

The zone of proximal identity development in apprenticeship¹ learning

La zona de desarrollo próximo de la identidad en entornos de aprendizaje de oficios

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Abstract

The purpose of this paper is to introduce and elaborate the theoretical notion of the «zone of proximal identity development» (ZPID). Building on Vygotsky's (1978) notion of a «zone of proximal development» (ZPD) where learning takes place when an individual is supported by others in participating in an activity, the ZPID posits a similar zone for individuals where identity development is possible. In this sociocultural view, learning environments are seen as involving participants in communities of practice that enact connections between past, present, and future, through reference to identities that are dialogically created, while using tools participants have a stance toward, serving purposes that give meaning to participant roles and agency, in scenes welcoming particular kinds of people and practices. The ZPID for each individual includes those portions of their immediate «trajectories of identification» that impact their participation in the learning environment on a moment-to-moment basis, and which lead to their longer term development of identity. Case study research in an out-of-school engineering apprenticeship for teenaged youth was conducted. The case studies show how work

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in the ZPID is a dialogic phenomenon that stretches across time and space as multiple individuals seize meaning and project significance on their participation in activities, and their expectations for future identification with those activities. Expected pathways of development within the apprenticeship learning environment from «newcomers» to «oldtimers» became culturally shared referents that helped to create zones for identity development, as did possible long-term career interests related to the work of the apprentices, such as in becoming a chemical engineer or a construction worker. As they work with young people, educators should consider the ZPID, because it affects the learning opportunity in the moment, and the trajectories possible for learners to pursue over longer stretches of time. Future research should elaborate the dynamics of interactions within the ZPID.

Key words: identity, development, sociocultural theory, case studies, educational research.

Resumen

Este artículo pretende introducir –y desarrollar– la noción teórica de «zona de desarrollo próximo de la identidad» (ZDPI). Partiendo del concepto de Vygotsky (1978) de «zona de desarrollo próximo» (ZDP), donde el aprendizaje se produce tomando parte el individuo en una actividad con la ayuda de otros, la ZDPI establece un espacio análogo para el desarrollo de la identidad. Desde este punto de vista sociocultural, los entornos de aprendizaje son ámbitos donde los individuos se integran en colectivos cuyo rasgo distintivo es determinada actividad, y en los que se establecen vínculos entre pasado, presente y futuro a través de la referencia a identidades que se construyen de forma dialógica, usando en contextos asociados a personas y actividades de determinada clase (para unos fines que confieren sentido tanto a los papeles que asumen los participantes como a las acciones que llevan a cabo) determinadas herramientas hacia las que los individuos implicados adoptan determinada actitud. La ZDPI de un individuo incluye los tramos de su «trayectoria (inmediata) de identificación» que inciden en su participación en un entorno de aprendizaje específico, y que desembocan en el desarrollo de su identidad a largo plazo. Se llevó a cabo –aplicando la metodología del estudio de casos–, una investigación en un entorno de enseñanza extraescolar para adolescentes orientado al oficio de la ingeniería, y se observó que el trabajo en la ZDPI es un fenómeno dialógico que se proyecta en el espacio y el tiempo a medida que diversos individuos van encontrando sentido –y dotando de significado– a su participación en determinadas actividades, así como a la perspectiva de identificarse con ellas de cara al futuro. Los patrones habituales del proceso de aprendizaje de un oficio –el camino que separa al «novato» del «veterano»– servían de referentes culturales comunes y, por tanto, facilitaban la creación de zonas

para el desarrollo de la identidad, a la vez que fomentaban en los «aprendices» el interés por dedicarse a determinado ámbito profesional a largo plazo, convirtiéndose en ingenieros químicos u operarios de la construcción, por citar dos ejemplos. Teniendo en cuenta que trabajan con jóvenes, los formadores deberían tener en cuenta la ZDPI, pues incide en el proceso de aprendizaje tanto en situaciones concretas como, eventualmente, en un lapso temporal más extenso. Sobre las dinámicas interactivas en la ZDPI, es necesaria más investigación.

Palabras clave: identidad, desarrollo, teoría sociocultural, estudio de casos, innovación educativa.

Like many educators, I have come to see identity and learning as inextricably linked in important ways (e.g., Gee, 2000; Rahm, 2007; Wortham, 2006). For instance, I was struck by how the school identities and affiliation group identities such as «gamers» and hip hop music fans intersected and sometimes conflicted for participants in after-school history clubs I had organized (Polman, 2006). More recent work in an out-of-school learning environment focused on science outreach work, which I call «YouthScience» (e.g., Polman, 2008; Polman & Miller, 2008a, in press), has extended and deepened this interest.

YouthScience is a youth development program in which high-school-aged children are employed by an informal science institution to do science outreach work. Important goals of the program include teens developing science and technology knowledge as well as general communication skills that simultaneously better prepare them for and interest them in professional careers. Since YouthScience has some features of a deliberate, old-fashioned apprenticeship (e.g. Lave & Wenger, 1991; Wenger, 1998), with some goals of a more traditional academic learning environment focused on science, technology, and communication skills, I view it as a particular kind of apprenticeship learning environment (Polman & Miller, 2008b). In this paper, I seek to explicate the notion of a «zone of proximal identity development» (ZPID) in order to explore its potential in understanding the role and development of identity in such a learning environment.

Lev Vygotsky's (1978) notion of the «zone of proximal development» has been extremely influential in education, in part because it provides a metaphor educators have found useful in creating supportive learning environments with

productive interaction and scaffolding. In this paper, I will expand and unpack the related notion of a «zone of proximal identity development,» which I coined in the discussion of an earlier paper (Polman, 2006). I illustrate how these related notions explain progress and difficulties encountered in this apprenticeship learning environment, and discuss the importance of these ideas for education.

Theoretical background

Before addressing identity issues, I will review Vygotsky's theories that included the notion of the «zone of proximal development» (ZPD) as described in his original work and expanded by his many subsequent interpreters concerned with psychology, learning, and education.

Vygotsky distinguished his notions of development and learning, and the relation between the two, from other theorists' ideas at his time (and since), and these distinctions are important to understanding the ZPD. Vygotsky saw Piaget and others as asserting that a developmental level of maturity needed to be reached biologically by a child before that child was ready to understand and respond to learning opportunities. In other words, development precedes learning. In contrast, Vygotsky theorized that «the developmental process lags behind the learning process» (1978, p. 90). He held that learners accomplish activities with the help of more expert others in a social setting –i.e., on the «intermental» (Wertsch, 1991) plane between minds– that the learners could not achieve on their own. The performance of action in one's world embodies learning in Vygotsky's scheme, and that performance leads to individual development. After such performance, learners can advance their own individual development and understanding, on what later theorists such as Wertsch (1991) terms the «intramental» plane (i.e., within an individual's mind).

Moreover, Vygotsky's «general genetic law of development» states that learners first participate socially or intermentally in the use of cultural tools and practices and then individually or intramentally appropriate the tools. This view of social learning has had important implications for how teachers organize instruction, because the student-and-teacher-acting-together-in-the-world provides a structure, in which students internalize understanding of practices so that

they can later act in similar fashions without the teacher's help (Cole, 1996). A now-classic application of Vygotsky's «general genetic law» is the «reciprocal teaching» instructional paradigm developed and studied by Annmarie Palincsar and Ann Brown (1984). In reciprocal teaching, the teacher places students in roles that divide up important metacognitive aspects of a reading task (such as comprehension monitoring and summarizing), supports the accomplishment of those roles, and through repeated activity involving role shifts for students brings the group, as individuals and together, to more expert performance.

Taking these ideas into account, the «zone of proximal development» (ZPD) grows out of the relation between meaningful social learning and individual understanding. Vygotsky defined the ZPD as:

The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (1978, p. 86)

In *Mind and Society*, Vygotsky pointed out that two children with the same actual developmental level (i.e., who could solve the same problems alone on a test) might have very different zones of proximal development. One might be able to participate meaningfully in more advanced problem solving with adult guidance or in collaboration with more capable peers than the other; the one who had a more extensive and fertile zone was in the position to learn through such participation, whereas the other whose zone did not extend to higher levels could not gain from the same efforts at guidance provided by adults or more capable peers.

Based on the theoretical notion of the ZPD, Vygotsky pointed out that «properly organized learning results in mental development and sets in motion a variety of developmental processes that would be impossible apart from learning» (1978, p. 90). Such properly organized instruction should «focus on how interpsychological functioning can be structured such that it will maximize the growth of intrapsychological functioning» (Wertsch, 1985, p. 71); or, as Vygotsky put it:

Instruction is good only when it proceeds ahead of development. Then it awakens and rouses to life an entire set of functions which are in the stage

of maturing, which lie in the zone of proximal development. (Vygotsky, 1934, cited in Wertsch, 1985, p. 71)

Using the terminology introduced by Wood, Bruner, and Ross (1976), good instruction involves effective «scaffolding» –acts of guidance and coaching that set learners up for success and advancement in their ZPD's–. Educational researchers have spent a good deal of time articulating how teachers can effectively structure and guide learning in various disciplines through scaffolding (e.g., Pea, 2004; Polman, 2004; Tabak & Baumgartner, 2004).

Playing off this theoretical backdrop for cognitive development, I (Polman, 2006, p. 249) posited the usefulness of the notion of a «Zone of Proximal Identity Development» (ZPID) to help explain identity development. I define the ZPID as:

The distance between the actual identity developmental level as determined by an individuals' past positionings and the level of potential identity development as determined through mutual negotiation of positioning and stance during actions associated with an identity, under adult guidance or in collaboration with peers.

This definition of the ZPID deliberately parallels Vygotsky's definition of the ZPD quoted above, for comparison and clarity. In this definition, «positioning» refers to self-positionings of an individual which reveal their view of «the kind of person they are» in terms of roles and affiliations, and «other-positionings» of the same individual which reveal the expectations of those others for that individual's roles and affiliations (e.g., Yoon, 2008). «Stance» refers to the resistance or appropriation of the identity implications of an act by the actor (Polman, 2006). Like the ZPD, the ZPID is a conceptual horizon of possibilities for development beyond the already-achieved state. In this case, already-achieved and agreed-upon positionings and prior stances of appropriation to one's identity don't represent change, so they are not in the zone; other-positionings that are so distant from individuals' prior experience that they are as yet unimaginable for them are beyond their zone. What is in the zone are steps along possible identity development pathways that the individual is capable of recognizing and willing to explore; not all these pathways will be taken a long distance but they are related enough to that individual's past understanding and identification to be imaginable and explorable.

This definition of the ZPID is based on my view of identity development as instantiated in «trajectories of identification» (Dreier, 2000; Wortham, 2006), which is situated within a broader sociocultural framework for understanding human action, learning, and development (Cole, 1996; Vygotsky, 1978; Wertsch, 1991, 1998). This sociocultural framework is based on the premise that individual psychological functioning (i.e., learning and development) is a product of social interaction and action embedded in contexts involving «tools.» These tools –such as words and ideas– also have a cultural history, in the various ways that they have been used by others over time.

Trajectories of identification refer to the experiences of individuals as they travel through space and time (Lemke, 2000), and across the borders of different «communities of practice» (Lave & Wenger, 1991; Wenger, 1998). Individuals experience multiple trajectories of identification over time corresponding to communities of which they are a part. These identity trajectories are «spread over the material and social environment» (Holland, Lachicotte, Skinner, & Cain, 1998, p. 4), and are dialogically negotiated, sometimes contradictory, and contested over time across the «cultural worlds» with which individuals interact. For instance, the social contexts of home, informal social groups, and schools all influence the identity development of youth in educational programs (Rahm, 2007; Sfard & Prusak, 2003; Tucker-Raymond, et al., 2007). Trajectories of identification are not definite paths, but instead have a motion with momentum and influences based on how individuals and their interlocutors interact in communities, and how they enact connections between past, present, and future. These connections across time relate the proximal development of individuals to distal identities, both real and imagined. For instance, the fact that a teen sees herself as becoming a chemist in the distant future will color her experience of a chemistry lab experience in a school or after school program.

Trajectories of identification are formed in part by the kinds of connections between past, present, and future described as «prolepsis». Cole (1996) describes prolepsis as the discursive and psychological process of how people such as parents enact the enculturation of youngsters into the kind of distal identities the parents expect for their children. He defines prolepsis as «the representation of a future act or development as being presently existing» (p. 183), and describes how parents recall their own past trajectories to imagine futures for their children. They then use that imagined future to influence their present interactions with their child. For instance, a science researcher may recall her own childhood

interests and occupations and pathways, which influence both consciously and unconsciously the books and summer programs and small interactions she has with her son relating to science. In this way, imagining him traveling a similar path as her own may encourage him to become someone like her. In this way, a distal past of the parent, and the distal expectation the parent has for the child, impacts the proximal interaction and development of the child. The converse is true as well, where a parent's memories and future expectations for their child cause them to discourage certain identity trajectories in the present, such as a parent from a working class who has moved into the middle class discouraging their child to consider a working class career. The parents' influence is not deterministic, however; children can choose to resist or modify their parents' desires.

Of particular interest to educators is how youth trajectories of identification within their present-day educational program activities involve connections made by people to possible proximal futures in the program and distal futures afterward. Identity connections may be made by youth themselves, as well as many other relevant individuals with whom they interact, such as the staff in institutions, their peers, and their families. For instance, a teen's interest and skill in tinkering with technology may have been cultivated by her parents, not recognized by her school, and viewed as odd by some of her peers; these others' opinions, as well as her own view of this aspect of her identity, would inform the teen's reaction to a youth program welcoming her tinkering skills and recognizing their value for a greenhouse design project.

In contrast to individual psychological notions of identity as a stable set of individual characteristics, sociocultural theorists join many others in stressing how identities are dialogically created within cultural contexts through interactions between individuals as they carry out actions, position one another in relation to cultural norms (e.g., Carlone & Johnson, 2007; Gee, 2001; Hermans, 2001; Holland, et al., 1998; Nasir & Saxe, 2003; Yoon, 2008) and are influenced by the multiple voices they have appropriated (Wertsch, 1991). Any one act of identification is contingent on specifics of that event, but categories of social identification «thicken» (Wortham, 2006) or accrete (Polman, 2006) on an individual as they repeatedly position themselves, or are positioned by others, as belonging to a social category. Wortham has demonstrated through his classroom-based research that local social categories such as «disruptive students» are created and maintained within communities of practice by their use as

«metapragmatic models» referred to by community members; these local models may mediate broader sociohistorical categories that exist in the culture beyond the classroom (e.g., Wortham's example of a young woman positioned locally as a disruptive student, and identified also with the broader category of «loud black girl»). Each incident in which an individual is contingently identified with a local metapragmatic model (or social category such as «disruptive student») makes it easier to identify that individual with the model or category in subsequent interactions (see also Brown, Reveles, & Kelly, 2005; Carlone & Johnson, 2007; Nasir & Saxe, 2003). Sometimes the identity positioning of an individual is contested, and the tensions between competing frames are in some ways parallel to what Bakhtin (1981) said about words which are «half ours and half-someone else's» (p. 345); the identities negotiated are partially created by individuals to the extent they exercise agency, and partially by those with whom they interact. In addition, even when individuals are seemingly acting alone in the present, the multiple voices they have appropriated from their past influence the dialogical construction of meaning and identification ascribed by the individual.

Trajectories of identification also relate to the kinds of «stances» individuals take toward the cultural «tools» they use within learning environments. Building on terminology introduced by Wertsch (1991, 1998), I distinguish between agents «mastering» a tool they are learning, or «appropriating» the tool (Polman, 2006). In the latter case of appropriation, the individual has a stance of «making the tool their own,» whereas mastery refers to the purely cognitive aspect of their facility with and engagement with the tool. Individuals can master a tool without appropriating it (e.g., learn to play the piano but resist it and never agree to do it except under duress), or appropriate a tool without mastering it (e.g., play the drums with persistent and deep engagement without developing strong fluency), or both. Sometimes mastery can drive appropriation (after 5 years of piano lessons under duress, an individuals' achievement develops into a more positive stance), and at other times appropriation might drive mastery (the love of the drums leads to fluency).

In addition, I utilize the sociocultural notion that the purposes, goals, or «objects» of an activity or set of actions are relevant to how participants interpret their roles, agency, and experiences (e.g., Leontiev, 1981; Wertsch, 1998). As Barbara Rogoff (1994) has pointed out, shared endeavors to reach a common purpose help to focus a «community of learners,» such as a healthy apprenticeship, so that learners develop through transformation of their participation in activities

over time. Lave & Wenger (1991) documented practices of apprenticeship, in which apprentices were expected to contribute to the purposes of the workplace. As O'Connor (2003) has noted, the traditional apprenticeships that Lave & Wenger profiled were deliberately «benign» communities of practice. By this he meant that apprentices were willing entrants into communities of practice in which the development of positively valued identities was not only possible for and expected of all participants, but in which activity was organized in such a way that newcomers in fact had ample support in developing these positively-valued identities (O'Connor, 2003, p. 67).

In such settings, all were expected to succeed in advancing their expertise from «newcomer» levels to «oldtimer» standards. As Hull & Greeno (2006) state, different identities with more authoritative agency are created through the development of «new roles and positions, different patterns of participating and interacting with others, different responsibilities and entitlements» (p. 80). Thus, in the case studies below, I will be concerned with examining how participants' roles and agency fulfill the purposes of the community.

Finally, the sociocultural framework I utilize also includes the «scene», «place», «territory»² or interpreted context in which actions are located and carried out. As Wertsch (e.g., 1998) has pointed out, different kinds of scenes are seen by different identity groups as being welcoming to them, and different kinds of scenes are seen as including certain cultural tools (both material and conceptual artifacts) and not others. Sociocultural researchers studying classroom practices have described scenes they refer to as «hybrid spaces» (Barton, Tan, & Rivet, 2008; Gutierrez, Larson, & Rimes, 1995) or «contact zones» (Orellana, 2009) which mix multiple cultural communities' norms and practices; creating tensions that may negatively impact discourse and learning opportunities, but may also lead to possibilities for productive change. Following these sociocultural researchers, I am concerned with how learning environments that serve as a hybrid of certain communities intentionally welcome certain kinds of identities and practices into them, and seek to exclude others.

⁽²⁾ I will use the term «scene» through the remainder of this text. Since they are both spatially-related terms, it is important to distinguish my meaning of «scene» from the «zone» of proximal identity development. A scene is a culturally defined shared place which frames participants' understanding of what goes on there. Within any one scene, there are individuals whose own developmental trajectories have zones of proximal development and identity development—the zone of proximal identity development defines steps along possible identity pathways for an individual. Thus, a scene is a larger shared space, whereas the zones to which I refer are the possible individual pathways within whatever scene individuals are acting.

In summary, my theoretical framework sees learning environments as involving participants in communities of practice that enact connections between past, present, and future, through identity positionings that are dialogically negotiated, while using tools they have a stance toward, serving purposes that give meaning to participant roles and agency, in a scene welcoming particular kinds of people and practices. The «zone of proximal identity development» for each individual is the distance beyond an individuals' past positionings and the level of potential identity development as determined through mutual negotiation of positioning and stance toward cultural tools during actions associated with an identity, under adult guidance or in collaboration with peers in the scene. As identity work is accomplished on a moment-to-moment basis in the zone, it thickens identifications, which lead to the long-term development of identity.

Participants and methods

The «YouthScience» program is a component of an informal science institution's community-based programs initiative designed to provide underserved (primarily African American) teenagers «a work-based, inquiry learning environment that focuses on science, mathematics, and technology». The YouthScience program was established in 1998. The youth development model and science activities have been refined over a number of years, and are based on a combination of related youth projects (e.g., Beane, 1990), iterative design of the program over time, and research on learning and development, especially among non-majority and urban youth (e.g., Garbarino, Dubrow, Kostelny, and Pardo, 1992; Howard, 1987; Jolly, Campbell & Perlman, 2004; Yates and Youniss, 1996).

At the time of this study (2006-07), around 120 YouthScience «teens» (as they are referred to in the program) worked as hourly employees earning minimum wage for 8 weeks in summers, and on Saturdays during school years. Some of the teens struggled in school and many of them attended struggling schools. The work experiences of teens in the program were directed toward a variety of community science projects, supervised by the adult staff. The teens' job also included a large amount of what the staff term «professional development» related to workplace skills such as communication. The workplace skills were based on the recommendations of the Secretary's Commission on Achieving Necessary Skills (SCANS, 1991).

The YouthScience program was divided into subgroups consisting of around 10 to 20 teens each, each of which had one or two adult staff supervisors. In this paper, I focus on one specific subgroup from Summer 2006 through Summer 2007, the «TechTeam». TechTeam focused on designing and building structures (an engineering venture) while utilizing computer technology, and learning about edible plants (a science venture). TechTeam included 17 African American youth ranging in age from 13 to 18 years old, and was co-led by a European-American male in his twenties with a bachelor's degree in physics («Shawn»), and a European-American female in her twenties with a degree in engineering and a background in international environmental education («Jordan»). The teens came from families ranging in income level from below the poverty level to middle class, and with parents ranging in educational attainment from partial completion of high school to graduate school. Most teens attended public neighborhood schools, but a few within this group attended public magnet schools, and a few attended private Christian schools. Slightly less than one-quarter of the youth were entering 9th grade in the fall, and joining the program for the first time. The remaining youth were in their 2nd-4th years in the program, and entering 10th-12th grade.

I conducted interpretive case study research in this program during eight weeks of these teens' full-time work in summer of 2006, with follow-up visits on Saturdays in the 2006-07 school year and later in the summer of 2007. Data collection techniques included observation of daily activity in the program, with running notes taken on a laptop computer. These notes were later supplemented by transcriptions of selected audiorecordings and videorecordings of key events. During and after the summer, I also conducted 2 semi-structured interviews each with 8 staff and 14 «focus» youth; the first interview in each case had to do with experiences with science, technology, engineering and mathematics (STEM) before entering the program, and the second with STEM experiences during the program and future aspirations. The focus youth were a purposeful sample representing a balance of genders, number of years in the program, and participation in various groups within the program. The interviews utilized a narrative approach adapted from life stories research (Drake, 2006; McAdams, 1993); the interviews covered critical events (peak experiences, nadir experiences, turning points, important early scene, important other scenes, challenges, positive influences, negative influences, and positive futures and negative futures). These interviews were transcribed for the analysis. Finally, I collected copies of artifacts created by the

youth and staff during the summer, as further evidence of their work and their thought processes.

For my analysis, I placed all the above records and textual data in a qualitative analysis program called NVivo, and coded for a number of elements. For this paper, the coding of positionings and stances were most important. The positioning codes marked instances where identities were dialogically negotiated with reference to the social categories that appeared to be relevant to staff, teen participants, and persons with whom they interacted or whom they mentioned in their interviews. I distinguished between self-positionings and other-positionings that demonstrated either acceptance of or resistance to an identification. In addition, I coded for «stances» toward cultural tools that provided evidence of work in or beyond zones of proximal development.

For this paper, I focus on the zones of proximal identity development of three teens as seen in their work on an engineering design project. These three cases were selected to show the diversity of experiences among TechTeam youth in relation to work in the ZPID; they are not representative of the overall group.

Siena: developing an engineering identity through participation

Siena, Jamal, Mercedes (all participant and program names are pseudonyms) and the other TechTeam members had been learning about the strength of various structures in their Saturday sessions during the Fall 2005 and Spring 2006 sessions. In these sessions, they created structures out of paper, toothpicks and wood, and had contests for height and strength. They inductively came to understand certain principles, such as the key role triangles can play in adding stability. During the summer of 2006, the supervisors Shawn and Jordan launched the group on an engineering project aimed at designing and building a greenhouse in which to grow edible foods (during part of their time, they were planting, growing, and doing inquiry projects on edible plants as well). The greenhouse activity consisted of two design-build-test sequences, in which groups of three or four teens explored potential shapes for the greenhouse, and then potential «skins» for its outer covering. Professional engineers from the National Society of

Black Engineers (NSBE) visited twice during this period to evaluate and provide feedback to the teens.

Siena was a 3rd year participant in YouthScience in the summer of 2006; her supervisor looked to her for leadership of younger teens, and her peers admired her. She worked another job, and thus could not be at all YouthScience sessions. She described herself as «very interested in most subjects» in school, and «very successful» as well. By the summer of 2007, Siena positioned herself as heading along a long-term trajectory toward a career in chemical engineering. It is worth tracing how her positioning of herself, and her positioning by others, contributed to this trajectory, along with the experiences she gained through participation in TechTeam.

As Siena recalled her personal history with science and engineering in an interview: It started when I was a kid, I always liked messing with stuff and seeing how stuff works ... And, the problem was breaking stuff, I couldn't put it back together ... So, I had to re-buy it, and I started, I took this part off, I guess it goes here ... And that, I did that for like, a long period of time, and then, um, I always had a niche for science. I was always like a real geek for science ... And then, um, when I got to chemistry, I clicked. Like, it was really easy for me to learn it ... And it was just really fun to learn different elements, and how you can take two things and put them together ... And, stuff like, moles and atomic numbers, and everything that involved chemistry. And uh, like, my favorite thing was to do stoichiometry³

Interviewer: Really? Siena: after I learned how to do it, yeah. And like, um, my teacher had me stay after class and be like a study aide ... and um, my um, teacher [at a particular school], he was going to put me in a AP Chemistry class, because we were only briefly touching on it in physical science, chemical and physical science.

³⁾ Stoichiometry is the study of the relationships between amounts of products and reactants in a chemical reaction.

As seen in the above quote, Siena positioned herself early on in her childhood as a tinkerer, who liked to take things apart (and try to put them back together). Her school experiences with chemistry, where she was positioned by her teacher, and positioned herself, as being promising and talented, led her to appropriate an identity of a chemistry student, and to both master and «make her own» some of the tools of chemistry (Polman, 2004; Wertsch, 1998).

While participating in TechTeam, she began to link her identification as a tinkerer to engineering, and combined this with her identification as a potential chemist, to formulate her identification as an intended chemical engineer. The practices of design-build-test, as implemented in TechTeam, involved Siena in cutting up, drilling, and lashing together PVC pipe to build a half-cylinder greenhouse structure with two other teens, which they then modified with a cross-beam to stabilize it, and then more systematically testing the strength of their and other people's structures. The tools and practices of tinkering were thus welcomed into this «scene» and had a valued role in building. In addition, Jordan introduced practices she'd learned in her own engineering training to the group, and assisted them in constructing tables with ratings in a spreadsheet summarizing their findings on strength (in terms of weight and shear) as well as affordability of the various designs. This culminated in the groups presenting their designs, and their strengths and weaknesses, to a visiting review panel from the National Society of Black Engineers (NSBE).

In the meantime, Siena and her father, who had dropped out of college after his football career ended due to injury, had been exploring career options for a number of years. At a «college seminar» she was struck by a job title that combined these two things she'd been enjoying – «tinkering» and chemistry: chemical engineering. As she said,

I saw the title, and said, «Chemical engineering, that sounds kinda cool.» So, I googled it up and saw what they do, and how they work with polymers, and different elements and, like, do stuff like cosmetics, and I recently found out they work with shoes, like, engineering the soles of shoes. And um, that really fascinated me. 'Cause I like the cosmetics, you know, 'cause I'm female ... And then, I like shoes, so I was like,... «I can do that» ... and maybe, just I don't know. I just love it. Like, anything about it is exciting.

Although Siena's ongoing interests and attention to fashion might be seen by some others as a potentially self-limiting gendered factor, Siena combined her fashion interest in a positive (and for her, natural) way with her chemistry and tinkering identities to make her own unique trajectory toward chemical engineering. Thus, her own unique history resulted in a trajectory toward a professional scientific career, but not in a way most others would expect. When the group of NSBE engineers visited TechTeam, Siena approached a black female engineer after the presentations, and discussed her interest in chemical engineering. This discussion eventually led to Siena getting a recommendation from a NSBE engineer, which resulted in a scholarship to an engineering summer camp at a university held in 2007, after her 11th grade. At the end of the camp, Siena was offered an early scholarship to study in that university's engineering program, which she accepted. She began attending that program in the Fall of 2008.

Although Siena's combination of advancement in a ZPID and ZPD were in many ways the ideal imagined by the program (and they were not typical), it is notable that they were not simply a matter of more expert others laying down a rigid pathway that acted as a scaffold for Siena to attach her thoughts and ideas. Siena came into the program with ideas about a distal identity as a chemist, and the program invited her to consider a distal identity of an engineer, while conducting an engineering project. Siena herself made meaning of the ideas offered by the program when she connected them to her earlier experiences with tinkering and chemistry. She continued to build her trajectory by eventually incorporating ideas from events taking place outside the program, as well as ideas, discussions, and opportunities within the program. Shawn and Jordan did not simply «scaffold Siena into chemical engineering» practices and a new identity; instead, it appears that Siena and others she interacted with both within and outside the program worked with her in her zone, and participated in the construction of a trajectory connecting Siena's past with her present and a possible future that was uniquely her own. Although it is not possible to trace the detailed dynamics of Siena's dialogical construction of identity shifts to particular conversations or sequences of actions, her retrospective discussion of the elements of her eventual trajectory toward chemical engineering included elements she originated and elements she picked up from the YouthScience program and her father.

It is also notable that Siena's stance toward the tools of engineering, such as the design-build-test techniques, was one of openness, while serving a

genuine purpose she valued to create the greenhouse. Within the apprenticeship environment set up at YouthScience, Siena was a valued part of the group contributing to the design, which provided her agency.

Jamal: developing a construction worker identity through participation

Jamal's case exemplifies some other ways that work in the ZPID is dialogically created in unpredictable ways over time by both the learners and the «more expert others» with whom they interact. Jamal was a second year YouthScience teen in the summer of 2006, and described himself as «a little bit interested in a few subjects» in school, and doing «poorly in some subjects and passing work in others.» He was not as engaged a participant in TechTeam as Siena either, based on observations. On many days, I observed Jamal slouching his way passively through the work the groups were doing. When they were supposed to be working on web research, spreadsheets, or Powerpoint presentations, Jamal often surfed the web for entertainment-related information, or spent time on social networking sites. Shawn and Jordan, the supervisors, consistently tried to position Jamal and the other students as capable and authentic practitioners of engineering, through the design, analysis and presentation activities. But Jamal consistently resisted that positioning, and instead positioned himself as passive, disengaged from and disinterested in such activities. After practicing their presentation, he said, «we had to do that presentation on the geodesic dome, and then we had to go back, and she told us we had to go back and fix the stuff that we kinda need to work on.» In addition to positioning himself as doing these things because he «had to» rather than having any desire to, Jamal characterized such activities as «like school», which he did not enjoy.

At some other times, however, Jamal was deeply engaged, and these corresponded with what he saw as «construction» activities. When they were preparing and assembling pieces, using hand tools, Jamal was deeply engaged. His engagement began in the phases of the project described above, in which Jamal enjoyed using the power tools and putting things together, and continued through the summer after they settled on the geodesic dome as the structure

the teens would use for their greenhouses. The group's next steps were to test various skins for the geodesic dome, construct a geodesic dome from a purchased kit, and then design their own low-cost model of a geodesic dome for the institution's community partners to grow plants in. Throughout the building of the geodesic dome from the kit, and the building of their own geodesic dome, Jamal contributed eagerly and without complaint to the physical labor in the blistering Midwestern summer heat. Although many of the other teens, both male and female, complained about the physical labor in the heat, Jamal never did, and in fact he'd sometimes stay after hours to help with construction. Thus, when the geodesic dome from the kit was completed one day after regular work hours, Jordan recognized that Jamal had put more labor into the construction than any other teen by having him place the final piece into the top of the geodesic dome, which made it into a rigid structure.

In order to build greenhouses, the program involved the teens in using saws, drills, and other construction tools and practices, which Shawn and Jordan also facilitated. Although Shawn and Jordan were consciously attempting to scaffold engineering practices as an explicit goal of their program, they were also facilitating construction practices, and the latter was more visibly appropriated dialogically by Jamal. He described his growing interest in construction work in an interview, when I asked him about future plans:

Jamal: I want to be a construction worker 'cause they make a lot of money, and I like building stuff. I'd probably like making stuff where I'd like build part of a bridge, or something like that.

Interviewer: Okay.

Jamal: Cause when we had got here at TechTeam ... and then we got started making the big, and then we got started making the geodesic dome, that was real fun.

Interviewer: Uh huh. So you really liked that.

Jamal: Uh huh.

Interviewer: So your idea about being a construction worker comes from working with TechTeam?

Jamal: Yeah.

Interviewer: Had you done any work like that before?

Jamal: No.

As in Siena's case, Shawn and Jordan would not have predicted that Jamal would «build» his trajectory of identification in the direction of construction, but like her, his participation in the ongoing activities of the program influenced his long-term career ideas. Although his supervisors were explicitly inviting him to consider distal identities related to engineering while using the conceptual tools and practices of engineering, they were also involving him with construction tools and practices. Jamal's stance toward the engineering tools was one of resistance, and perhaps linked to his past resistance to «school-like» practices, whereas his stance toward construction tools and practices was one of «making them his own». While using the tools of construction, he «imagined himself» as a construction worker, thus taking some steps in this zone of proximal identity development aimed at that distal career possibility. Because the TechTeam scene as implemented involved the teens in authentic practices of designing and test as well as building, a teen like Jamal could resist some of them and appropriate others while feeling a sense of agency in contributing to the overall goals of the group.

Mercedes: sustaining a career identity while developing from a newcomer to an oldtimer

In the previous two cases, I focused on how participation in this program interacted with ZPID's in terms of potential career paths, but Mercedes' case shows another dimension. Mercedes was entering her second year in the YouthScience program. She described herself as «interested in some subjects, but not interested in others,» and doing «passing work in most subjects, and good work in some.» She struggled in science, but excelled in and enjoyed math. Mercedes' identification of her career interests remained stable throughout her participation in TechTeam: she came in interested in becoming a lawyer, and she remained focused on that profession later. But her positioning of herself as a serious member of TechTeam contributed to her participation in practices that she not only mastered but also appropriated (Polman, 2006; Wertsch, 1998). In particular, her ZPID in relation to moving from an identity as a «new teen» to an «older teen» contributed to her advancing in her ZPD toward more sophisticated participation in the formal communication practices of presentations.

As mentioned previously, the teens presented the results of their design-build-test cycles for the greenhouse structures and greenhouse «skins» to a review panel from the National Society of Black Engineers. In the first presentation, Mercedes and most of the other teens made a number of common presentation mistakes relative to more expert practices. Specifically, Mercedes and her two partners overused certain distracting features of Microsoft Powerpoint, including visual transitions in which text spun around the screen, and an effect whereby each letter within a specific point was typed on screen, causing them to have to wait in order to proceed after their large amounts of text had appeared one letter at a time. In addition, they did not maintain consistent focus on their topic, as exemplified by the fact that they'd included eight «fun» photographs of themselves that did not illustrate the content of the slide (they did, however, include six informative photos as well). Finally, like most of their peers, they did not utilize representations such as graphs and tables at all.

At the end of the presentations, the NSBE engineers offered some suggestions and tips on presentations, including feedback about staying on message, and not distracting the audience. In addition, one of them offered the tip to use the procedure «touch-turn-talk» when interacting with slides, touch the slide, turn to the audience, and then talk about the slide. This tip helped the engineer keep from speaking away from the audience while reading the slide. Mercedes and the other teens took this feedback seriously when preparing for their second round of presentation, and the TechTeam supervisors provided other tips such as limiting extraneous photos and utilizing graphs and tables when possible. Mercedes and her group members practiced their presentation, repeating the «touch-turn-talk» procedure. When they gave the presentation, it had 3 photographs that illustrated a point, no extraneous photos, one table and two graphs summarizing their findings, and no distracting or time-consuming visual transitions. They more consistently spoke directly to the audience, rather than face the slides.

Although it is possible to make links to Mercedes' career trajectory and her participation in presentation practices, she did not offer evidence that she was doing so; instead, she appropriated these tools for communication because she cared about the communication task at hand. The extent to which she made consequential transitions (Beach, 1999) of those skills to other settings, and to her aspirations to become a lawyer, are not known. But her ZPID as a committed YouthScience teen hoping to move toward more sophisticated participated in the program activities provided a space in which she desired to improve her skills. In

interviews, Mercedes and other teens in the program, as well as supervisors, made consistent references to what they called «older teens» commanding the respect of their peers, and showing «new teens» (usually teens in their first year) by their example how to contribute productively to the workplace. Thus, all YouthScience teens including Mercedes and the other TechTeam members were expected to have a ZPID advancing them to more mature workplace participation, and as a second-year participant she may have been working to earn the moniker of «older teen». For instance, she said she wanted to distinguish herself from some of the first-year boys who she said »just sit on their butt, and they don't want to do nothing unless you ask them,» and wanted to improve the groups' teaching of younger kids, «because the first time we went, it was all right, but it could have been much better, because we didn't have everything planned».

Communication skills were highly valued in their particular workplace, as they were part of a framework they'd adopted (SCANS, 1991). Teens and supervisors alike provided accounts of many teens moving from being ineffective communicators to effective communicators, especially in public presentations. When the NSBE engineer and the program supervisors gave specific suggestions on how to improve the communication within presentations, they were inviting the TechTeam teens on a pathway toward being a more effective «older teen», and Mercedes responded to that with a stance of openness and eagerness. In this way, the supervisors and older teens were connecting past, present and future within the program, rather than with reference to more distant careers, the past progressions of other teens from «new teen» to «older teen», with associated improvements in communication skills. Because Mercedes wanted to move along the pathway from newer teen with less presentation skill to older teen with more presentation skill, she appropriated the tools of «touch-turn-talk» and making use of graphics to communicate a point.

Conclusion

As they work with young people, educators should consider the Zone of Proximal Identity Development (ZPID), because it affects learning opportunizing in particular moments and across the span of learning activities, which in turn affect the trajectories possible for learners to pursue over longer stretches of time. Although there is still a great deal to learn about the dynamics of how learners and peers or more expert others discursively accomplish identity work in the ZPID, this paper has provided a definition and theoretical grounding, as well as some instances of the construct's potential for explaining important aspects of human development.

The theoretical construct of the ZPID can inform the work of educators in several ways. Just as teachers routinely seek to investigate the prior knowledge of students in their charge in order to more sensitively facilitate scaffolding of learning, they should consider the prior trajectories of identification of their students and aim to work in their zones of proximal identity development. The case studies presented in this paper begin to show how work in the ZPID is a dialogic phenomenon involving possible identity pathways introduced by the students as well as significant adults such as parents and teachers. Although vocations and careers are not the only important markers of identity, the focus that the YouthScience program had on inviting teens to consider careers in science, technology, and engineering made that aspect of identity development particularly salient to two of the three case studies reviewed here. The TechTeam youth were invited to «imagine themselves» into career identities while carrying out an authentic project of designing, building, and testing greenhouses. Siena's experience designing greenhouses opened her up to the possibility of a long-term career as a chemical engineer, whereas she had previously imagined herself moving toward a career in chemistry. Teachers who know their students well can attempt to make connections between the career aspirations of their students and the career-related skills and understandings of their learning goals. This had a positive impact in Siena's case, but no link was made in Mercedes' case to her aspirations to become a lawyer. As they attempt to make connections to possible careers, teachers need to remember that invitations to thinking about career possibilities are not deterministic of the nature of participation and identification taken up by students. Although Jordan and Shawn attempted to invite Jamal to

connect the greenhouse design-build-test activities to engineering careers, he imagined himself as a construction worker while building the greenhouses. In addition, the appropriation of stances toward tools of a subject matter associated with a career does not guarantee mastery, though it can become a motivational driver toward mastery.

Although the cultural «pathways» represented by careers are relevant, they are not the only aspect of the ZPID that educators should consider. Work in the ZPID not only involves students' and others' consideration of long-term career aspirations, but also short and medium-term connections to socially shared identifications which may be local. Affinity groups, communities of practice, and apprenticeships have culturally shared notions of how people tend to develop over time within that group. In the YouthScience apprenticeship, identification with the notion of becoming an «older teen» was a source of positive directions in teens' ZPIDs, because it provided a valued local «metapragmatic model» for how to gain respect within the YouthScience community. This was an important pathway for the development of Mercedes among the cases described in this paper. Teachers and other educational leaders should remember that scaffolding in participants' zones will need to be improvisationally built through the course of activities, and should be sociohistorically situated in the lives of participants, the broader disciplinary traditions influencing the tools and practices they use, and the design of the particular learning activity at hand. This implies that educators may benefit from considering the ways that pathways for action and identification in the medium term of the learning activities which they design and facilitate invite developmental progressions that provide an interplay between cognitive challenge and identity roles.

Although this work does not provide answers to exactly how educators can work most effectively with their charges to foster the development of positive and productive identities, it provides some signposts for consideration in practice and research. Whether we pay attention to the identity work accomplished in learning environments, the zones of proximal identity development will impact the conduct of and impact of learning activities. Considering and better understanding activity in the ZPID may better us to facilitate human development in all its myriad forms.

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