A Path Less Traveled: Fostering STEM Majors' Professional Identity Development through Engagement as STEM Learning Assistants

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Professional identity development of undergraduate STEM majors is associated with their retention, engagement, and career success. Student professional identity development is posited to occur when students engage in professional roles. Learning assistants (peer learning facilitators) assume roles of authority, leadership, and content experts, which we posited would foster a more mastery perspective of learning (focused on concepts over facts) and internalize perceptions of themselves as professionals. Our research on a group of STEM education learning assistants revealed over time the students tended to shift toward a mastery perspective of learning and used internal cues to communicate their professional identity.

INTRODUCTION

The development from novice to expert is a long term process with concentrated effort and practice (Ericsson, 1998). Becoming an expert involves acquiring deep content knowledge, developing efficiency in skill application, and understanding of the norms of a domain (Ericsson, 2006). Developing expertise is particularly challenging in science, technology, engineering and mathematics (STEM) due to the complexity and integrated nature of STEM knowledge, relationships and applications of domain knowledge, and the increasing interconnection of STEM concepts and norms (National Academy of Engineering [NAE] & National Research Council [NRC], 2014). Solving problems within STEM disciplines and the more integrated STEM problems associated with food, energy, clean water, and access to healthcare requires the application of knowledge and skills from multiple STEM domains. We argue that the confidence and efficacy required to effectively engage at the professional level in solving STEM problems is correlated with the extent to which individuals identify themselves and are identified by others as STEM professionals. Therefore, we assert that STEM students' development of their professional identity is critical to their success as STEM professionals.

We posit that STEM student engagement as peer learning facilitators could catalyze the development of their STEM professional identity due to experiential learning interactions that are aligned with those of a professional; such as holding a high level of content knowledge, reliance on a range of communication skills, adaptability to a range of individual needs, development and implementation of student-focused learning conditions, and interactions and collaborations with faculty as peers. We created and distributed a survey to determine if engagement as a learning assistant (i.e. peer learning facilitator) impacted student

professional identity development. Of particular interest to us were the aspects of the learning assistant experience that may be influential on the learning assistant's perceptions of themselves as STEM professionals. Research indicates that being a learning assistant can increase students' content knowledge (Otero, Pollock, & Finkelstein, 2010), however, there is a lack of empirical evidence to document how being a learning assistant influences students' professional identity development. Our research addressed this gap by gathering evidence of STEM students' professional identity, a unique contribution to the Learning Assistant program research.

Before we delve into our research methods and data we lay the groundwork for our research through a discussion of self-authorship, learning assistant programs, learning goals, and becoming an expert. We follow with our methods and results. We conclude with a discussion of our results, the implications of our findings, and limitations of our research.

Self-Authorship and Professional Identity

When examining students' professional identity growth, it is beneficial to use a theoretical framework that effectively details the development of students' perceptions of themselves as professionals. We selected Baxter Magolda's (2004) self-authorship framework to guide our investigation of how students employed as learning assistants influences their professional identity development. Self-authorship has been used primarily to explore and explain *personal identity* development. However, we have used the structure of the self-authorship framework to create a parallel framework for examining and explaining students' *professional identity* development (Authors, under review).

The self-authorship framework (Baxter Magolda, 2004) is a developmental model that suggests that as people engage in complex or personally challenging experiences, they transgress from using external references or cues as indicators of their identity to the use of internal references in their identity expression. Similarly, we anticipate students in early stages of professional identity development to use external cues, such as course-work grades, academic major, finishing a degree, comments and approval by faculty members, or other institutionally-based elements, as references for their professional identity. Thus, we would anticipate that individuals in beginning stages of their professional identity development to be followers who adhere to the lead of others, and engage in professional interactions guided by tasks and authority (Authors, under review). Further, the focus on completing tasks and following the activities and authority of others as references for their professional identity would suggest that these students are more likely to take a performance approach to learning (Linnenbrink & Pintrich, 2002).

Alternatively, we would expect students who are in more advanced stages of professional identity development, who have developed more advanced self-authorship (Baxter Magolda, 2004), to use more internal references to communicate their professional identity. Similar to more advanced stages of self-authorship, we anticipate that individuals with advanced professional identity will use more internal reference such as interest, self-reliance, motivation, self-confidence, self-regulation, eagerness, sense of responsibility, collaboration, and a desire to share knowledge (Baxter Magolda, 2004). Thus, we would anticipate that students with more advanced professional identity developments to be contributors or collaborators, acting more as colleagues in professional settings (Authors, under review). We posit that individuals with more advanced professional identity are also more likely to focus on concepts and deep understanding, taking a mastery approach toward learning (Linnenbrink & Pintrich, 2002).

Self-authorship development is catalyzed by experience, interactions with others, mentoring, and context (Baxter Magolda, 2004). According to Baxter Magolda (2004) self-authorship develops as people successfully negotiate situations of responsibility, effectively solve complex problems, have positive interactions with diverse populations, and become comfortable with conditions of uncertainty and ambiguity. Similarly, we maintain that when individuals encounter situations that require responding in a manner consistent with a professional in their field or domain (e.g. STEM) they are likely to experience growth in their professional identity (Authors, under review). The Learning Assistant model by nature, can effectively afford the conditions that promote self-authorship and occur in a professional setting, and therefore we posit that being a learning assistant fosters development of student professional identity. Thus, the references that learning assistants use to communicate their activities and interactions may be

used as indicators of their professional identity development. We feel it is important to recognize that the influence of being a learning assistant on student professional identity growth is likely to be contextual and individualized.

The language and references students use to describe their professional interactions are key indicators of their self-authorship development (Baxter-Magolda, 2004) and, therefore, are also effective for determining level of professional identity development. We contend that when examining data for the impact of being a learning assistant on professional identity development, it is essential to ask learning assistants questions that elicit responses that can be used to determine how they behave in professional situations.

The Learning Assistant Model

The Learning Assistant program is a unique approach to peer tutoring (Otero, Pollock, & Finkelstein, 2010) that has some overlap with other student learning support programs such as the *supplemental instruction* program (Arendale. 1994) and some other academic student tutoring and peer mentoring programs (Budge, 2006; Crisp & Cruz, 2009). The initial development of the Learning Assistant model was to address STEM student success in large scale STEM lecture based courses (Otero, Pollock, & Finkelstein, 2010). The Learning Assistant model has been replicated in several institutions (Goertzen, Brewe, Kramer, Wells, & Jones, 2011) with some variation based on campus culture, structure, and learning needs of the students. However, the basic framework of the program is to prepare undergraduate STEM students to support their peers' development of academic skills by enhancing the students' self-regulation of learning (Goertzen, et al., 2011). The students who act as learning assistants may engage as leaders in recitation sections, as peer coaches during classroom interactions, and facilitator of learning during study sessions.

Regardless of the structure of learning assistant sessions, the students acting as learning assistants assume leadership roles that require deep content knowledge, understanding of processes and skills associated with the academic area they are supporting, and knowledge of the norms in terms of student's expectations related to learning. We speculate that because of the knowledge, leadership, and nature of the interactions of STEM students engaged as STEM learning assistants they experience accelerated professional identity development. The responsibility for facilitating peer learning, interactions with faculty teaching the courses associated with the LA program, and the gains in content knowledge, catalyze student internalization of references of themselves as professionals, advancing their professional identity development.

Professional Identity: Why STEM?

Although professional identity development is arguably important to individual integration and effective engagement into nearly all professions, the development may be even more salient in the STEM professions. There is strong and sustained demand for highly prepared STEM professionals that necessitates institutions of higher education to prepare and graduate well qualified STEM professionals (NRC, 1999, 2002). The qualifications require graduates to have the confidence and capacity that is associated with those working in STEM professions. To meet the demand for STEM professionals we need to retain the students who enter STEM degree programs. One manner in which retention of students may be achieved is by assuring they have a sense of belonging in the programs (Hausmann, Schofield, & Woods, 2007). We argue that through the development of professional identity students are more likely to see themselves as part of the STEM community (Pierrakos, Beam, Constantz, Johri, & Anderson, 2009) and therefore are more likely to persist in the completion of degrees and be stable in their careers as STEM professionals. The development of a self-image as a professional correlated with perceptions of belonging influence their commitment and increase the likelihood that they will contribute to the greater academic community (Wilson et al., 2012). We posit that STEM student engagement in the Learning Assistant program enhances their perceptions of themselves STEM professionals and they experience an increase in their commitment and engagement in STEM education and their associated careers.

Through professional identity development students are likely to be both persistent and engaged in course work that may be highly challenging, which is particularly important in gateway classes. We posit that STEM student professional identity leads to greater levels of motivation and success, reducing failure rates, and the costs and course access implications to the student and university associated with retaking courses. Thus, we argue that student engagement in the Learning Assistant program positively influences the students' development of a STEM professional identity which has positive ramifications at the personal, institutional, and professional levels.

METHOD

Our research was a cross sectional study of STEM students engaged as learning assistants. We generated and administered a survey to gather data to determine the levels of professional identity development and learning goal orientation of the participating STEM learning assistants. To guide our study we developed the following research questions:

- *What were the levels of professional identity of students working as learning assistants?*
- *What is the relationship between level of professional identity and the engagement of students in Learning Assistant sessions?*
- *What influences did being a learning assistant have on the students who assumed roles as learning assistants?*

We hypothesized that STEM students' engagement as learning assistants would influence their professional identity development due to the nature and expectations of the interactions required to be successful as a learning assistant. Further we predicted that students acting as learning assistants were likely to have advanced levels of professional identity development and would be more mastery goal oriented toward their learning and their work as learning assistants, focusing on concepts and systems, rather than tasks and discrete events.

Participants

The participants in our research were those STEM students who were actively working as learning assistants in a metropolitan university in the northwestern United States. The students were all undergraduate STEM majors and none of them had been a learning assistant for longer than two years, and were in their second to fourth year of their STEM degree programs. Due to the likelihood of our ability to identify students by their demographics, we elected not to ask the participants to share their personal characteristics with the anticipation that students would be less likely to provide candid and honest responses to our survey questions if they perceived that they might be identified. However, inferred from the general population of learning assistants at the university, we would anticipate the participants to be first degree seeking students, about 20-25 years old, evenly distributed as males and females, and academically high achieving.

Survey Tool Development

We began the development of our survey with a consideration of the overlap between the work of learning assistants and the work of STEM professionals, particularly STEM faculty. Our objective was to create items that would elicit responses from the learning assistance that could be used to determine level of professional identity as well as goal orientation toward their work as students and as learning assistants. Further, we also know from our prior research on professional identity development (authors, under review) that when asked to share their level of professional identity development, students tend to provide responses that indicate more advanced professional identity than their behaviors would indicate. Thus, we have found it is important to create items that can be used as proxies for professional identity development. These proxy items ask participants to share how they behave in professional challenging situations (e.g. situations of conflict, ambiguity or complexity). In addition to the proxy items we also wanted to gather some general information about the learning assistants' experience (e.g. duration,

engagement in the learning assistant seminar). Thus, we developed a survey with an item to determine the duration of the participants' learning assistant experience asking questions, "Including this semester, how many semesters have you worked as an LA?" We then developed a series of items to determine the participants' engagement in learning assistant preparation activities by asking questions regarding engagement in the learning assistant seminar by asking questions such as, "What was the greatest benefit to attending the weekly seminar?" We anticipated that the answers to these items could provide insight into both the professional identity development and their goal orientation.

Since our goal was to determine level of professional identity in the context of being a learning assistant, we generated a series of free response items that prompted the participants to describe their work as a learning assistant. We recognize that the students' behaviors as a learning assistant were likely to reveal data reflective of level of professional identity; therefore, we used prompts such as "How did you interact with the course instructor/faculty member?" and "What were the challenges or barriers?" We also determined prompts that required participants to share personal experiences related to being a learning assistant that would provide insight into their image of themselves as professionals and therefore we asked them to respond to items such as, "Did your ideas about yourself as a learner change from being an LA?"

Once we created our items we vetted them with several individuals familiar with the Learning Assistant program, professional identity development, and goal orientation. Based on the feedback received from those who reviewed our survey we made minor changes to a few of our items to make them more comprehensible or focused. Our final instrument contained a total of seventeen items (the survey is appended).

Data Collection

To collect data we ported our instrument into a web-based survey provider. We included the consent form submitted with our application to the Institutional Review Board with the survey. Once we tested the survey to assure it functioned as expected, we distributed the access link to the learning assistants through email with an invitation to participate in the research project. We allowed two weeks for completion, sent out a second reminder and closed the survey after a third week of data collection.

RESULTS

Of the 35 STEM learning assistants, we had 28 participate in our research. However, once we examined the responses we found that 8 of the participants provided less than adequate completion of the survey to include them on our analysis. Thus, our final analysis included responses from 20 STEM majors acting as learning assistants.

Data Conditioning and Coding

For our analysis we determined it was most effective to combine the survey responses of each participant into a single monolog, which was essentially a narrative of each of the students' experiences that could be analyzed for indicators of level of professional identity and their goal orientation. We created multiple categories for classifying the students' responses using a number of indicators to index the students' levels of professional identity development. We determined that "follower: was representative of those at low levels of professional identity development as they use external cues as references for their professional identity. Conversely, those at higher levels of professional development use more internal cues typical of collaborators. The categories we developed using the follower and collaborator classifications and goal orientation were; follower/performance orientation (FP); follower /mastery orientation (FM); Collaborator/performance orientation (CP); and collaborator/mastery orientation (CM). We created a combination of categorical and nominal coding variables to analyze relationships between aspects of the learning assistant program elements and professional identity indicators.

Levels of Professional Identity

Our first research question asked, "What were the levels of professional identity of students working as learning assistants?" To answer this question we examined the participants' narratives describing their work as learning assistants with respect to their goal orientation and references to encounters in professional situations. As we have argued, goal orientation is a proxy for level of professional identity with a mastery approach aligned with the "collaborator or contributor" professional identity stage and a performance approach reflective of the "follower" professional identity stage. Our analysis revealed the majority of the learning assistants communicated a mastery approach when describing their work, reflecting practices aligned with those of professionals. Thus, many of the students' communicated professional behaviors aligned with those at a professional identity stage of "collaborator and contributor" focusing on systems and concepts in their approaches to professional situations. However, about a third of the students communicated learning assistant behaviors reflective of a performance goal orientation and indicated a "follower" level of professional identity focusing more on tasks and processes. See Table 1 for examples of the language used by the learning assistant and the corresponding alignment to goal orientation and levels of professional identity.

TABLE 1
GOAL ORIENTATION WITH LA SESSIONS, PROFESSIONAL IDENTITY, FREQUENCY OF THE RESPONSES, AND EXAMPLE RESPONSE

Goal Orientation - Professional Identity	Frequency	Percent	Representative Passage
Mastery - Collaborator	12	60.0	"Through our discussions, I reflected on myself and came up with new strategies for improving my learning assistant sessions."
Performance - Follower	6	30.0	"I can do problems on the board all day but how to get into a discussion about the deeper meaning with people that just want to know how to use the formula is still a little above me."
Unclear or Insufficient	2	10.0	N/A

We continued our analysis of the narrative for indicators of professional identity development in tandem with the self-authorship framework. As discussed in the review of literature, we maintain that the source of the cues or references when describing interactions in professional situations is reflective of level of professional identity. Through our analysis we found the majority of the participants communicated internal cues in their narratives, an indicator of the "collaborator and contributor" stage of professional identity. Again, about a third of the participants used language reflective of external cues which indicates they are likely to be at the "follower" professional identity stage. See Table 2 for examples of the language used by the learning assistant and the corresponding alignment to levels of professional identity.

TABLE 2
PROFESSIONAL IDENTITY INDICATORS - INTERNAL AND EXTERNAL CUES AND LA NARRATIVES

Professional Identity Indicator	Frequency	Percent	Representative Passage
Collaborator - Internal Cues	13	65.0	"I started tutoring to see if I could handle the teaching aspect, and found that I was more passionate about tutoring and the idea of being a teacher than I had been about either Philosophy or Math."
Follower- External Cues	5	25.0	"Graduate Teaching Assistantships require you to teach and becoming a learning assistant is a step in the right direction both for grad school applications and for the teaching requirement while in grad school."
Unclear/Insufficient	2	10.0	N/A

In our next stage of analysis we examined the overlap between our cue codings and goal orientation codings. The goal of this analysis was to determine if there was alignment between the references the learning assistants used in relationship to their work with the motivation for the goals they communicated. Our analysis revealed an alignment between use of follower cues and performance goal orientation as well as use of collaborator cues and mastery goal orientation, which suggests a consistency in language and indicators of level of professional identity. Our results revealed that the majority of the participating learning assistants used collaborator cues in their communication and conveyed a mastery goal orientation. Consistent with our previous analysis about a third communicated content more aligned with follower cues and a performance orientation. We present the alignment between the coded professional identity cues and coded goal orientation in Table 3.

TABLE 3
COMBINED GOAL ORIENTATION AND PROFESSIONAL IDENTITY INDICATORS

Classifications	Frequency	Percent
Follower Cues/Mastery Goals (FM)	1	5.0
Follower Cues/Performance Goals (FP)	4	20.0
Collaborator Cues/ Mastery Goals (CM)	11	55.0
Collaborator Cues/ Performance Goals (CP)	2	10.0
Unclear/Insufficient (U)	2	10.0

We continued our analysis by aligning our four groups of goal orientation and level of professional identity with the years of experience of the students as learning assistants (see Table 4). We then conducted a Chi Square analysis of the distributions. Our analysis revealed a significant difference in the distribution of self-authorship indicators and the goal orientation pairs between the learning assistants in their first year and those with more than one year of experience ($\chi^2 = 9.27$, $p < .05$, $df = 3$). Our text of

independence analysis suggests that goal orientation and professional identity are dependent on years of experience as learning assistants.

TABLE 4
DURATION OF PARTICIPANT INVOLVEMENT AS A LEARNING ASSISTANT AND INDICATORS OF PROFESSIONAL IDENTITY AND GOAL ORIENTATION

Years of Experience	SA Indicator and Goal Orientation Pairs			
	FM	FP	CM	CP
First semester LA	0.0% (0)	40.0% (4)	30.0% (3)	20.0% (2)
Experienced LA	10.0% (1)	0.0% (0)	80.0% (8)	0.0% (0)

Professional Identity and Learning Assistant Sessions

Our second research question asked, "*What is the relationship between level of professional identity and the engagement of students in Learning Assistant sessions?"* We determined that the most effective way to answer this question was to examine the participants' perceptions of their roles as learning assistants in conjunction with their ability to engage students in their learning assistant sessions.

Through our analysis we found that the learning assistants tended to describe their role in two contexts. One context was as a facilitator of learning in which they worked to help students think and develop conceptual understanding, a mastery approach. The second context was as a provider of answers, which was essentially as a tutor to help students complete tasks, a performance approach. Using these two classifications we examined the participants' levels of attendance in their sessions, as we speculated that the approach they took in their session would influence student engagement and the perceived value added for the sessions. Our analysis revealed a significant difference in levels of attendance (see Table 5), with learning assistants who took a conceptual development approach having higher levels of student participation than learning assistants who took more of a task approach (χ^2 (1, 2) = 5.69, $p < .05$). Thus, learning assistants who held sessions that we anticipated to be more conceptually focused attracted more students to their sessions than those learning assistants who were more task oriented.

TABLE 5
LEARNING ASSISTANT APPROACH AND AVERAGE SESSION ATTENDANCE

Learning Assistant Approach	Average Session Attendance	
	High Attendance	Low Attendance
Facilitator	63.6% (7)	36.4% (4)
Tutor	11.1% (1)	88.9% (8)

Influences of Learning Assistant Experience

Our third research question asked, "*What influences did being a learning assistant have on the students who assumed roles as learning assistants?"* To answer this question we examined the responses

of the participants along multiple lines including influences on career aspirations, changes in approaches in their roles as learning assistants, and influence on the participants' perceptions of themselves as learners or professionals.

We began our analysis with an examination of the participants' narratives to determine how being a learning assistant may have influenced the participants' career paths. An analysis of the responses revealed that the majority (70%) of the learning assistants communicated that the experience as a learning assistant was important to helping them bring clarity to their career plans, which included components of or foci on teaching (K-12 and higher education). Four of the learning assistants (20%) explicitly reported a "newly found" passion for teaching as having changed their career plans. Over two thirds of the learning assistants (70%) indicated that they did not experience a change in their career plans. Some of the no-change in career plan responses indicated that being a learning assistant intensified, reinforced, enriched, or advanced their career plans (see Table 6). Less than one third of the learning assistants indicated that being a learning assistant did not influence their career plans. Thus, our analysis revealed that being a learning assistant influenced the career perspectives of most of the students who worked as learning assistants, resulting in shifts in direction of career plans for some of the participants' while strengthening or reaffirming the career plans of others.

TABLE 6
INFLUENCE ON CAREER PATHWAY OR CAREER COMMITMENT

Coding	Frequency (Percent)	Representative Passage
Yes change- and clearly identified the experience as having helped them identify a passion for teaching	4 (20%)	*I NEVER thought I would enjoy tutoring as much as I did. I have always loved helping others, but going into a teaching profession was something I thought I could never do. In fact, it was the one job that I always said that I couldn't do. Going through this LA program showed me that I could teach students, even students that were my age or older*
No change- but the experience had solidified their existing career plans.	4 (20%)	*I was already in education when I began working as an LA. If anything, this experience has just cemented that decision.*
No change- but LA experience enriched or advanced an existing career plan that included teaching	6 (30%)	*Teaching was always part of the plan, that's why I got the gig.*
No change- explicitly state that the experience had not factored into their career decisions	4 (20%)	*I really enjoy learning about my current material to become a mechanical engineer. I do love teaching, and perhaps someday I may even teach engineering classes myself, but right now, I want to become an engineer and design things*
No Change- But lacked explanation response to "Why"	2 (10%)	

In our examination of the learning assistants' comments regarding their roles as learning assistants, the majority (84%) shared that they experienced increased confidence in their role and nearly half (42%) developed some essential skills such as leadership or ability to guide learners. The participants who indicated that they experienced change attributed the shift to their roles as learning assistants. For example one learning assistant shared, **"**I think tutoring has helped my confidence both in the subject I'm tutoring and in my ability to communicate and socialize. It has also helped me develop a greater sense of empathy for my peers." Another learning assistant shared, "I've learned just how difficult and important communication skills are with teaching or being a learning assistant. I feel I better understand both my position as a learner and the position of the teacher. I believe becoming a learning assistant has actually improved my study habits as well." Through our analysis we also found that as learning assistants the participants gained a deeper level of content knowledge, sense of leadership and responsibility as they took initiative to lead groups of students, and a sense of mentoring as they indicated empathy and a desire to help students.

With regard to whether being a learning assistant changed the participants' perceptions of themselves as learners, our analysis of responses revealed that 75% of the participants perceived that they had changed as learners, while 25% indicated that being a learning assistant did not change their ideas about themselves as learners. Many of those who indicated they experienced change made comments such as "I now see myself as being solely responsible for my learning." and "Yes, I realized that when presented with a problem, I do much better if I have some time to think about them." indicating that they had become more reflective in their learning. The justifications provided by participants who indicated that they did not experienced change in their perceptions of themselves as learners, shared that they were already rather reflective in their learning as made evident with passages such as, "Always evolving myself as a learner." and "I love teaching and I know teaching is a continuous process which I know years before I started working as a LA."

DISCUSSION AND IMPLICATIONS

We posit that STEM students' professional identity can have a profound influence on their engagement as learners, the way that they interact with others in professional situations, and their long term commitment and success in STEM professions. We posit that there are other constructs related to student professional identity such as their goal orientation (Linnenbrink & Pintrich, 2002) and self-authorship (Baxter Magolda, 2004). Through a survey we developed we prompted learning assistants to share thoughts and experiences that could be used to determine the students' level of professional identity. We posited that level of professional identity would be associated with how learning assistants run their sessions and the attraction of those sessions to students. We also posited that due to their responsibilities as learning assistant students would likely experience shifts in how they learn and gain clarity regarding their career aspirations.

Our research exposed a relationship between goal orientation and indicators of professional identity indicating that these two constructs are likely related. Given that STEM professionals are likely to be more effective if they are mastery motivated and strongly committed to their profession, it is critical that they have high levels of professional identity. The relationship between professional identity and goal orientation suggests that by creating the right conditions that fosters students' development of both, such as being a learning assistant is likely to contribute to the preparation of students for successful engagement in STEM careers.

Our data indicated that most of our participants could be considered to be at higher levels of professional identity development due to their references to mastery learning and use of internal cues. We speculate that the learning assistant role attracts students who may be primed for progression in their professional identity due to the responsibility of the position. Further, through the process of being a learning assistant, participants are likely to develop professional level skills and the associated identity due to the necessary leadership and knowledge associated with being a learning assistant. Thus, we suggest that placing students in learning assistant roles helps them develop their professional identity. A

more longitudinal examination of the influence of the learning assistance role on student professional identity development is likely to be a fruitful direction for future research.

We found that the approach that learning assistants took with their sessions (correlated with level of professional identity) was related to student participation in their sessions. We speculate that even though students may be driven by task completion, they know that they benefit greater from learning the concepts and therefore are more attracted to a mastery approach to learning. Thus, students may be are more likely to attend learning assistant sessions that help them learn than those sessions that are simply focused on completing tasks. Thus, our data suggest that there is a substantial support to assuring learning assistants are at a higher level of professional identity that is aligned with conveying a mastery approach to learning. How learning assistants at different levels of professional identity development entice students to attend their sessions and how they interact with them once they are in their sessions is an excellent direction for future research.

The potential influence of the role of a learning assistant on the professional identity development of our participants suggest that the program may be another mechanism to promote STEM student professional identity growth. The leadership, content knowledge, and the communication required to be a successful learning assistant suggests that students who take the role are likely to experience substantial growth in their perceptions of themselves and behaviors as STEM professionals. Thus, the learning assistant program is likely to substantially increase the STEM profession identity development of the students who act as learning assistants.

Limitations

The results of this study demonstrated the learning assistant experience influenced the professional identity development of the students in the LA role; however, there are limitations to this study that could impact the generalizability or validity of the findings. Future research in this area may consider increasing the sample size or the use of a longitudinal design. Additionally, including participants from multiple universities would strengthen any future studies.

A second limitation is the nature of our data collection. We used a survey approach which relies on self-report. While surveys may have the advantages of being easy to distribute and collect data, they lack the ability to provide the data that is fully commensurate with observational data. Future research into the professional identity development of students in the learning assistant role could seek to off-set the limitations of self-report by gathering and reporting observational data, however, such situations are subject to some of the same limitations that influence self-report approaches.

CONCLUSION

The Learning Assistant model is becoming recognized as a best practice for enhancing the undergraduate STEM student learning experience. Prior research has examined the influence of the program on the learning assistants' content knowledge. However, there is a gap in the research on how being a learning assistant fosters student development as professionals, particularly, their professional identity. We addressed this gap with our research, providing a foundation for examining how being a learning assistant may lead to a more a mastery approach to learning situations and internalization of perceptions which are consistent with a more advanced professional identity development. Thus, our research indicates that when students engage as learning assistants for sustained periods of time they are likely to experience significant increases in their professional identity development.

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*Louis S. Nadelson conducted this work while a faculty member at Boise State University.

APPENDIX

Survey of the STEM learning assistants

1. Including this semester, how many semesters have you worked as an LA?
2. Did you attend the LA Seminar? Why or why not – please explain.
3. What was the greatest benefit to attending the weekly seminar?
4. What could be done to improve the weekly seminar?
5. How did your tutoring skills evolve over the semester? What do you attribute that change (if any) to?
6. Did your ideas about yourself as a learner change from being an LA?
7. Has being an LA changed your career plans? Please explain.
8. Do you feel you have made a difference in the class in which you were an LA? Please explain.
9. How did you interact with the course instructor/faculty member? What were challenges or barriers?
10. On average, how many students came to your sessions?
11. How did you advertise your session and how often did you advertise?
12. How did you run your session – what did they typically look like?
13. Do you feel you got the support you needed to be an effective LA? Please explain.
14. What do you feel would be helpful to improve your effectiveness?
15. What additional training do you feel you need?
16. Why did you want to be an LA?
17. What are the ideal qualities of an LA? Please break down into the following categories:
    a. *Knowledge* (defined as the body of information necessary for task performance).
    b. *Skills* (levels of competency or proficiency needed for task performance)
    c. *Abilities* (traits or capabilities necessary to perform the job).