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Developing as a College Science Teacher: Using Identity to Examine Transformation

Robert J. Ceglie Sr.
Queens University - Charlotte, ceglier@queens.edu

John Settlage
University of Connecticut

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Abstract
Guided by identity theory, this study investigated how a college biology professor's early career experiences contributed to the transformation of his identity as a college science teacher. This study showcases the four components of identity as described by Gee as a lens and it specifically focuses on the emergent role of institutional identity and its associated conflicts with incompatible belief systems. This qualitative study illustrated the utility of Gee's theory to study how various components of identity can be useful to examine the transformation of a college faculty member. The participant's position as a non-tenured faculty member created dissonance between his developing beliefs concerning quality science instruction and those imposed on him by his department

Keywords
science, college, teaching, identity

Developing as a College Science Teacher: Using Identity to Examine Transformation

Robert J. Ceglie Sr.[1] & John Settlage[2]

1 Queens University - Charlotte
2 University of Connecticut

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Guided by identity theory, this study investigated how a college biology professor's early career experiences contributed to the transformation of his identity as a college science teacher. This study showcases the four components of identity as described by Gee as a lens and it specifically focuses on the emergent role of institutional identity and its associated conflicts with incompatible belief systems. This qualitative study illustrated the utility of Gee's theory to study how various components of identity can be useful to examine the transformation of a college faculty member. The participant's position as a non-tenured faculty member created dissonance between his developing beliefs concerning quality science instruction and those imposed on him by his department.

INTRODUCTION

There is ample evidence for the need to improve science instruction at all levels of education as calls from agencies such as the National Science Board (NSB) and the International Council of Associations for Science Education (ICASE) continue to highlight the importance of improving science instruction (ICASE, 2013; NSB, 2012). All levels of science instruction need attention and some argue that an increased emphasis on college level teaching and learning may be critical as college professors help promote scientific literacy across a wide range of students (NRC, 2015). One major challenge for college level instruction is to maintain a balance between the need to improve scientific literacy to create better educated citizens and the goal of supporting those who desire careers in science, technology, engineering and mathematics (STEM) disciplines. Regardless of the ultimate long-term goal, a key consideration is designing appropriate learning environments and experiences for students to excel in these disciplines.

Early attention to science instruction at the collegiate level came from work which examined the dropout rates and general dissatisfaction of students engaged in early college level science coursework. Pioneering work by Seymour and Hewitt (1997) examined reasons that students left science related majors. The most prominent factors for departing STEM majors included as loss of interest, poor teaching, overwhelming pace and inadequate advising or faculty accessibility. More recent work by Geisinger and Raman (2013) and Ulriksen, Madsen and Holmegaard (2010) illustrate that poor science teaching at the college level is an important factor for why students leave these majors. Research has examined the culture and climate created in college science classrooms and reports of overly competitive and unwelcome environments have been wildly reported (Crisp, Nora & Taggart, 2009). These environments conflict with research supporting the creation of supportive classroom atmospheres which have been demonstrated to improve student motivation and engagement (Askell-Wiliams, Helen, & Murray-Harvey, 2007). These findings offer evidence that college level science faculty must re-examine their practices and adopt better pedagogies. Science specific efforts have focused on moving away from a dissemination approach to create more active learning environments however, research suggests that considerable institutional barriers continue to limit sustained change (Guess-Newsome, Southerland, Johnson & Woodbury, 2003).

The majority of research in science instruction examines the role of the learner with particular attention placed on pre-college experiences. Fewer studies examine the role of the educator, especially college level science faculty who often have little training in teaching. Thus, there is a need to better understand the pedagogical decision-making patterns of college science faculty to examine ways to support high quality science instruction. One way of framing how and why pedagogical decisions are made can occur through the exploration of an individual's identity. Identity research has been utilized in numerous explorations of teacher identity (see Beauchamp & Thomas, 2009) and our work uses Gee's (2001) characterization of identity to examine the development and negotiation of identity. Since there is limited research which surveys college level science instruction at an individual decision level, there is great potential in using identity as a lens to understand individual and institutional factors which ultimately help or hinder reform based practices in college science classrooms.

RELATED LITERATURE

Many scholars have identified identity theory as a tool for studying changes that occur when individuals encounter challenges which cause them to reexamine their sense of self (Côtè & Levine, 2002; Sfard & Prusak, 2005). Additionally, identity theory, specifically Gee's conception of identity have been used in a growing number of science education studies. The focus of many of these studies has been to characterize how one's identity shifts in response to varying experiences (e.g., Carlone & Johnson, 2007; van Winkel, van der Rijst, Poell & van Driel, 2017). Studies have used identity to explain the role of culture and its influence on participation in high school (Brown, 2006), college participation (Trujillo & Tanner, 2014) and learner identity in elementary science students (Reveles, Kelly & Duran, 2007). It has been offered as a mechanism for preparing future science teachers (Luehmann, 2007) and was used to study young children's conceptions of themselves as scientists (Tucker-Raymond, Varelas, Pappas, Korzh & Wentland, 2007). The range of uses provided an impetus to employ this framework in this work.

James Gee (2001) proposed the existence of four major components to identity. Gee's identity theory provides a tool for considering individuals and their perceptions of self as well as making sense of identities as enacted and influenced within

dynamic social interactions. Without being a template that constrains identity research, Gee's conceptualization is an important heuristic to guide empirical work. The four components of Gee's identity framework consist of nature, institutional, affinity and discourse. Nature identity refers to inborn characteristics which cannot generally be changed. These characteristics, such as gender and skin color, are not chosen by an individual, and thus are static qualities that maintain meaning to both the individual and to others who recognize these qualities as meaningful. Institutional identity, in contrast, related to a person's activities and demands that are imparted by a formal institution. Institutional identities cannot arise solely by themselves; they must be conferred by an "official" formal institution. Examples include being a science teacher (endorsed by a licensing agency), a high school graduate (by virtue of being given a diploma), or a tenured professor (as conferred by a Board of Trustees). Gee suggests that the institutional identity could be a vocation a person has sought and embraces. However, he explains that institutional identities must be thought of as a continuum in terms of how actively or passively a person fulfills his or her role or duties.

Affinity identity is distinct in that the individual joins with the practices of a group rather than becoming a member of a formal organization. The affiliation is based on a common interest that connects a group of people to similar goals, values or beliefs. This component of identity is largely at the discretion of the individual and may have no relation to other identity components. A biology teacher may participate in a church group that opposes teachings of Darwinian evolution. These positions appear to conflict, and they may cause a tension with the institutional values of this person's place of employment. Another important distinction is that decisions to align oneself to a group do not require a formal sanctioning of this label by an authority. Gee suggests that one of the key differences between affinity and institutional identities is in the power that does the assigning. Institutional identity is authorized by a formal organization while affinity identity is found through one's alignment with a shared set of practices.

The final identity component is discourse, and it manifests itself in the dialogue and discussion in which an individual participates. Discourse identity also represents a part of a person's individuality. Gee provides the example of a "charismatic" person. This trait is based on a person's individual personality and can be observed through the way a person talks and acts. Like the other three components, discourse identity must be recognized by others. The source of its power is through discourse and interactions with other people.

Given the flexible nature of identity and its development, interactions between one's identity and events may shift a person's identity. This movement of an identity through time can be conceived as a trajectory (Dreier, 2003). Wortham (2004) suggests that the "trajectories of participation" are individual and unique as people pass through sociohistorical events. In studying how a person's identity is developed, attention must be given to the events that influence changes in identity. One's identity can be conceptualized as a moving trajectory that intersects with an event. The event maintains the potential to alter or modify the current trajectory leading to changes in one of the four components of one's identity. Our study explored the unique relations and experiences that impact the identity of one college science faculty member. We explored the growth and development occurring within a novice college biology instructor using an identity framework to guide our study.

The purpose of this study was to explore the characteristics and qualities of identity formation in a college biology teacher. We set out to identify sources of dissonance leading to tensions within the constructed identity of the participant. The questions guiding this study were:

RQ1: How are elements of identity formed with respect to one's growth as a college biology teacher?

RQ2: What factors contribute to tensions in the formation of identity reported by a college professor and how do these factors contribute to identity formation?

METHODOLOGY

The approach used for this qualitative research follows a single case study approach as guided by Merriam (1988) and Cresswell (2007). Both suggest that the researcher focus on one individual, gather data through collections of the person's stories, report these individual experiences and analyze their meaning (Creswell, 2007). The data gathered included ongoing interviews with Steven, informal discussions, observations of student/teacher interactions, classroom observations and a collection of artifacts. The initial interview was conducted prior to observations to provide a baseline for analysis and focused on Steven's interests and motivations in teaching, his perspectives on curriculum and pedagogy and background on his experiences. The second interview occurred after the second semester and focused on his perceptions of his teaching and the pedagogical discussions he made. The third and final interview occurred during the following summer and we discussed desired changes in his teaching, his changing beliefs of teaching and his future goals as an educator. Interviews were developed using a semi-structured protocol with the goal of exploring the elements of identity guided by Gee's framework as well as focusing on perspectives on his college teaching position. Informal discussions occurred during class visits, informal meetings and email communication and these were recorded by audiotape or written notes. Classroom observations were made twelve times during the semesters. The observations were audiotaped and notes were taken to support the narrative. The researcher acted as participant observer as described by Merriam (1988) and made best efforts to be hidden during lectures. Notes were taken with an emphasis on delivery, content, and teacher/student interactions and class artifacts such as handouts and tests were collected.

These data were coded to discern the major themes that emerged from the data (Miles, Huberman & Saldaana, 2014) with one focus on identifying the four identity components. Once the identity components were found, the data was analyzed for additional emergent themes using a constant comparative approach (Creswell, 2007). The identification of themes was an iterative process, moving amongst the data to identify common and comprehensive themes. Using multiple sources of data allowed for triangulation of the evidence and results. The participant was provided with the findings from this study and allowed to comment and clarify on its validity. Finally, detailed thick descriptions have been used to represent the data (Lincoln & Guba, 1985).

In this study, the participant, Steven, is an assistant professor at a major public university in the northeastern United States (State University) and is responsible for teaching large introductory biology courses (over 240 students). He is a Caucasian male in his late thirties, who attained his PhD in Biology within the past five years. At the time this study began, Steven had been employed at this university for five semesters (fall/spring) as a lecturer and coordinator of the introductory biology courses. The job is unique as it is a non-tenure track position with a three-year contract. There is no research component expected with this position; thus, this job has a different emphasis compared to his biology faculty peers whose research requirements are a major element of their work. At State University, the teaching component maintains a significantly lower status for the tenure process. Steven's unique role at State University amid the traditional research faculty members in biology creates a very real possibility for exclusion and/or diminished prestige among his peers.

At the time of the first interview, Steven was preparing for the spring semester where he would be teaching a portion of Biology 102 course. Biology 102 is primarily designed for non-science majors and the enrollment fluctuates between 220-270 students and is taught in a large auditorium. To accommodate tenure track faculty, Steven was only required to teach one portion of the course with other faculty accounting for the remaining two-thirds of the semester. However, in the following fall semester when observations were done, Steven was the sole teacher of the Biology 102 course. This was the first time he had taught this course from beginning to end.

FINDINGS

Through the analysis of the data, all four of the identity components were elucidated as well as additional themes which relate Steven's development as a biology teacher.

Nature Identity

On the surface, the Nature component of Steven's identity fell in line with what was expected, however during close examination, there were subtle, but important elements of his nature identity which contributed to his actions. During our discussions, Steven explained that he has been inhibited within his teaching practices by what he described as "all kinds of sensory issues." These issues first surfaced when we discussed possibilities of increasing contact with students through his presence at lab sessions. He noted that he had considered becoming involved with the sensory perception lab activity, but did not have the time to devote to it. However, Steven then revealed that he had a hearing problem and this lab would provide an opportunity to better connect with the students. Later, during several class lectures, Steven explained to the class that they would need to speak up when asking questions but he didn't reveal his problem to them. Both semesters of the Biology 102 class took place in a 300-seat lecture hall; therefore, having a hearing problem was an issue when students asked questions, however, a casual observer would not be aware of the magnitude of his problem. We documented numerous instances where communication between Steven and the students were weakened when he could not hear their questions or comments during class. This led to times of confusion on both Steven and the student's part. In retrospect, had Steven explained how problematic his hearing was at the start of the semester, issues of communication would likely have been reduced. We even suggested that this might be a great discussion topic when covering the topic of hearing in lecture. Ultimately, students were not privy to the problem and difficulties in communication persisted as a lost opportunity to better connect with students was not realized. We hypothesize that these lost opportunities to build rapport with his students worked against his desire to build relationships with his students.

A second element of nature identity arose during the second interview, Steven was asked if he felt his age, race, or gender might influence the way that students perceive him as a teacher. He noted that "I would expect a professor's age and sex to have some affect" although he gave no reason as to why. When pressed on the influence of his race, he explained that it should not make a difference. He explained:

> *There's a part of me that says that shouldn't matter. If I were Black, that doesn't mean I was better able to talk to the Black students in class…The professor's personality and teaching style should be what drives your learning, not if they grew up as a minority student.*

Additionally, he expressed discomfort with the possibility that race mattered:

> *It would offend me if that [race] really made a difference. If there were students in class saying he would be better if he was Black or I would've learned more from him… I guess I just want to reject that notion. It's got to come to teaching styles, the classroom culture that you create. The Black student should feel perfectly comfortable talking to me. Maybe they don't always, so maybe that's a lofty goal.*

Our interpretation of Steven's belief in the lack of the impact of gender and race on learning is likely due to a genuine lack of education and experience on the power of these factors, especially on women and minorities. We do note that Steven had recently become involved in an Inclusive Science Committee on campus which may have heightened his awareness about how his Nature identity could have an impact upon some students. The goal of this committee was to educate professors on factors such as these, and Steven shared that he learned a lot about how some students struggle when they encounter faculty who look different from them (ex. Female or African American). However, he rejected the notion that *his* race influences *his* students. Additionally, since he is unable to alter these characteristics, it may be that he prefers to direct his attention on factors over which he feels he has some control.

Institutional Identity

Institutional identity was the easiest to document because all of the interactions between Steven and the researchers occurred while on the State University campus. As noted, Steven's role was unique, as his position as lecturer distinguished him from the rest of the biology faculty by his lack of research obligations. Steven's responsibility was focused on teaching, however, he had no influence upon the instructor assignment process. Decisions about who among the research faculty would be assigned to team-teach with him were made by the department chairperson. During the two semesters we observed Steven, his only solo teaching responsibilities involved the Biology 102 course during the fall semester.

During the spring semester, Steven was the third professor of the term for students enrolled in Biology 102. We were amazed that this practice was occurring and Steven explained that the department rotates tenured faculty through this course to complete their teaching obligations. Steven had concerns that this "team teaching" approach was a disadvantage to the students and strongly opposed it. He recognized that this was done to accommodate faculty schedules, but he felt that others were "too distracted" by their own research to be devoted to the students' needs and saw this in the student performance. He stated: "It's done to meet the faculty schedules and it's not benefiting the students at all."

Steven's frustration was based on students' reports of difficulties adapting to different teaching styles. He articulated a concern that student outcomes were negatively impacted by abruptly switching teachers during the semester. Steven felt the university conveys mixed messages to him and his students. The school hired a lecturer, whose responsibility was teaching, yet they undermined this by placing who he called "unmotivated professors" alongside him. Steven speculated that team teaching placed a strain on him during this semester as students always had low grades upon his takeover. He explained that when he takes over the course, students had previously taken two of the three tests for the term. In one course we observed, Steven attempting to convince clearly skeptical students that the 66 and 67 class averages from the first two tests could be remedied through hard work for his test. He shared "my test averages are never that low" and he was "dismayed" by student dissatisfaction with the other professors. Additionally, his goal of building student self-confidence, interest and motivation after two dismal tests appeared to be an uphill battle. His mantra to the students was "we will do this together" and although his presentation was believable, students were likely skeptical based on their experiences from the first part of the semester. We did observe that the test average for the test that Steven gave during one semester was a considerable improvement, with an average of an 80. We do not suggest that Steven's teaching was the only reason for the improvement, though his attitude and encouragement were likely positive contributors. We concluded that there was considerable conflict in Steven's institutional identity as it appeared to conflict with is personal beliefs about what is best for students. With research that has revealed the poor quality of some science teaching, Steven is likely observing a firsthand account of the problem, but is actively working to improve student outcomes which he can control.

Affinity Identity

Insight into Steven's past provided an important link between his institutional and affinity identity. Steven spoke of his academic background coming into college as being "a lousy high school student" which prohibited him for attending one of the "better colleges." After taking a year off after high school to work, he decided to attend a local state college. Steven described his academic advisor, Dr. James, as his first mentor and as a crucial influence on his success in college. During his undergraduate years, he worked with Dr. James, and consequently, they formed a strong relationship. Steven described Dr. James as his "inspiration" which still supported him. This description of the supportive nature of a faculty member seemed to suggest the type of teacher Steven wanted to be. When asked about this, Steven noted that "that relationship really modeled how I want to relate to all my students."

Steven's affinity identity aligned him with his students, not with the biology faculty. This influenced his disconnect with his peers as he noted that he "felt isolated because I know the faculty are busy with their research… yet I am focused on providing a quality instruction." When we asked him who he preferred to spend time with outside of class he stated: "I would be hanging out with the undergrads. I would have an entourage of students hanging around me." He explained that he would use those opportunities to discuss "school work, career choices and career goals, whatever things that were coming up in their lives." His primary aim was to help the students become successful.

During his time at State University, Steven had taught large enrollment classes. To provide support, he was readily available outside of class. This was demonstrated during observation of his first class. His first PowerPoint slide displayed his office hours as "Anytime. All the time." In class, he strongly encouraged students to come for help when needed. At the beginning of every lecture we attended, Steven always began with reminders to the students of what they should be doing to be prepared and how he was available for help. We also observed this during visits with Steven where there were always students around his office. Despite his expectations, Steven noted that he still did not have the type of student interactions he expected. Steven expressed a desire to provide similar opportunities for relationship to his students that he experienced with Dr. James. The affinity identity we observed was clearly focused on finding ways to build relationships with his students, qualities which research supports improves learning, especially in minorities (Meeuwisse, Severiens & Born, 2010).

Conflicts between Steven and the biology faculty strained Steven's ability to develop his own teaching style. He explained how other instructors with whom he taught had complained to the department head. They said that Steven was "changing policies" and "his exams were too easy," both of which he denied. In the fall semester, Steven was presented with the opportunity to teach a whole section of Biology 102 by himself. This was his first time this was made available to him and his excitement for the chance to have a whole class to himself was evident in our discussions. However, what became apparent during the planning and teaching of the class was that Steven was fighting for flexibility to do different things in the course. In one case, Steven wanted to change the sequence of topics for the class. Pedagogically speaking, the decision to change the order was thought out and was appropriate. However, he encountered resistance from his supervisor and the changes were rejected. Considering identity theory, Steven's view of his institutional identity was in conflict with what his colleagues expected and clearly conflicted with his affinity identity. This finding supports claims by Beauchamp and Thomas (2009) who explain that "identity can be represented in multiple ways and has a dynamic, shifting nature" (p. 178). In the classroom and in his office, Steven expressed one facet of his identity which was being supported by his students, but inhibited by his colleagues.

Discourse Identity

Steven's discourse identity became apparent through discussions about his love for teaching. During interviews, Steven commented several times that his current employment was his "dream job" because it allowed him to share his love of biolo-

gy with others. Steven's initial exposure to teaching occurred as a teaching assistant during graduate school. He explained that his most rewarding experiences occurred during those teaching opportunities. He recalled the times when he was not teaching, "those were the most miserable semesters…I felt isolated." In his current position, he was afforded an opportunity to influence the careers of those students who decided to pursue a biology degree as well as increase appreciation of biology to those who choose other majors. In lecture, he informed students that the material they learned might be important later in life and consistently gave real world examples of connections between science and everyday life.

Steven's classroom discourse demonstrated his interest in supporting student success, which was a clear link with his affinity identity. He frequently provided students with tips for studying and his open-door office policy validated his classroom statement that "I will always talk to you guys first." We observed this when visiting Steven at office hours when on one occasion, a student stopped by his office to get clarification on notes. Steven's words of encouragement were refreshing as he reminded the student of study tips and encouraged him to come by again if he needed more help. In commenting on how he talks to the students, he noted, "I make a conscious effort to speak to students as an ally. I think my attitude walking into the classroom is I don't like [them to think] I'm the PhD, I know everything. No, I'm your ally here."

Elements of Identity Conflict

The most salient identity conflict we noted was with Steven's perspective on teaching and with the institutional expectations and norms at State University. Steven's alignment as a teacher placed him as an outsider in his department. As the only member of the department hired as an instructor, we visualize him placed at the periphery of the community of professors. Lave and Wenger (1991) fostered the notion that to be identified as a part of a community of practice (i.e. college faculty) one must become recognized by others in the community. Steven may have wanted to strengthen his institutional identity to keep his job and be respected by his peers, however the characteristics valued by his peers where not aligned with his stated interest in promoting better learning opportunities for his students. This research/teaching divide is most apparent within the science fields, where research is the primary function of most faculty. This friction between Steven's view of teaching and his peers' apparent diminished value of teaching has led to conflict. A contributing factor to this institutional friction is that Steven is relatively new to the department. The instructors who taught with Steven were all tenured faculty with distinguished histories at State University. As a newcomer to the department, the changes initiated by Steven were likely viewed as challenges to the tenured professors. Steven's perception was that there where many areas that needed to be addressed concerning the instruction in the introductory courses; however, others did not see any need for change.

One example of this dissonance was illustrated through Steven's account that his peers lacked concern regarding class attendance. Steven felt that promoting high attendance was an integral first step to improving learning. "Students need to be in class if we expect them to learn anything." His attempts to promote attention to attendance problems were not embraced by his peers. At State University, there was no attendance policy; nonetheless, Steven took daily attendance in his large lecture classes. Despite continued suggestions to his co-teachers, none of the other introductory biology teachers did the same. Steven posited that they either lacked concern if students attended class or they felt taking attendance was too much of an effort. Steven strongly disagreed with both statements and continued to attempt to promote this change to other teachers.

Steven expressed that his department displayed little concern toward the importance of good teaching. Steven felt this was especially the case for the introductory courses which Steven felt could support the stream of interested students into the major. The lack of interest in student welfare and instructional quality troubled him, but despite the lack of support, he continued to strive to become a better teacher and provide valuable learning opportunities for his students. Introductory biology courses are often perceived as weed out classes, to eliminate students from advanced studies in biology. Steven expressed concern that this elitist philosophy left students at a disadvantage and thus "average students" were not given a fair chance to succeed. This was particularly so for the Biology 102 course which was explicitly designed for non-majors. Others felt these courses should be just as rigorous as the major's version of the course, despite targeting a different type of student. Further conflict arose as Steven's peers felt that he was being too "easy" on his students. Steven's perspective was different. His teaching philosophy focused on developing interest, motivation and study habits and thus providing opportunities for success in the course. To this end, he utilized active learning practices, used relevant examples, provided daily handouts and outlines, he also provided sample exam questions and practice questions for upcoming tests to support his classes. Combined with his open-door office hour policy, his actions may have been seen by other professors as catering to his students. Their research schedules may have not allowed them time for this type of instruction and it is possible they harbored resentment that they were not as effective teachers. It is not surprising that Steven received higher student reviews by his students. Regardless of his effectiveness in the classroom, Steven's actions placed him in a difficult situation in trying to fit in within his department. During one consultation with the biology department chair, Steven was advised that he was making the other faculty members who taught with him "look bad, because they could not put in the time and effort" to teach effectively. Steven continued to confront this issue with one of the administrators who commented to him "that she knew that she had hired him for an impossible job." Steven did not view his job as impossible, but his relationships and status with other faculty and administrators would be strained if he continued to his efforts to improve the current learning conditions.

It became apparent that as Steven became more comfortable with teaching and expanding his understanding about best practices, he was running into increased opposition from the institution:

> *The big problem is that I have the time to improve the course to make my teaching better. To put together lecture outlines like I do. It's a tremendous investment in energy. And [the supervisor] said none of us have time to do that. People feel like we look bad because of that. What does that mean I'm supposed to? Am I supposed to not do what I think are going to make improvements or progress? I came here to become the best teacher I could possibly be.*

This quote signifies the difficulty that Steven had in creating a professional identity and highlights the conflicts between institutional expectations and the personal and affinity aspects of his identity. We also are reminded that identity formation and development is not entirely in control of the individual since the social setting imposes and molds the identity that is recognized by the group. The observations and interviews provided insight into the dynamics leading to an acceptance of the compromise that go into negotiating a balance between his affinity and institutional identity.

DISCUSSION

Collectively, the four components of Gee's identity theory offered insights into the shaping of our science professor's identity, thus addressing our first research question. The institutional component was evident through Steven's resistance against the traditional culture of his department. His unique position created an institutional identity that shifted as he infused his personal ideas and ambitions into his classes. Steven's affinity identity was related to how his institutional identity was received. Had Steven fallen in line with the other biology faculty members, his identity may not have engendered so much tension. His preference for interacting with students could incur negative consequences for how other faculty members perceive him. This had the potential to further isolate him from them, but places him in a more positive light with his students.

Steven's affinity identity was important as it had the potential to influence his view of his students and colleagues. He maintained a love and passion for teaching which were influenced by his experiences with Dr. James as an undergraduate student. Looking back over his academic career, his nature identity as a Caucasian male might have influenced his chances to attain the level of education he obtained; other research suggests that race and sex are important factors for educational attainment (Kao & Thompson, 2003). Additionally, we observed how factors related to his nature identity, Steven's hearing problems, potentially negatively impacted his teaching abilities.

Finally, Steven's discourse identity was demonstrated through his conversations with the researchers and observations of his students in class. He continuously expressed his love for teaching. The enthusiasm he demonstrated when talking about his job sent an explicit message to others that he was concerned about providing students with opportunities to succeed in his class. Consequently, this attitude influenced his institutional and affinity identity, therefore suggesting that several of these components of identity are tightly connected.

Gee's model of identity theory provided a revealing framework for studying Steven's experiences and conflicts in his current role at State University. The interrelated nature of the four parts of the framework illustrated various components of his identity as a professor. This study helped illustrate that it is possible to isolate each identity component from the others, but it also highlights their interrelated nature. Researchers suggest that identity is tentative and can change within a given situation. Findings from this short time period of ten months suggest that identity can be useful to illuminate shifts because of events. This also supports research that claims that individuals often alter and negotiate these identities based on their circumstances (Côté & Levine, 2002).

We addressed our second research question through the observations of the institutional/affinity conflict and illustrated how these factors influenced identity formation. Steven's relationships with his peers within the biology department created tension. Steven's frustration occurred within the conflicts between the institutional demands and his personal commitments to his students. At one point, Steven commented that "his identity was amorphous" given his conflicts with colleagues and his discussions with other faculty members. Steven's enjoyment of the teaching aspect of his job contributed to his persistence to improve his teaching and the experiences of his students. When we consider the stress he felt to teach in ways advocated by the department, it is likely that Steven will need to continue to hold strong to his beliefs and values to provide him with confidence to continue to develop his unique identity. One cannot underestimate his recent experiences with his own students as influential to his professional identity. Steven's open-door policy also demonstrated the emphasis he placed on student interactions. Most recently, Steven has attempted to create a formal class for non-biology majors who show interest in both science teaching and learning. He has begun to seek out other professors who share his interests and commitments about improving their teaching. These relationships, combined with his experiences with his students, will be reflected in his overall identity as a professor.

Despite Steven's role within his department, many of his feelings illustrate that he views the culture of science to be different from the more conventional view. Influenced by his own experiences as a student and a novice teacher, Steven envisions a world where all students can succeed. Although, this may seem a naïve view of the realities in the world of education, it is nonetheless a component of Steven's belief system. In terms of his identity, we noted how his affinity is aligned with his students. Thus, it is not surprising that he believes they can all succeed. His personal interest and investment of both time and effort to become a better instructor highlight his view as a role model to his students. He could also be described as a guide, facilitating student progress toward improved understandings and success in science.

We suggest that the framework of legitimate peripheral participation as described by Lave and Wenger (1991) provides a lens to understand Steven's position at State University. Lave and Wenger used this framework to describe how learning takes place in the context of social settings. Although the focus of our study was not explicitly about science learning, during the analyses we found that this model was useful for explaining Steven's tenuous relationship with his peers. In this framework, Lave and Wegner described how members of a community form what they called "communities of practice." Within these communities are the oldtimers and the newcomers. The oldtimers are full participants within this community as they have become legitimate members through their actions and have been allowed full access and participation in the practices of the community. The newcomers begin their interactions with the community on the periphery, first as non-participants, and through their actions gain access to the full social practices of the community. Over time, these members become legitimized and progress to becoming oldtimers and full participants within the community. This metaphor provided a framework to study Steven's actions as a newcomer to the larger community of biologists in his de-

partment. This framework complements identity theory as it suggests that participants will undergo transformations during their experiences and induction into the new community. Recent research by van Winkle, van der Rijist, Poell and van Driel (2018) demonstrated that faculty identity development can be viewed as a "process of *continuous revision* of roles and identities" (p. 540). Our work supports this claim and further hypothesizes that faculty employed in "teaching only" positions encounter a heightened tension to maintain quality teaching practices while peers who are research faculty may not see the value that they value.

We conceptualize that there are two communities of practice in which Steven is attempting to participate. Steven's unique role as a non-tenured, teacher-only member of the biology department do not align with the culture colleagues created within this community of research biology professors. At one point during his doctoral study, Steven would have been moving toward full participation of this community. Thus, he has learned their norms and the actions required to become a full member. In his current position, it appears as if Steven has rejected many of these norms and is moving away from full participation. For example, his lack of research agenda in the biological field is misaligned with the culture of this community. However, Steven must retain membership with this community, despite differing belief systems, as his current position is housed in the biology department. Steven's transforming identity has forwarded his involvement with the education community of practice. He does not maintain any formal status within the department of education at State University, but his participation in the inclusion to science workshops, as well as his new relationships with education faculty have moved him toward legitimate participation within the education community. His interests, beliefs and recent experiences in his role as biology instructor have allowed him to reflect on the education side of science.

The utility of Gee's identity theory helped tease out the different facets of identity construction in one participant situated in a unique position within a university biology department. The majority of studies which have explored identity in science education have done so through the lens of students (e.g. Brown, 2006; Carlone & Johnson, 2007), pre-service teachers (e.g. Luehmann, 2007) and in-service K-12 teachers (e.g. Akerson et al., 2014) and our findings build on the value of the use of identity as a framework for study. Additionally, our findings contribute to the scant research that focuses on identity formation of college level instructors, specifically ones in science who have been under scrutiny to change their teaching styles considering recent reform. We offer that identity studies such as ours are warranted to better understand how college teachers can negotiate their own personal perspectives with historical perceptions of the profession and pedagogical tensions that exist in these institutions as reform is occurring.

REFERENCES

Akerson, V. L., Pongsanon, K., Weiland, I. S., & Nargund-Joshi, V. (2014). Developing a professional identity as an elementary teacher of nature of science: A self-study of becoming an elementary teacher. *International Journal of Science Education*, *36*(12): 2055-2082.

Askell-Williams, H., Lawson, M. & Murray-Harvey, R. (2007). What happens in my university classes that helps me to learn?" Teacher Education Students' Instructional Metacognitive Knowledge," *International Journal for the Scholarship of Teaching and Learning*, *1*(1), Article 8.

Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education*, *39*(2): 175-189.

Brown, B. (2006). It isn't no slang that can be said about this stuff: Language, identity, and appropriating science discourse. *Journal of Research in Science Teaching, 43*(1): 96-126. doi: 10.1002/tea.20096

Carlone, H. B. & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, *44*(8): 1187-1218. doi: 10.1002/tea.20237

Côté, J. E. & Levine, C. G. (2002). *Identity, Formation, Agency, and Culture: A social psychological synthesis*, Mahwah, NJ: Lawrence Erlbaum.

Creswell, J. W. (2007). *Qualitative Inquiry & Research design: Choosing Among Five Approaches*. Thousand Oaks, CA: Sage Publications.

Crisp, G., Nora, A., & Taggart, A. (2009). Student characteristics, pre-college, college, and environmental factors as predictors of majoring in and earning a STEM degree: An analysis of students attending a Hispanic serving institution. *American Educational Research Journal*, *46*(4), 924–942.

Dreier, O. (2003). Learning in personal trajectories of participation. In *Theoretical psychology: Critical Contributions,* edited by Niamh Stephenson, 20-29. Concord, Ontario: Captus Press.

Gess-Newsome, J., Southerland, S. A., Johnston, A., & Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal, 40*(3): 731-767. doi: 10.3102/00028312040003731

Gee, J. P. (2001). Identity as an analytic lens for research in education. *Review of Research in Education, 25*(1): 99–125. doi: 10.3102/0091732X025001099

Geisinger, B. N. & Raman, D. R. (2013). Why they leave: Understanding student attrition from engineering majors. *International Journal of Engineering Education*, *29*(4): 914-925.

ICASE. (2013). The Kuching Declaration. Final Proceeding of the World Conference on Science and Technology Education (WorldSTE2013). Kuching, Malaysia.

Kao, G., & Thompson, J. S. (2003). Racial and ethnic stratification in educational achievement and attainment. *Annual Review of Sociology*, *29*(1): 417-442.

Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge, UK. New London Group

Lincoln, Y. S., and Guba, E. G. (1985). *Naturalistic Inquiry*. Thousand Oaks, CA: Sage Publications.

Luehmann, A. (2007). Identity development as a lens to science teacher preparation. *Science Education, 91*(5): 822-839. doi: 10.1002/sce.20209

Meeuwisse, M., Severiens, S. E., & Born, M. P. (2010). Learning environment, interaction, sense of belonging and study success in ethnically diverse student groups. *Research in Higher Education*, *51*(6): 528-545.

Merriam, S. (1988). *Case Study Research in Education: A Qualitative Approach*. San Francisco, CA: Jossey-Bass Publishers.

Miles, M.M., Huberman, A. M. & Saldaana, J. (2014). *Qualitative Data*

Analysis: A Methods Sourcebook (Third Ed.). Thousand Oaks, California: Sage Publications

National Research Council. (2015). *Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering*. Washington, DC: The National Academies Press.

National Research Council. (2012). D*iscipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering.* Washington, DC: The National Academies Press.

National Science Board. (2012). *Research and Development, Innovation, and the Science and Engineering Workforce: A Companion to Science and Engineering Indicators 2012*, Arlington, VA.

Reveles, J., Kelly, G., & Durán, R. P. (2007). A sociocultural perspective on mediated activity in third grade science. *Cultural Studies in Science Education,1*(3): 467–495. doi 10.1007/s11422-006-9019-8

Seymour, E. & Hewitt, N. (1997). *Talking About Leaving: Why Undergraduates Leave the Sciences*. West Press; New Ed edition.

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, *34*(4): 14–22.

Trujillo, G., & Tanner, K. D. (2014). Considering the role of affect in learning: Monitoring students' self-efficacy, sense of belonging, and science identity. *CBE-Life Sciences Education*, *13*(1): 6-15.

Tucker-Raymond, E., Varelas, M., Pappas, C., Korzh, A, & Wentland, A. (2007). They probably aren't named Rachel: Young children's scientist identities as emergent multimodal narratives. *Cultural Studies of Science Education*, *1(*3), 559-592. doi:10.1007/s11422-006-9017-x

Turner, L. & Tobbell, J. (2017). Learner identity and transition: an ethnographic exploration of undergraduate trajectories. *Journal of Further and Higher Education* doi: 10.1080/0309877X.2017.1311993

Ulriksen, L., Madsen, L. M., & Holmegaard, H. T. (2010). What do we know about explanations for drop out/opt out among young people from STM higher education programmes? *Studies in Science Education*, *46*(2): 209-244.

van Winkel, M., van der Rijst, R., Poell, R. & van Driel, J. (2017). Identities of research-active academics in new universities: towards a complete academic profession cross-cutting different worlds of practice. *Journal of Further and Higher Education, 42*(4), 539-555 doi: 10.1080/0309877X.2017.1301407

Wortham, S. (2004). From good student to outcast: The emergence of a classroom identity. *Ethos*, *32*(2): 164–187. doi:10.1525/eth.2004.32.2.164