.

To combat technostress among graduate students and faculty, Dr. Antentor Hinton from Vanderbilt University and Dr. Sandra Murray from the University of Pittsburgh started a technology accountability group (TAG) to stay current on developing technologies and to build a collaborative network of individuals to inform, evaluate, and discuss the research relevance of emerging techniques and instrumentation. Here, we discuss a framework for establishing, implementing, and sustaining two such TAGs: Technique Information (TAG-TI) and Technique Acquisition (TAG-TAcq).

2 | TECHNIQUE INFORMATION GROUP FRAMEWORK AND STRUCTURE

The goal of TAG-TI is to share information on current and emerging technologies, discuss their potential applications in research, and, in some cases, increase the incentive to learn how to use new technologies. The TAG-TI group draws its foundation from two main theoretical social methods of learning: social constructivism and communities of practice. Social constructivist learning theory states that learning occurs by way of social interaction (Hattie & Timperley, 2007). In the context of STEM, a social constructivist view emphasizes that scientific and technological inquiry, especially in the context of answering complex research questions, is not based on a fixed body of facts, but a dynamic and evolving process of inquiry that requires individuals to engage in continuous dialogue (Toma et al., 2024). For example, in a TAG-TI group, knowledge about machine learning methods to analyze data collected with advanced microscopy would be acquired through back-and-forth dialogue and even debate. In contrast, learning this information in isolation may require more effort from the end-user, with a potentially lower return on the information obtained. Similarly, in communities of practice (CoP) learning, information is acquired through group communication and interactions. CoP are where groups of individuals with shared interests regularly meet to deeply engage within their practice. CoPs have been defined as having (1) a shared domain of interest, (2) a community of engagement and open dialogue, and (3) a shared skillset (Li et al., 2009). A recent systematic review by Reinholz et al. (2021) showed that CoP was one of the most common change theories used in STEM education to create educational interventions and increase learning (Reinholz et al., 2021).

The TAG-TI meeting frequency, length, agenda, and format vary depending on several factors that include: participants' goals, the makeup of the TAG-TI group, the subject matter, and the availability of the participants. The structure of a typical TAG-TI includes scientists in groups of 5–10, from various departments and institutions via a video conferencing platform (e.g., Zoom, Microsoft Teams, Skype, etc.). Meetings could be held in person or via video conference. Furthermore, individuals on virtual mediums can take turns sharing their screens and quickly reinforce concepts and facilitate learning by introducing diagrams, images, or videos. Rapid retrieval of multimedia information during an in-person interactive discussion is generally not as time-efficient. TAG-TI meetings increase excitement and stimulate innovative thoughts needed to push research projects, programs, and scientific discovery forward. By formalizing a group that meets regularly, group participants may hold each other accountable to stay technologically current in their fields. In addition, sometimes spontaneous meetings can be very beneficial for participants.

3 | CASE DESCRIPTION OF A SUCCESSFUL TAG-TI DURING A TECHNICAL WORKSHOP

Some TAG-TI groups have come together after attending technical workshops. For example, following the conclusion of a workshop in the cell biology field, members were asked to meet to recap the activities of the day. A quick introduction to the need for the gathering and the concept of a TAG was given. The participants were asked to introduce themselves and identify any areas where the workshop was unclear, difficult to decipher, or where additional explanations would be useful. Participants were invited to join in a discussion to clarify or fill in missed information and a consensus was reached by the end of the TAG. The

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process of identifying knowledge gaps can be helpful for everyone to reinforce concepts. During the second day of a 2+ day workshop, the organizers/speakers were invited to correct misunderstandings or provide additional information. TAG-TI works best with a 2+ day conference since participants can have time to absorb information from the first day and then ask questions the following days. The second TAG session may contain more people as TAG participants invite others.

Workshop organizers may consider scheduling time for the participants to form TAG-TI meetings to support an interactive learning approach. After initial TAG meetings, participants often continue to interact to increase their depth of understanding of complex/evolving technical areas. In some cases, while writing a grant or manuscript, it becomes evident that a deeper knowledge of some technical advancement is needed. A group of experts who have the same goal of increasing their understanding and use of a given technology will form a new type of TAG, the Technology Acquisition group (TAG-TAcq).

4 | TECHNIQUE ACQUISITION GROUP (TAG-TACQ)

TAG-TAcq shares the common framework of social constructivism and CoP, however, the focus and implementation of the session differ slightly. Unlike TAG-TI, which seeks to identify how technologies can answer specific research questions, TAG-TAcq seeks to teach or refresh knowledge of a specific technology. TAG-TAcq works best with fewer people (e.g., 2–5 members), and the group makeup may change depending on the skill set being acquired. The acquisition can be by either watching prerecorded videos or webinars together via video conference or participating in workshops, and then debriefing with TAG-TAcq members, at the end of the day or during breaks. Here, group learning can:

- Allow the adaptation of information to individual contexts to make the information more personally relevant and user-friendly.
- Identify problem areas that individuals may have so that they can be addressed and corrected early in the process.
- Make learning fun.

TAGs are not limited to working with people in the same location. A case in point, our group recently played imaging instruction videos in Virginia, while a faculty mentor shared their video conferencing screen in Pittsburgh for their mentee. In this manner, both parties could watch tutorials and interact together to learn 4D image analysis with Imaris software (Oxford Instruments). At various intervals, we stopped the program to assess our progress. By the end of the fifth video (provided online by the software company) we were successfully harnessing the technology to analyze organelle movement.

Other examples of successful TAG-TAcqs were modeled during a 4-day computational modeling workshop and a workshop on image analysis hosted by Dr. Teng-Leong Chew (Janelia Campus). Each evening, a video conference debriefing was conducted with Dr. Andrea Marshall (Vanderbilt University) and Dr. Murray to enrich their understanding and acquisition of computational programming skills for cell and organelle image analysis. We convened to review the information discussed that day, ensured that the programs were operational on our computers, and assessed our comprehension based on the day's presentation. During the sessions, learners supported senior faculty by sharing their expertise in Python. This exemplified how peer teaching within the TAG-TAcq model can leverage social capital, enhance individual self-esteem, and foster a sense of belonging in STEM.

5 | CONSIDERATIONS FOR IMPLEMENTATION

Given the integration of digital platforms in STEM education combined with the fact that the purpose of TAGs is to showcase different technologies, TAGs can be easily implemented on a virtual platform. Virtual mediums may also enhance cross-institutional collaborations within the country, and around the world. The unintended positive consequence of a virtual platform is that TAG participants may gain access to valuable virtual mentoring networks (Neikirk et al., 2023). Additionally, there is no gold-standard time schedule to ensure accountability. Every TAG will be different based on individual and group goals, and the decision on how often to meet should be made on a case-by-case basis. As a TAG progresses, these parameters may be adjusted to fit the needs of its participants (Spencer et al., 2022). Lastly, regardless of the medium of the TAG, including pleasant breaks such as coffee-breaks, physical activity, and/or time for small-talk can bolster productivity (Albulescu et al., 2022) and re-engage the social and personal aspects of the collaborative learning model (Neikirk et al., 2023). Additionally, it is important that individuals track their goals within each TAG session so that they can gauge progress and maintain a sense of direction. Participants should be encouraged to reflect on their goals before/after each TAG to ensure they are on target and change the goal if necessary. Moreover, by integrating regular goal tracking and reflection into TAG sessions, organizers can also ensure that individual needs are met, particularly in environments where there are variable levels of competency and proficiency within the group. Overall, setting goals as part of accountability groups can be an important aspect to increase accountability and promote a sense of achievement and camaraderie within the group (Stewart et al., 2023).

6 | UNINTENTIONAL CONSEQUENCES OF TAGS

The obvious benefits of the TAG model are highlighted above, however, the unintentional consequences of TAGs, like their WAG counterparts, (Spencer et al., 2022) are important to explore as well. With a similar theoretical model and ultimate purpose as TAGs, WAGs have been shown to effectively facilitate peer support (Neikirk et al., 2023; Spencer et al., 2022). A study by Bourgault et al. (2022) showed that WAGs resulted in increased collaborations and informal mentoring. These benefits were experienced by all participants but were most pronounced among those in the earlier stages of their careers (Bourgault et al., 2022).

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By including scientists from various career stages, mentoring in these groups can often be bidirectional. For example, more junior members can aid in explaining technologies while senior faculty can offer perspective on how the information gained from the technology can be applied to specific problems or used for grant applications. These bidirectional relationships were observed in the knowledge exchanges within our TAG-TAcq. In addition to early-career faculty, minorities in STEM can preferentially benefit greatly from the TAG model as they can gain a valuable mentorship network and meet other individuals who identify as an underrepresented minority within the TAG. For example, this positive effect of reverse mentorship was demonstrated in our recent pilot study on a nontraditional, varied WAG for historically excluded and under-represented persons in STEM (Neikirk et al., 2023).

7 | CONCLUSION

In summary, TAGs serve as a platform for knowledge sharing, discussions, and acquiring new information in a manner that lessens the stress of learning new technologies. By including scientists from various career stages, mentoring in these groups can often be bidirectional. In the future, we plan to enhance the TAG by establishing a diverse network of institutions and incorporating regular invitations for guest speakers, including experts in emerging fields, to join TAG meetings as facilitators. The dynamic nature of the TAG model ensures that participants remain at the forefront of technological advancements, as they continue to gather new information, identify resources, discuss emerging technologies, and acquire new skills to advance scientific discovery.

AUTHOR CONTRIBUTIONS

Manuscript conception and design: Feather Ives, Sandra A. Murray, Antentor Hinton. *Manuscript drafting*: Feather Ives, Sandra A. Murray, Antentor Hinton, Vijayvardhan Kamalumpundi, Kit Neikirk. *Funding acquisition and supervision*: Sandra A. Murray, Antentor Hinton. *Revision, edits, input, and final approval*: Feather Ives, Vijayvardhan Kamalumpundi, Celestine Wanjalla, Jazmine I. Benjamin, Kit Neikirk, Sulema Perales, Annet Kirabo, Debra D. Murray, Anthonya Cooper, Edith M. Williams, Antentor Hinton, Sandra A. Murray.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ORCID

Celestine Wanjalla http://orcid.org/0000-0001-9159-5414
Annet Kirabo http://orcid.org/0000-0001-8580-9359
Antentor Hinton http://orcid.org/0000-0002-7730-952X

REFERENCES

Albulescu, P., Macsinga, I., Rusu, A., Sulea, C., Bodnaru, A., & Tulbure, B. T. (2022). Give me a break!" A systematic review and meta-analysis on the efficacy of micro-breaks for increasing well-being and performance. *PLoS One*, *17*, e0272460.

Bourgault, A. M., Galura, S. J., Kinchen, E. V., & Peach, B. C. (2022). Faculty writing accountability groups: A protocol for traditional and virtual settings. *Journal of Professional Nursing*, *38*, 97–103.

Chen, Y.-C. (2013). Effect of reverse mentoring on traditional mentoring functions. *Leadership and Management in Engineering*, *13*, 199–208.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*, 81–112.

Li, L. C., Grimshaw, J. M., Nielsen, C., Judd, M., Coyte, P. C., & Graham, I. D. (2009). Evolution of Wenger's concept of community of practice. *Implementation Science*, *4*, 11.

De Lora, J. A., Hinton Jr., A., & Termini, C. M. (2022). Creating inclusive environments in cell biology by casual mentoring. *Trends in Cell Biology*, *32*, 725–728.

Murray, S. A., Shuler, H. D., Davis, J. S., Spencer, E. C., & Hinton Jr., A. O. (2022). Managing technostress in the STEM world. *Trends in Biotechnology*, *40*, 903–906.

Neikirk, K., Barongan, T., Shao, B., Spencer, E. C., Kabugi, K., Conley, Z., Vang, L., Vue, M., Vang, N., Garza-Lopez, E., Crabtree, A., Alexander, S., Beasley, H. K., Marshall, A. G., Killion, M., Stephens, D., Owens, B., Martinez, D., Palavicino-Maggio, C. B., … Hinton Jr., A. (2023). A pilot study on our non-traditional, varied writing accountability group for historically excluded and underrepresented persons in STEMM. *Heliyon*, *9*, e22335.

Reinholz, D. L., White, I., & Andrews, T. (2021). Change theory in STEM higher education: a systematic review. *International Journal of STEM Education*, *8*, 37.

Spencer, E. C., Neikirk, K., Campbell, S. L., Powell-Roach, K. L., Morton, D., Shuler, H., Murray, S. A., & Hinton, A. (2022). Intentional and unintentional benefits of minority writing accountability groups. *Trends in Microbiology*, *30*, 1015–1018.

Stewart, V. R., Snyder, D. G., & Kou, C.-Y. (2023). We hold ourselves accountable: A relational view of team accountability. *Journal of Business Ethics*, *183*, 691–712.

Thorpe Jr., R. J., Beech, B. M., Norris, K. C., Heitman, E., & Bruce, M. A. (2020). Writing accountability groups are a tool for academic success: The obesity health disparities pride program. *Ethnicity & Disease*, *30*, 295–304.

Toma, R. B., Yánez-Pérez, I., & Meneses-Villagrá, J. Á. (2024). Towards a socio-constructivist didactic model for integrated STEM education. *Interchange*, *55*, 75–91.

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