

Teachers' Stories of Autonomy, Competence, and Relatedness in Becoming Innovative Facilitators With Ubiquitous Computing: The Need for Understanding Innovative Facilitator Development

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Abstract

Many classrooms have access to ubiquitous information communications technology (ICT), and teachers have been trained on the way to use it. However, few teachers use technology in what many consider the most powerful way to learn. This study investigates four teachers who have developed from traditional teaching into innovative facilitators with ubiquitous ICT. Specifically, how did teachers who were innovative facilitators describe their salient experiences to satisfy their autonomy, competence, and relatedness in their identity development? As an instrumental case study, we analyzed their stories to understand why and how they developed. Participants taught in middle and high schools representing a range of school sizes and sociocultural populations. All teachers described salient episodic learning experiences and students' input as key to transforming their autonomy and competence with ICT pedagogy, contrasting with other studies. Teachers emphasized supportive internal relationships because they distinguished themselves from other traditional teachers. The study concludes that educational leaders help teachers access their beliefs with episodic learning to develop innovative facilitators on their based on their pedagogical beliefs that influence ICT classroom learning.

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Keywords

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The role of teachers as facilitators rather than merely lecturers has been admired for decades, and is considered best practice for many learning environments (Dewey, 1938; Gay, 2018; Krishnamurti, 1974). Advocates of educational technology often view ubiquitous information communication technologies (ICT) as a vehicle to facilitate teaching and promote innovative thinking that increases student active learning (Cuban, 2002; ISTE, 2017; Sandholtz et al., 1997). Ubiquitous ICT can support teachers in their role since some repetitive learning tasks can be offloaded to the computer and lecture time can be diminished with customized applications and with the abundant content available on the Internet that can assist collaborative and project-based learning (Donovan et al., 2010; Gulek & Demirtas, 2005; Papert, 1980; Sandholtz et al., 1997; U.S. Department of Education, 2017).

Ubiquitous ICT, where every student has a computer device, has also been called one-to-one computing (Penuel, 2006). In the earliest longitudinal study of ubiquitous ICT, Sandholtz et al. (1997) found that teachers used technology devices in different ways to support distinctive classroom environments (ACOT, 1995). After observation, researchers contrasted classrooms into two categories: traditional environments and extended knowledge construction environments (see Table 1), with differences in activity, roles, learning emphasis, types of concepts, success determinants, assessment, and how technology was used. They specified that the teacher in “extended knowledge construction” was a “collaborator and sometimes learner” (ACOT, 1995, pg. 13). The way that the teacher’s role is identified and described is the most relevant for this study.

Other current literature and research studies on classroom technology integration describe contrasts as well. Teachers who deliver more traditional instruction expect students to use technology primarily for skill-based tasks, for replicating information by memorizing facts, and for independent work with a focus on norm-referenced test scores (Howard, 2013; Rogers & Wallace, 2011; Tamim et al., 2011; Tondeur et al., 2017). The teacher often believes students learn best through lectures, and so the primary ICT will likely be presentation software and skill and drill technologies (Liu et al., 2017).

In extended knowledge construction, teachers facilitate learning by using technology for individual skill development but focus on technology to develop creativity, collaboration, and critical thinking. By using project-based learning in learner-centered activities, technology empowers students to create through presentations and collaborative documents (An & Reigeluth, 2011; Bowman et al., 2020; Emo, 2015; Er & Kim, 2017; Liu et al., 2017; Olsen, 2016; Palak & Walls, 2009; Sandholtz et al., 1997; Tondeur et al., 2017). Teachers prioritize the quality of student work by basing success on criteria-referenced and performance-based assessment (Sandholtz et al., 1997; Tondeur et al., 2012).

Standards-based documents describe the teacher facilitator role. The U.S. Department of Education, in *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update* (2017), proposes that educators act as “guides, facilitators, and motivators of learners” (p. 31) in their classrooms. Over the years, the International Society for Teachers in Education (ISTE) has further described the teacher’s role in technology integration standards (ISTE, 2000; ISTE, 2008; ISTE, 2017). The most recent educator standards (ISTE, 2017) state that teachers should “design authentic, learner-driven activities and environments” (Standard 5, p. 2), “create innovative digital learning environments that engage and support learning” (Standard 5c, p. 2), be a “facilitator” (Standard

6, p. 2), and “foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings” (Standard 6a, p. 2). To consolidate descriptions, this paper will refer to the teacher who enacts the characteristics described in these standards as “innovative facilitators.”

Table 1.

Traditional (instruction) versus extended (knowledge construction)

	Traditional (instruction)	Extended (knowledge construction)
Activity	Teacher-centered and didactic	Learner-centered and interactive
Teacher role	Fact teller and expert	Collaborator and sometimes learner
Student role	Listener and learner	Collaborator and sometimes expert
Learning emphasis	Facts and replication	Relationships and inquiry
Concept knowledge	Accumulation	Transformation
Demonstration of success	Quantity	Quality
Assessment	Norm-referenced and multiple guess	Criteria-referenced and performance portfolios
Technology use	Seat work	Communication, collaboration, information access, and expression

Note. Reprinted from “Changing the Conversations about Teaching Learning and Technology: A report on 10 years of ACOT research,” by Apple Computers, 1995, p. 13.

Though technology integration standards have embraced the innovative facilitator role for two decades and a wave of guidelines congest the literature with ways to assist professional developers (Bowman et al., 2020; Connolly et al., 2018; Darling-Hammond et al., 2017), research indicates that traditional teaching still dominates education (Bowman et al., 2020; Cuban, 2002, 2013; Ertmer & Ottenbreit-Leftwich, 2010; Graves & Browsers, 2018; Sandholtz et al., 1997).

To untangle the obstacles of technology integration, Ertmer (2005) conceptualized two major barriers for teachers: first-order barriers and second-order barriers. The first-order barriers include external influences such as a lack of administrative and technical support and ever-changing technology (Ertmer & Ottenbreit-Leftwich, 2010; Makki et al., 2018; Sandholtz & Reilly, 2004; Zhao & Frank, 2003); a school culture focused on traditional curriculum and assessment (Ertmer & Ottenbreit-Leftwich, 2010); the demands of high-stakes testing (Bridwell-Mitchell, 2015; Cuban, 2013); and inadequate training during teacher preparation and in-service programs (Aslan et al., 2012; Hong et al., 2017).

After first-order barriers are overcome, there are the second-order barriers, which are internal to the teacher and include the teacher’s confidence, school culture, competence, and pedagogical beliefs that influence classroom practice (Bowman et al., 2020; Er & Kim, 2017; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hanny et al., 2021; Tondeur et al., 2017). Studies have been done on

facilitative teachers from similar schools who have overcome the second-order barriers, which indicate that these teachers are likely to have a constructivist belief system guiding their choice of teaching approach (Emo, 2015; Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2017) and that they dislike boredom (Emo, 2015). The question remains: How did the teachers become innovative facilitators or what experiences supported their development?

In general, human experiences and personal interpretations of those experiences drive much of who people are and what they become (Buehl & Fives, 2009; Deci, 1995; Er & Kim, 2017; Levin & He, 2008; Ryan & Deci, 2017). People develop toward particular directions based on their motivations and how they see themselves—their identities (Mockler, 2012; Olsen, 2016; Ryan & Deci, 2017). Thus, an innovative facilitator in a ubiquitous ICT environment likely develops through experiences and the interpretation of those experiences. Little is known about the identity development of innovative facilitator teachers, but the knowledge could inform teacher development since leaders could take salient aspects into consideration when planning professional learning activities.

Conceptual Framework of Identity Formation in ICT Teacher Development

Identity development has been theorized from many perspectives (Gee, 2000; Zemblyas, 2003). For this work, Self Determination Theory's (SDT) explanation of identity formation (Deci, 1975, 1995; Ryan & Deci, 2017) was chosen since the theory provides explicit explanations to motivate development toward particular directions. SDT uses a holistic approach to address the complexity of identity and acknowledges inherent growth through the psychological organismic lens, positing that identity formation is the result of *self-as-process* that interacts with *self-as-object* within a social environment (Ryan & Deci, 2017).

Self-as-object identity refers to the me-self or the "I" (Ryan & Deci, 2017) or people's beliefs about themselves that could be based on their vocations, interests, and beliefs that intersect with the roles they have (Akkerman & Meijer, 2010). People refer to the "I" positions in different contexts of their beliefs about themselves. For example, I am a teacher; I am a parent; I am a counselor. But even the "I" as object is not static because the experience is always shifting. When defining the "I," people compare themselves to situations and to other people, so the "I" shifts and people have multiple identities.

Self-as-process identity refers to the various experiences and dynamic interpretations of the experiences humans encounter. As a person interacts with numerous environments (Gee, 2000), work situations (Akkerman & Meijer, 2010), and various people (Zemblyas, 2003), the person's identity keeps shifting (Ryan & Deci, 2017). Identity is formed and reformed constantly over time. As teachers assume new roles, identity is constantly mediated by the classroom, societal expectations, administration, and teachers' own personal histories (Mockler, 2012; Olsen, 2016). Identity is seen as dynamic and ever evolving, tied to sociocultural expectations that can empower or inhibit an individual's sense of agency (Akkerman & Meijer, 2010; Gee, 2000; Ryan & Deci, 2017).

Iterative dynamics of self-as-object and self-as-process create an identity formation interpreted through three key dynamics: relatedness, autonomy, and competence (see Figure 1). Because identity encompasses the whole person, identity supplies the interpretative frame through which people see the world, coloring interpretations of how people, events, and processes are viewed (Olsen, 2016). Therefore, being aware of the ways teachers view themselves and their role becomes critical to their growth, development, and ability to embrace pedagogical innovations within their profession (Danielewicz, 2001; Mockler, 2012).

Identity Formation Toward a Particular Direction

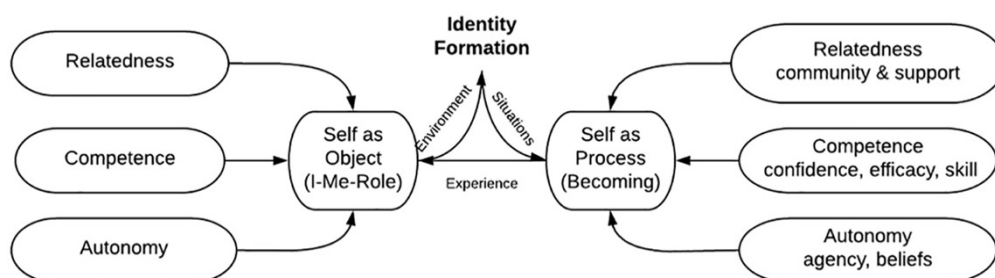
Teacher education and professional development are concerned with pedagogical growth, and many authors agree that pedagogical growth is tied to a teacher's identity (Brookfield, 1995; Danielewicz, 2001; Gee, 2000; Olsen, 2016; Zemblyas, 2003). According to SDT, identity develops as the self-as-process and self-as-object interact in a particular trajectory based on the basic psychological needs for personal fulfillment (see Figure 1):

1. people develop identities . . . to satisfy their needs for relatedness, competence, and autonomy, and
2. the degree to which they experience the needed satisfaction while forming identities has a strong influence on both the content of those identities and the way they are anchored in the people's psyche. (Ryan & Deci, 2017, p. 385)

When the basic needs of relatedness, competence, and autonomy are satisfied, a person's identity can develop in a fulfilling direction.

Following are explanations of SDT's description of identity formation, combined with existing literature on teacher identity studies and ICT teacher development. Though studies may not directly reference SDT, they address synonymous concepts of autonomy, competence, and relatedness and are grouped accordingly.

Figure 1
Visual Representation of SDT Model of Identity Formation



Note. Visual representation of SDT model of identity formation of self-as-process and self-as-object with the interaction of the psychological need for relatedness, competence, and autonomy based on teacher education literature.

Autonomy. The need for autonomy goes deeper than the commonly used definition of “self-governing” (Merriam-Webster, 2021). In SDT, the need for autonomy expands by referring to a feeling of alignment between one's own beliefs, values, and interests with the agency one has in a particular context (Ryan & Deci, 2017). In education, autonomy includes the relationship between the way a teacher believes learning occurs and the way they implement those beliefs in the classroom (Pajares, 1992).

When looking at ICT, teachers' autonomy toward innovative facilitation has previously been considered (Brownlee et al., 2017; Greene & Yu, 2016). Emo (2015) researched the identity and motivation of 30 self-selected teachers who embraced innovation in a single location. Teachers sought

to improve students' learning and eschewed boredom, which aligns with Ertmer's (2005) second-order barriers for ICT integration. The teachers also valued their professional development and collaborated within their context, which helped them overcome first-order barriers (Ertmer & Ottenbreit-Leftwich, 2010). It is unclear from the study how the teachers evolved in their beliefs.

Examining reflection on beliefs is common in preservice teacher education (Buehl & Fives, 2009; Er & Kim, 2017; Korthagen, 2004; Levin & He, 2008; Orrill, 2001; Thoonen et al., 2011), but we found no examples for in-service teacher development with a purposeful examination of experience. In preservice teacher education, Er and Kim (2017) used preservice teachers' memorable experiences, also called episodic memories, to shape personal learning theories and support belief remolding. It is unclear how reflecting on experiences would help shape in-service teachers' beliefs to become facilitative with technology.

Competence. The need for competence refers to the confidence built from skill development and the feeling of self-efficacy to act aptly within a situation (Bandura, 1993). People desire "effectance and mastery" (Ryan & Deci, 2017, p. 11) to be motivated to grow in a particular direction. To gain mastery, they need to have the "strategies and the capacity for obtaining the desired outcome" (Deci, 1995, p. 64), and they want to feel effective in their identities, in this case, a teacher who successfully uses ICT. In relation to ICT classroom integration, past research notes that competency develops in three main forms: (a) when teachers have technical training on how ICT works; (b) when they use ICT for personal purposes as well as professional work (Liu et al., 2017; Ritzhaupt et al., 2012); and (c) when they know how ICT integrates into their specific content areas with aligning pedagogy (Harris & Hofer, 2011; Koehler et al., 2013; Lee & Lee, 2014).

Relatedness. The need for relatedness could refer to support, community, kinship, or affinity for a particular group or cause (Gee, 2000). Because identities are formed through experience, a sense of belonging is central to identity formation. Studies on teacher identity development support the need for teachers to relate to others both professionally and personally. Absence of relatedness may cause intense frustration (Hong et al., 2017; Palmér, 2016; Sinha & Hanuscin, 2017). The literature has suggested satisfying the need for relatedness through specific practices: collaboration within a job-embedded context (Connolly et al., 2018; Darling-Hammond et al., 2017), mentoring (Glazer et al., 2009; Sinha & Hanuscin, 2017), and a supportive school environment (Caskey & Carpenter, 2012; Davis et al., 2010; Davis et al., 2009; Liu et al., 2017). Though school-embedded community is highly recommended, teachers find supportive communities in other ways. In a study on identity, Kempe and Reed (2014) found that eight teachers who attended graduate school together maintained "innovative or risk taking" identities even two years after graduation. It is unclear how teachers will compare when they do not know each other or come from different environments (Caskey & Carpenter, 2012; Davis et al., 2010; Kempe & Reed, 2014; Davis et al., 2009; Liu et al., 2017).

Three Needs Synthesized for Identity Formation

In the previous section, three physiological needs were described in isolation; however, all three interact for identity formation motivated toward a particular direction. When there is a conflict between autonomy, competence, and relatedness, teachers have emotional consequences. If teachers feel tension between their expectations and competence, their autonomy suffers (Abbitt, 2011; Connolly et al.,

2018). In a study by Reeves (2018), teachers lacked support for ICT integration because standardized test scores alone were used as the measure of being a good teacher. Other studies on in-service and preservice teachers in ICT-rich schools have reported a lack of competence and training. Still, teachers aspire to conduct learner-centered teaching, affecting teachers' identity formation (Palak & Walls, 2009; Rogers & Wallace, 2011), and school culture and policies need to endorse ICT best practices so teachers' identities can develop (Bridwell-Mitchell, 2015; Butler et al., 2015; Tondeur et al., 2017).

Need for Study

Previous studies have focused on the identity or motivation of innovative facilitators with ICT and have been based on self-selected participants, all within similar sociocultural contexts, with no attention to a teacher's past experiences (Avidov-Ungar & Forkosh-Baruch, 2018; Emo, 2015; Kempe & Reed, 2014), and have not addressed how teachers felt they developed into innovative facilitators. In this study, participants did not self-select; instead, administrators identified teachers who had developed their pedagogy from traditional to innovative and facilitative in a ubiquitous ICT environment. This study advances the research by extending knowledge from past findings and delving deeper into the stories of four teachers from schools in the United States with different sociocultural dynamics.

The analysis explicates teachers' narratives about what influenced their personal change. Specifically, we asked the following question: How do teachers who were innovative facilitators describe their salient experiences to satisfy their autonomy, competence, and relatedness in their identity development? Teachers' narratives were analyzed using SDT of identity development concepts (Ryan & Deci, 2017). The narrative yields petite findings that can be used to inform the development of innovative facilitators within ubiquitous ICT learning environments.

Method for Study

This research assumes that an exploratory study of people's change processes is often best understood through thick description of episodic stories that describe meanings in context (Martin, 1993; van Manen, 1997). Within stories, people share their "subjective meanings of experience" (Creswell & Creswell, 2018, p. 5), describing a "complexity of views" (Creswell & Creswell, 2018, p. 8) that influences their actions. Aligning to this belief, teacher interviews were the primary data-gathering strategy, supported by field notes and observations in the classroom so that the research could gain a wholistic picture of each teacher (Creswell & Creswell, 2018; Stake, 1995; Yin, 2003).

Teachers were viewed independently, and then their stories were compared to each other as an instrumental case (Creswell & Creswell, 2018; Stake, 1995). An instrumental case seeks common elements throughout multiple stories rather than focusing on a single story. Stake (1995) explains that an instrumental case addresses dominant "issues outside the individual person" (p. 3). Similarly, this research examines the dominant issue of teachers becoming innovative. They came from sociocultural diverse schools that were 200-400 miles (643 km) apart, but they had the shared experience of ubiquitous ICT (See Table 2).

Participant Selection

The participant teachers were purposefully chosen (Creswell & Creswell, 2018) based on what Lincoln and Guba (1985) call “extreme” cases since their stories could be “enlightening” (Lincoln & Guba, 1985, p. 103) for those who could learn from their experiences. The teachers did not represent traditional educators but those that conducted best practices with ubiquitous ICT as defined by previous research (Bowman et al., 2020; Cuban, 2002, 2013; Ertmer & Ottenbreit-Leftwich, 2010; Graves & Browsers, 2018; Sandholtz et al., 1997) and ISTE standards (ISTE, 2017).

Administrators selected participants who had once taught traditionally but “stood out” from others to become “facilitative with ICT integration.” Asking administrators to select teachers is a strategy used in other studies (Judson, 2006; Tondeur et al., 2013) to distance the researcher from the selection process and to remove self-selection bias (see Table 2 for general participant information). The selection method produced a limitation as well. Bias was then shifted to the administrators, who have preferences. The first author interviewed each administrator for one to one-and-a-half hours; each explained why they choose the particular teacher(s). Administrators used descriptions such as “forward thinking” (Anne’s administrator), “teaching style change” (Wyatt’s administrator), “differentiated instruction at its best” (Zoe’s administrator), and “alternative ways to do things and think” (Jessica’s administrator). All chose teachers that were once traditional in their style and who evolved to what they saw as some of the most facilitative in their schools.

The first author observed the teachers in their classrooms for an hour each, and interviewed the teachers twice. The teachers shared how they planned out the year and daily lessons, and it assumed that since their administrators chose teachers, they had demonstrated consistent classroom strategies. Teachers displayed the characteristics identified in “extended knowledge construction” (Table 1) and centered projective-based and authentic experiences (ISTE, 2017) in their classrooms. Importantly, the teachers saw themselves as learners. with the students in the ICT environment. Their activity, student expectations, and processes verified alignment to an innovative facilitator.

Teacher Interviews with Data Collection

With informed consent approval, participants agreed to semi-structured interviews and observations conducted in person. The questions were broad so that the participants could “construct the meaning of the situation, typically forged in discussions or interactions” (Creswell & Creswell, 2018, p. 8) with the interviewer. Prior to the study, the interview questions were vetted through an independent panel of scholars to check for the ability to elicit authentic participant responses. Designed to elicit teachers’ organic stories without the use of educational clichés that could lead to “textbook” answers, questions did not use the word “identity.” Teachers’ development stories were collected through their own words in a conversational manner, which aligns to the naturalistic paradigm (Stake, 1995; van Manen, 1997).

Questions addressed three areas of SDT identity development within the stories. First, teachers were asked to tell anything about themselves that might shed some light on how they became teachers. The purpose of this question was to glean hints of their autonomy linked to ethnographic data that could establish a baseline on their belief systems (Gee, 2000; Olsen, 2016; Ryan & Deci, 2017). The second and third questions asked the teachers to tell stories explaining how they got to where they are now, sharing any people or experiences that influenced them, and their role and what it was really like. These questions sought their feelings of relatedness and competence that could have been influenced in

professional development, collegiality, or leadership (Gee, 2000; Mockler, 2012) and descriptions of their current roles (Ryan & Deci, 2017; Senge, 2000). The fourth and fifth questions inquired about teachers' emotions, which included their hopes, fears, and excitement associated with the ubiquitous ICT learning environment, to get a sense of the teachers' satisfaction with all three needs of autonomy, competence, and relatedness formation within the teacher's context (Ryan & Deci, 2017; Saunders, 2013; Zemblyas, 2003).

Table 2
Participant Demographics and School Context

Pseudonym	Teacher Characteristics	Demographics and School Context
Wyatt	Teacher Age = 28 Years Teaching = 5 years Ubiquitous ICT = 3 years Teaching Grade 8 English Language Arts	Public City Middle School, School Size: 570 pupils Demographics: 65% Latinx, 25% White, and 10% Black Income indicator: 80% free or reduced lunch Passing rate on state proficiency test: 55% Reading, 70% Math
Zoe	Teacher Age = 37 Years Teaching = 9 years Ubiquitous ICT = 3 years Teaching Grade 9 Earth Science	Private Boarding School K-12, School Size: 2,000 pupils Demographics: 50% White, 50% Black and Latinx Income indicator: 100% low income, does not receive public funds No testing data available
Anne	Teacher Age = 46 Years Teaching = 13 years Ubiquitous ICT = 4 years Teaching Grades 10 and 12 English Language Arts	Public Rural High School, Size: 1,015 pupils, 14-18 years old Demographics: 98% White, 4% Black, and 5% Latinx. Income indicator: 20% free or reduced lunch. Passing rate on state proficiency test: 80% Reading, 78% Math.
Jessica	Teacher Age = 25, Years Teaching = 5 years Ubiquitous ICT = 2 years Grades 5 and 6 combined All major content areas	Public Charter Middle School, Size: 100 pupils, 11-14 years old Demographics: 87% White, 4% Latinx, 3% Black, and 3% Asian Income indicator not available Passing rate state proficiency test: 60% Reading, 60% Math

Interviews were recorded and transcribed. Two interviews were conducted with each teacher; the first lasted two hours, and a month later, a second clarification interview lasted 30 minutes. For further construct validity, the researcher spent an additional hour observing each teacher and student interactions, as well as interviewed the administrators who selected the teachers for an additional hour

each. The observations allowed the researcher to see some of the teachers' actions that were described in conversation. Sixteen hours of direct, in-person time was spent.

There were field notes on the school that were gleaned from observations and websites, such as school report cards, and real estate information. The information was used to confirm that the participants were from different demographic and socioeconomic contexts. Classroom observation notes included drawings of seating arrangements for each class, student questioning, instructional movements, and teacher-student interaction. The researchers used the classroom observation notes to confirm that teachers had cultivated similar learning environments, despite their distance and socioeconomic differences.

Data Analysis with Trustworthiness of Analysis

Coders were used throughout, but the primary researcher, who is the first author, oversaw all stages, including transcribing the interviews verbatim. The interviews were analyzed in multiple stages. First, interviews were open coded to stay close to the teachers' words. Second, field notes with a one-hour class observation were examined to support or question teachers' narratives. After the initial interviews, additional interview questions were created to clarify information for each person. Interviews were again transcribed and analyzed with open codes for a total of 142 open codes between both interviews (Creswell & Creswell 2018; Yin, 2003). Similarities and differences were examined across cases for emerging themes (Creswell & Creswell 2018; Yin, 2003), while remaining cognizant of the divergent voices (van Manen, 1997). The first author conducted the different levels of coding to summarize the stories.

Third, the teachers' stories were written by theme and sent for participant checks (Creswell & Creswell 2018; Yin, 2003). All participants agreed with the themes and findings, and some were surprised that the findings captured their descriptions so well. Findings were inspected through two more channels. Theme codes were cross-checked by two independent coders with 92% agreement. After participants verified their themed narratives for internal validity, stories were consolidated for a literature comparison.

Only teachers' salient stories were analyzed using the SDT framework of identity formation. The experiences were categorized into autonomy, competence, and relatedness. Then, the authors of the study analyzed which statements were static in nature for self-as-object and which statements were more process oriented that led to self-as-process statements or stories. The process statements suggested the movements that influenced their growth. In the findings and discussion, comparisons were made with previous studies, and new findings could be found to contribute to the knowledge base of developing innovative teachers.

Positionality and Training of Researchers

The first author was previously a tenured middle school educator and an instructional technologist and is now a professor who was extensively trained in the techniques of open coding, theme coding, axial coding, and using theory in analysis (Creswell & Creswell, 2018; Lincoln & Guba, 1985). Two graduate students, who were not primary or secondary school teachers but instructional technologists for higher education, were trained by the primary researcher. The advanced graduate, the second author, had done prior ethnographic work for non-profits in both Uganda and Norway and was trained

as an early childhood educator in the United States. Three of the four researchers were people of color and came from four different ethnic backgrounds. There was no conflict of interest since researchers had no previous or subsequent associations with the teachers or schools.

Findings: Stories of Innovative Facilitators' Identity Formation

There are four cases: Wyatt, Zoe, Anne, and Jessica. Each teacher explicated stories that influenced their identity formation as innovative teacher facilitators. These narratives have been parsed into the SDT principles of autonomy, competence, and relatedness to demonstrate how the principles are actualized in real life and how narratives become interwoven. Autonomy relates to a person's belief system, aligning with the context they are in. Competence refers to the knowledge, skills, and confidence to actualize what is known. Relatedness implies the connectedness a teacher feels in his or her environment. Within each story, a diagram represents the salient elements so the reader can more easily conceptualize the process.

Case 1: Wyatt, Public City Middle School

Autonomy. With the implementation of the ubiquitous ICT program, Wyatt felt his teacher identity had changed significantly: "I was more 'teacher centered' at the beginning, and I've shifted from 'teacher centered' to 'teacher-facilitator.'" Wyatt highlighted the disposition needed by teachers in the role reversal between teacher and student in ubiquitous environments.

A lot of teachers are control freaks. . . . We have to have things a certain way. When I first started with the computers, it was that way. If you want to grow, and you just kind of loosen up a little more each year and it happened . . . I don't know why.

Wyatt could not find the words to describe why he "loosened up," but felt he did. He felt there was "no book or prescriptive teaching" that could help a teacher learn to become a facilitator.

Although Wyatt spoke positively about moving to ubiquitous computing, it was a difficult experience for many months. Even as someone who felt comfortable with computers, he described the experience as "nerve wracking." He said,

You have to be, if not tech savvy, kind of tech courageous . . . not afraid to just go out there and experience, and not be afraid to give some control to the students. . . . It's okay if you don't have all the answers, because they're not afraid.

Wyatt experienced fear himself and in his fellow colleagues, but after the experience, he felt this fear was unnecessary because the students helped one another and him.

Wyatt described his evolving beliefs about how students learn, who he is, and his role in the classroom in these stories. Unlike his peers, he felt he could give the students more control. Conscious of fear and the need for courage, Wyatt embraced learning with his students.

Competence. When Wyatt's school moved to ubiquitous computing, he and eight other teachers received advanced training on using computers. He found the training inadequate but still acquired ideas on how to incorporate computers into teaching. He taught his colleagues how to use more advanced technical features, creating projects and rubrics to implement computer-based projects with his class.

With ubiquitous computing, his pedagogy evolved. Wyatt noticed how quickly students could retrieve information for spontaneous learning. In one incident, Wyatt asked a question, and a student quickly Googled the answer. First, he accused the students of cheating, but then he realized they were doing the same things adults do. Another time, students used online searches to find answers to historical and current events questions, so the students gave him confidence to teach differently.

These experiences influenced Wyatt's pedagogical shift; he explained, "I kind of let go a little more control because a lot of times, a lot of my kids are on task with what they're doing . . . I'm letting them do a lot of learning themselves and teaching themselves too." Then, Wyatt began using the computers for daily reading. Students began each class reading and answering questions about a current event found on news sites and writing reflections in their word processing journals. "I think it's just given me more breathing room," said Wyatt. By "breathing room," he means using computer resources so students can do more independent work.

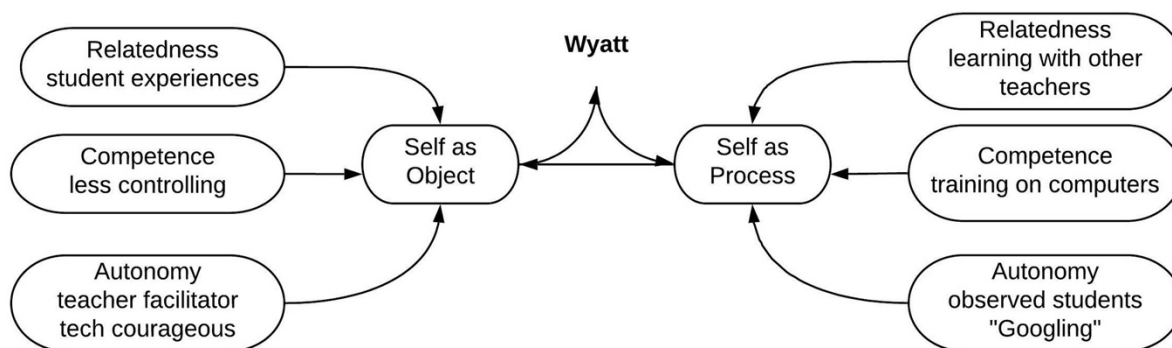
Wyatt mentioned what he does: "I can just let the kids learn on their own as long as I'm reining them in every once in a while and keeping an eye on what they're doing." He grew comfortable guiding students through projects. His competence grew in terms of computer skills and pedagogy. The pedagogical shift related to his autonomy, and his belief system also evolved.

Relatedness. Wyatt was raised under difficult family conditions and in poverty, which allows him to relate to his students' lived experiences. He began teaching in the inner city as a student teacher and continued after graduation. He noted, "Some of these kids, they're like me; they're experimental. So, you just show them a couple of steps." He felt a close connection to how his students learned, especially when using computers. The experience of observing students using the computers changed his pedagogy and shaped his belief in the importance of playing alongside his students.

Though Wyatt is White and most of his students are from marginalized populations, he felt he could relate to them and how they learned. These student observations propelled him to become more student centered, be more of a facilitator, embrace learning with the students, and give them tools to find answers in their learning.

Figure 2

Visual Representation of SDT Model of Identity Formation for Wyatt



Case 2: Zoe, Private Boarding School for Students Living in Poverty

Autonomy. College education significantly shaped Zoe's beliefs about teaching and learning. She learned about constructivist methodology, although her professors never modeled it in their classes. Her professors taught by lecturing, which she described as frustrating: "Because, you go to your college professors, and they say this is the worst way to teach while they stand up in front of you and teach to you that way." Nevertheless, the theory caught her attention as a realistic teaching method for teaching science and ultimately developing her pedagogical belief system.

Zoe said she "thought outside the box" with self-declared undiagnosed attention deficient hyperactivity disorder. Zoe described how she perceived herself and how it could have affected her administrators: "I'm an envelope pusher. I tend to take a school administrator out of their comfort zone." In seventh grade, she asked her teachers if she could teach a topic that really interested her. She was not concerned with how she would be perceived but with how she would be supported.

In Zoe's classroom, computers are used for project-based science learning. She began asking specific questions to help her decide on computer use: "If it doesn't make it more meaningful, if it doesn't allow for a deeper level of understanding in a method that you couldn't achieve without it, you shouldn't be using it." Technology had to be better than a textbook to deepen students' understanding in a meaningful way. Zoe expressed feelings of joy when her students learned to question data, a significant start to "real learning."

Zoe felt strongly about who she was and in her belief system, which included the way students learned science, the use of technology, and what she needed to succeed in the profession. Her teaching and learning environment provided support for the way she wanted her class to function.

Competence. A teacher-in-service professional development opportunity had a profound effect on Zoe; participants interpreted data that she used in her classes. "If you don't collect data, then what good is it? . . . If you can't quantify data, how are you going to recreate it in a meaningful way?" In her own classroom, students focused on the data and what it meant, allowing for variations in findings. Zoe developed rubrics so she could assess their varied conclusions.

With technology, Zoe began fostering ideas toward more project-based approaches: "I had these ideas and I'd write them down." Zoe began with small projects and moved to larger ones, or as she put it, "I did not set out to build the Taj Mahal on my very first try. I got to the point where I felt confident enough that I think I can take some baby steps out and do this." Her confidence in teaching grew over time as Zoe became more familiar with the content and expectations.

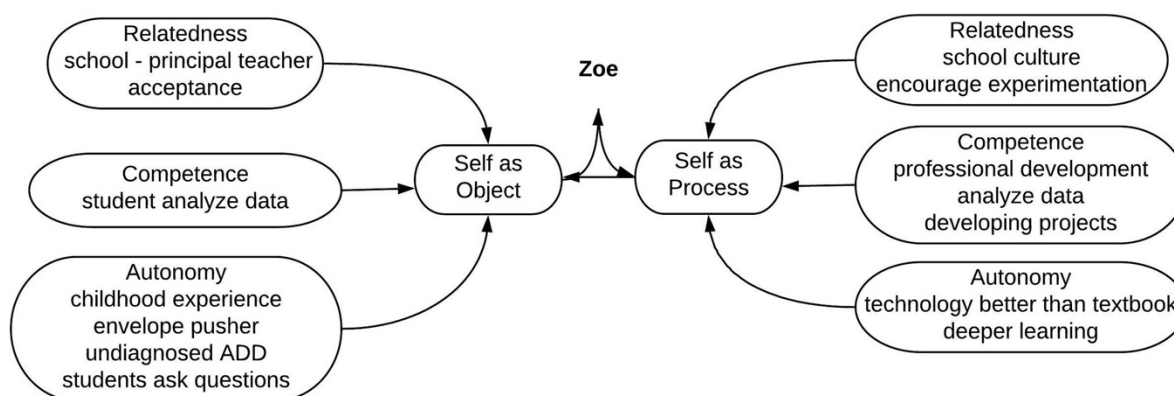
Relatedness. In the past, Zoe left a teaching job that did not encourage experimentation and went to one that did, a private boarding school for underprivileged students. Zoe stressed the importance of the school culture on her development. She described her current teaching experience as "very progressive"; she felt encouraged in her experimentation with different teaching methods and nurtured in her use of a constructivist teaching method. She noted, "I need somebody who will be willing to say . . . okay, I'm going to give you the opportunity . . . and if you fall on your face, it's okay. It's not shameful." Zoe wanted administrators to support her experimentation.

Though she desired support, Zoe held herself to high expectations: “If it doesn’t work out then what does that mean to my administration? How will that reflect on me professionally? Will people in other departments want to work with me again?” As most student units consisted of multiple tasks involving several teachers, Zoe tried to minimize “mistakes” so that teachers were likely to partner with her again in the future.

Zoe valued her administration and colleagues backing her growth. An environment with strong relatedness where her autonomy could flourish was so central to who she was that she chose where she wanted to work based on the support she would receive.

Figure 3

Visual Representation of SDT Model of Identity Formation for Zoe



Case 3: Anne, Rural Public School

Autonomy. Anne developed her beliefs about learning over time. She observed what was happening in the US’s workplaces. “I saw the importance of working together”, and Anne felt computers made collaboration more accessible. Students did not have to rely solely on their teachers and learned best by taking more responsibility in their learning. “We could put so much more responsibility, honestly, on the kids. . . . Kids learn when you say . . . look here’s this really cool thing . . . see what you can find out.” She contrasted her attitudes with those of her colleagues with technology: “Some of my colleagues don’t want to deal with it at all.” In contrast to her colleagues’ feelings, Anne developed a sense of creativity and power she had not felt in the past.

Computers gave Anne a new tool to actualize her beliefs. She noted that computers “are adding so much more creativity to my own lesson planning” and thrives on her students’ creativity, creating rubrics to match their projects and taking pleasure in their enthusiasm.

Our kids learn so much. We always joke about tricking them into learning things because they’re having such a ball doing it. They’re having so much fun, that they don’t stop to think . . . oh my goodness, I know all about the *Inferno*.

Anne believed learning could be engaging for the students.

In addition to creativity, Anne believed that subjects of history and English were “married.” “If literature is my mate I am married to, then history is my secret lover.” This belief instigated a European-

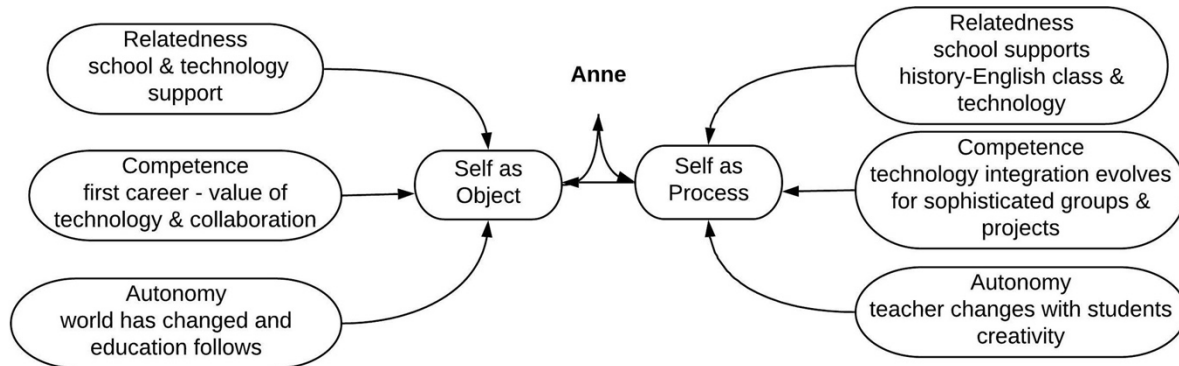
history-English-language-arts project-based course that Anne co-created and co-taught with a history teacher.

Competence. Teaching was a second career for Anne, and she claimed she went into the “computer age kicking and screaming.” Hesitant to face the new technology pedagogy, her fears were quelled when she realized the potential for productive and creative change with ICTs, first when typing reports in graduate school, then when teaching English at the public school. She noticed the benefits of using computer labs for word processing. “They could keep doing writing, and I could watch, be there watching the creation process happen.” With increased use of computers and access to one-to-one computing, Anne developed a broader outlook on the inclusion of computers as textbooks, means of accessing Internet resources, and, importantly, for creative design of classroom structures

Anne believes in using cooperative groups but worries about student accountability. She became concerned because students often depend on one student to complete most of the work. Through experimenting, Anne learned to create assignments for which students used different resources to determine answers and then shared within groups to create interdependent group work with available technology resources. Students’ creativity drives her. She noted, “They come up with so many wildly inventive, wonderful things,” and she felt encouraged when she had to create extra rubrics to accommodate student work so students could be accountable.

Figure 4

Visual Representation of SDT Model of Identity Formation for Anne



Relatedness. Anne, an English teacher, collaborated with a history teacher, Jerry, to propose a high school English-history course to the school board. She told the school board, “You’ve provided us with the computer, it’s going to be everything for us! It’s our textbook, it’s our library, it’s our research, it’s our project development . . . it’s everything for us!” The board supported the dual class for seniors, and additional support came from teaching colleagues who provided Anne’s students access to workspaces in the woodshop, the art room, and even in unsupervised areas throughout the school so they could do projects. The administrators arranged common planning time with her co-teacher.

Anne did not feel supported by most of her peers, who she felt balked at efforts to create an interdisciplinary and project-based course, but she did feel supported by her co-teacher Jerry, who held

similar beliefs about learning. With him, Anne could develop a learning environment with ubiquitous computing that aligned with her beliefs, and she could grow in competence with the project-based learning that her students valued.

Case 4: Jessica, Charter School

Autonomy. Jessica recalled two teachers in her elementary schooling years who sharply discouraged her career ambitions. She noted, “Yeah, it was hard . . . I was afraid to be shot down.” The experience stayed with her. By contrast, she believes her teaching job entails supporting students’ dreams. Reflecting on her own elementary school experiences, she determined that it was important to “Never demoralize them,” and instead, “lift them up and give students the skills to perform the duties of any career.” Jessica believes in helping students feel successful, which coincides with her belief about the role of a teacher.

Reflecting on her teaching at the charter, Jessica concluded, “Students learn best in a project-based, multidisciplinary approach where they can engage in meaningful and sometimes emotional activities.” Her current school embraces project-based learning in its belief system, but her past schools did not.

Competence. There were two specific teaching and learning skills that shaped Jessica’s pedagogical development early in her career. In her first teaching position, she taught a lesson about the US Declaration of Independence, and students had to take a stand on an issue. She noticed how the students were fearful and excited, relating students’ own actions to the original signatories to the US Declaration of Independence in 1776. Later, Jessica learned to make interdisciplinary lessons in professional development sessions. “It was amazing. The science curriculum integrated literature and math with science while reading books, and the whole shebang . . . But they connected it all.” Jessica felt “real learning” was happening when students were “making connections and asking questions,” “looking for answers on their own,” and “connecting with the content.” Jessica wanted to continue to grow and employ project-based learning, but she knew where her career began was not the place that would push her to grow.

Relatedness. At her second teaching experience, the charter school community had confidence in Jessica, which inspired her to have confidence in herself. When she first applied for the job at the charter school, she was nervous about technology, designing large projects, and posting them to the web. However, her concerns were allayed during the job interview with four or five teachers who “had faith in me. When I saw their confidence, I had confidence in me.” She received mentorship and learned the necessary computer skills to facilitate seamless, large-project-based learning.

At the school, teachers shared projects with one another during in-service and provided feedback to the presenters. Jessica gained skills and confidence through collaboration:

When you do your project, you only have one perspective, and you get so excited. . . . Then some of the questions came out. And, I was like, oh, wow. It was so perfect. Then, I was like, “Oh, I could do that. Why didn’t I think of that?”

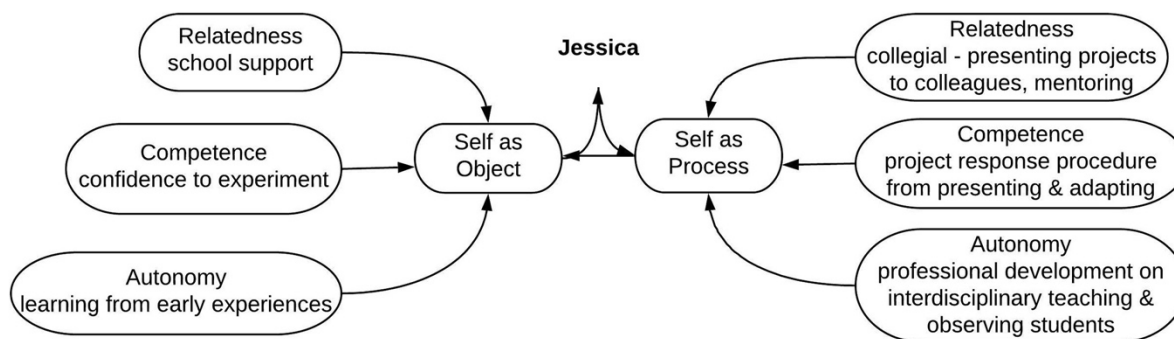
By extension, teachers expected the same collegial questioning from their students. Jessica related to her students’ reactions and frustration with their projects, providing vital insights into improving her projects. She created a response procedure to ask students about their struggles, to self-assess, and to

provide feedback on the rubric. Together, teachers and students made modifications to encourage learning.

Jessica experienced relatedness with her school and students through the expected process and products. She could be in a place that reflected her beliefs, helped her grow competence, and supported her development.

Figure 5

Visual Representation of SDT Model of Identity Formation for Jessica



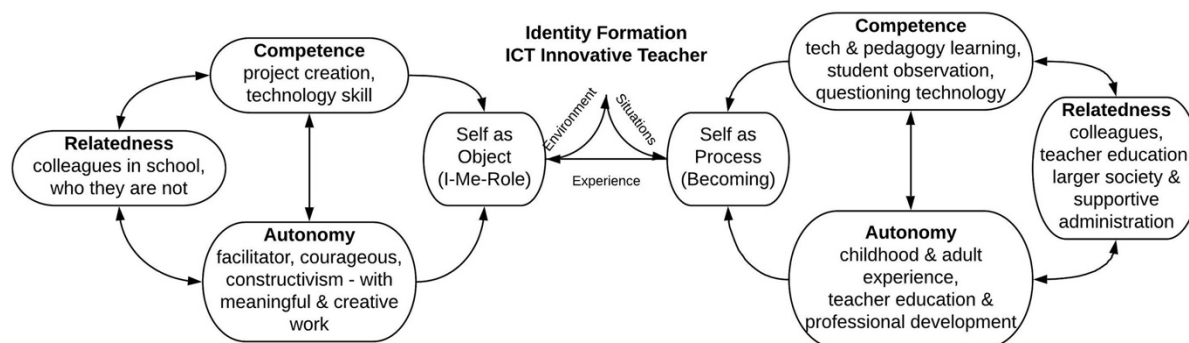
Findings and Discussion in Cross-Case Analysis with Literature

Though the teachers came from sociocultural different schools and did not know one another, they showed similarities when examined in a cross-case analysis of their narratives about becoming ICT innovative facilitators. Some findings echo those of other studies, but three particular findings stand out from this study: (a) episodic memories influenced the identity aspects of autonomy and relatedness when teachers were becoming innovative facilitators; (b) teachers' interpretations of student observations when learning with ICT and the relatedness of student feedback influenced the development of pedagogical competence; and (c) relatedness was influenced by relationships at the schools, including self-comparison to ICT-resistant teachers.

Regardless of the interview questions, teachers spoke about both competence and autonomy with a sense of relatedness in their stories, which coincides with the literature: "central to the process of accepting identities are people's inherent desires to experience relatedness to individuals, groups, or cultures" (Ryan & Deci, 2017, p. 386) (see Figure 6). Therefore, relatedness will not be discussed in isolation but instead with the competence and autonomy that describe the interrelationships of the needs. The written descriptions of the themes emphasize self-as-process rather than self-as-object because the process refers to the development of the teacher. Findings are synthesized and compared to other studies, with suggestions for further research within each theme.

Figure 6

Visual Representation of SDT Model of Identity Formation for ICT Innovative Facilitators



Episodic Memories Influenced the Identity Aspects of Autonomy and Relatedness When Teachers Were Becoming Innovative Facilitators

Teachers' beliefs were influenced by life beyond formal teaching, including childhood and adult experiences. For instance, Jessica had a negative childhood experience, Anne noticed collaboration in the workplace, Zoe had a "lit fire" for teaching, and Wyatt compared his childhood to that of his students. The episodic memories influenced the types of classrooms they wanted to create and the types of meaning and learning experiences they wanted for students. Similar to Emo's (2015) study, teachers were motivated to perfect teaching, eschew boredom, and improve student learning, but, in addition, the four teachers explained *why* they wanted all those things. Their poor past experiences motivated them.

These case findings contrast with an earlier study of 27 teachers from eight universities attempting to implement ICT using best practices (Avidov-Ungar & Forkosh-Baruch, 2018). The researchers found the teachers struggled with the perception of being a teacher facilitator with technology because their professional identities were being challenged, and they felt that technology was replacing them. Instead, the four teachers in this study found that technology enhanced who they wanted to be.

The episodic memories influenced beliefs that contributed to teachers' autonomy. According to Ryan and Deci (2017), autonomy encompasses the feeling of alignment between one's own beliefs and the agency to enact those beliefs. Three of the four teachers explicitly shared their experiences, interwoven with their expectations of the administrators' support needed for project-based strategies, so they could implement what they believed.

Past experiences played a role in teacher beliefs, so this research supports the work of Er and Kim (2017), who used the episodic belief change model with preservice teachers to help evolve their belief systems for effective technology integration. The research stopped in the classroom. Er and Kim's work did not address in-service teachers nor the results of those desires for support. The episodic memories connection between beliefs about teaching and learning and desired relatedness based on those beliefs led to further questions. If a teacher evolves their belief system to be an innovative facilitator but does not feel agency to enact their beliefs in their teaching environment, what happens to that teacher's identity? Researchers could investigate how to use the episodic belief change model with in-service teachers in a work-embedded context, which has shown to be a best practice for teacher development (Darling-Hammond et al., 2017; Glazer et al., 2009; Orrill, 2001; Saunders, 2013).

Teachers' Interpretation of Student Observations When Learning with ICT and Relatedness of Student Feedback Both Influenced the Development of Pedagogical Competence

Every teacher emphasized how they learned from observing and being challenged by students, which they said pushed their growth. Anne observed her students using word processing to increase efficiency, encouraging interdependence through group work, and later challenging her to create more rubrics for their creative projects. Wyatt was challenged by how quickly his students searched for answers using the internet and how he needed to adapt. Jessica and Zoe observed their students' connections with online content and created more project-based learning experiences. By observing their students, teachers did not feel inferior in their technology skills but instead found ways that technology supported learning differently. Their observations led to increasing competence in ICT pedagogy.

The process of student observation and student feedback propelling pedagogical growth is not a new concept in teacher development (Livingston, 2006; Sandholtz et al., 1997; Tondeur et al., 2017). In fact, ISTE Educator Standards (2017) embrace student feedback and learning with students when investigating technologies. Standard 4 explicitly mandates that "educators dedicate time to collaborate with both colleagues and students to improve practice, discover and share resources and ideas, and solve problems" (ISTE, 2017, p. 2). The teachers from this study would concur. Feedback from students may seem generous in writing, but is harder to implement. Sinha and Hanuscin (2017) found that even teacher leaders felt their identities were being challenged with student feedback. Receiving feedback and collaborating with students may impact identity and a teacher's feelings of incompetence or fear of being replaced by technology (Avidov-Ungar & Forkosh-Baruch, 2018). Researchers may want to examine teachers' identity struggles within the intersection of autonomy, including teachers' personal beliefs and the receptiveness to student feedback to make pedagogical decisions.

Relatedness Was Influenced by School Relationships, Including Self-Comparison to ICT-Resistant Teachers

Unique to this study, teachers from four different schools distinguished themselves from other teachers within their experiential stories. Because they were not prompted by the researcher, their choices to share the comparisons demonstrate the relevance these stories held for them. Participants did not feel a teacher should be "resistant" to technology (Anne), "demoralize" students (Jessica), "lecture" continually (Zoe), or be a "control freak" (Wyatt). The innovative facilitator values their experimentation with particular colleagues but distances themselves from others. According to Ryan and Deci (2017), "In forming an identity, an individual is negotiating an intersection of autonomy with relatedness" (p. 383). In the teachers' negotiations, they seemed satisfied with being different but did not want to have to act alone.

Teachers identified supportive environments for growth and felt competent in their abilities to be facilitative with technology in those environments. Three of the four teachers (Anne, Wyatt, and Zoe) taught in environments that did not have whole-school collegial support, but they did have

administrative support. From these cases, the administrative support seemed to outweigh the need for whole-school peer support. Researchers could determine the salient aspects of support needed for teacher growth to be innovative.

Limitations Leading to Inquiry

As this study was a naturalistic inquiry, its context, participants, and researchers who acted as instruments of interpretation cannot be replicated, nor do the participants represent a population for generalization (Creswell & Creswell, 2018; Yin, 2003). The limitations encourage further studies through construct, context, and method. First, the construct of identity is fluid and vast; this study did not investigate aspects surrounding age, ethnicity, race, geography, neurodiversity, or other common elements used as identity markers that impact how teachers develop (Aguilar, 2020; Hammond, 2015). Further research could investigate how self-perceived identity markers impact episodic memories in pedagogical development.

Second, there are limitations from the contexts, most recently from the Covid-19 pandemic, which caused most of the world's teachers to have to instruct online and may have developed innovative facilitators (Arnet, 2021). Third, in future studies, a survey method could permit greater participation to enable generalization to compare identity development across relatedness, competence, and autonomy (Ryan & Deci, 2017). An international study, over a prolonged time, would develop a deeper understanding of teacher identity development through cultures. In comparison to potential future studies, the current research generates petite theories that are similar to history, in which readers can empathize and use the findings to influence future creations.

Conclusion and Implications of ICT Innovative Identity Development

There is a paucity of research that examines the stories of teachers who have evolved from traditional teaching to became innovative facilitators. This study coalesced teachers' experiential experiences to extended research on ICT integration into innovative practices and facilitative pedagogy by integrating SDT of identity formation to understand teacher development. The teachers spoke about skills gained through their professional development, but most of their discussions focused on how they interpreted their formative experiences, which included how to implement ICT and what they did not want to do (Theme 1). Their answers included how they viewed both themselves and their students in the learning process with ICT (Theme 2). They contrasted their interpretation of their ICT experiences with other teachers and the support needed for their continual ICT implementation with facilitation (Theme 3). The findings highlight additional areas for further research, including how to further use episodic experiences for in-service teachers, teachers' identity development and the use of student observation feedback, and support of innovative and facilitative teachers.

Olson (2010) states the importance of teacher identity: "What makes someone a good teacher is not methodology, or even ideology. It requires engagement with identity, the way individuals conceive of themselves so that teaching is a state of being, not merely a way of acting or behaving" (p. 9). Because teachers who are facilitative and innovative with ICT are considered to enact best practices (Bowman et al., 2020; Ertmer, 2005; Graves & Browsers, 2018; ISTE, 2017), studying their identity formation was a logical next step. One way to study identity formation is based on SDT, which posits that people satisfy their needs for autonomy, competence, and relatedness in their identity formation (Ryan & Deci,

2017). Specifically, this study investigated how four innovative facilitators describe their salient experiences to satisfy their autonomy, competence, and relatedness in their identity formation with ICT. Uncovering these nuances of teachers' identity development could help researchers better understand the process, thereby informing future professional development.

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