

RUNNING HEAD: POSITIVE TECHNOLOGICAL DEVELOPMENT

Positive Technological Development: The Multifaceted Nature of Youth Technology Use
towards Improving Self and Society

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Introduction

Too often youth experiences with technology are framed in negative terms (e.g., cyber-bullying, sexual predation, invasion of privacy, addiction to videogames or MMOGs). For example, works such as those by Li (2007) on cyber-bullying especially among schoolmates, Grusser, Thalemann, and Griffiths (2006) on videogame addiction and aggression, and Palfrey and Gasser (2008) on new challenges faced by digital natives, especially regarding online safety and privacy, all highlight the dangers and perils of new technologies. The literature has pointed to many risk factors including poor home environment, lack of parental oversight, depression, history of abuse, and substance use as correlates to poor choices and negative uses of new technologies (see Schrock and Boyd, 2008 for an extensive overview).

The work presented here on Positive Technological Development is an attempt to both identify and foster an alternative to this deficit discourse about youth experiences with technology. Researchers such as Jenkins (2006), from a media studies perspective, and Resnick (2008), from an educational technologies focus, have also taken a positive approach to understand how children use technology. PTD complements this work by adding the psychological/developmental science perspective. PTD builds on previous work on Positive Youth Development (Benson, Scales, Hamilton, & Sesma, 2006; Damon, 2004) that looks at pathways of thriving individuals in the first two decades of their lives and parallels its origins as a reaction to a prevalence of discussion about “at-risk” youth that ignores positive development. The focus on positive process informs the work presented in this chapter; the underlying assumption is that youth are already using technologies, and can use them even in better ways, if presented with educational opportunities, to construct their sense of identity as having agency towards promoting changes in their own selves and society. This paper presents a measurement

tool that establishes and operationalizes the PTD construct, and in turn provides a way to evaluate outcomes of technologically rich educational experiences for youth.

Since the early 1960s, the growing field of educational technology has developed assessment instruments to examine how learning with and about computers happens based on the constructs of computer literacy and technological fluency. From an outsider's perspective, both constructs are similar and both address the questions of what it means to successfully use technology for teaching and learning (Committee on Information Technology Literacy, 1999). However, there is a difference between these constructs. Computer literacy, defined by researchers such as Luehrmann (1981, 2002), Hoffman and Blake (2003), and Livingstone (2004), is about developing instrumental skills to improve learning, productivity, and performance by mastering specific software applications for well-defined tasks, such as word processing and e-mail, and knowing the basic principles of how a computer works. Technological fluency includes instrumental skills but focuses on enabling individuals to express themselves creatively with technology (Papert, 1980). The concept of technological *fluency* (in contrast to mere *literacy*), as introduced by Seymour Papert (1980), described fluency as the ability to use and apply technology as effortlessly and smoothly as people use language.

Recent research has also suggested that in addition to computer literacy and technological fluency, students' attitudes toward computer technologies may also influence their use and experience of computer and technology-mediated learning (Coffin & MacIntyre, 1999; Tsai, Lin, & Tsai, 2001). Because of the changing digital media and technology-rich environment that surrounds today's youth, the use of technology is multifaceted (Jenkins, 2006). The ability to use technology meaningfully in the context of learning no longer rests only on skills, but also on a variety of psychosocial and emotional factors. Teasing apart these various dimensions is an

important task in understanding the sources of variations among youth's attitudes toward technology use and self-efficacy.

For instance, gender differences in students' technology use have been a topic in the literature in the past decade (Kafai, 1996; 1998). When taken as a whole, many researchers have found that male students tended to score more positively in attitude toward technology or higher in technology self-efficacy tests than female students. However, recent studies have taken a closer examination of this gender issue and found that gender differences may be rooted in terms of approach and goals (Ching, Kafai, & Marshall, 2000). Gunn (2003) argues that male students tend to take a more exploratory and developmental approach and are less swayed by technical problems, whereas female students are more practical and instrumental in their technology use. Because there is evidence to suggest differences in various aspects of technology use, research must take steps to pull apart these various dimensions of the use of technology.

Given the multitude of contexts and purposes for which youth utilize computers for learning (both in and out of school), our comprehension of their technology-related behavior must now expand beyond computational literacy and fluency. While cognitive factors are important, the social, cultural, emotional, civic and moral dimensions of technology use should also be acknowledged. The construct of positive technological development (PTD) was developed to provide the theoretical basis to design and evaluate technology-related experiences that take into consideration the individual attitudes and the psychosocial processes influencing the positive uses of computers by youth in the context of their developmental trajectories (Bers, 2008).

PTD attempts to describe youth development in technology-rich settings while acknowledging that computers use is no longer limited to teaching and learning in school

settings. Young people use computers at home, at work, in the library and in after-school settings. They use them to communicate with friends, to listen to and exchange music, to meet new people, to share stories with relatives, to organize civic protests, to shop for clothing, to engage in e-mail therapy, and to find romantic partners (Subrahmanyam, Greenfield, Kraut, & Gross, 2001). While all these activities involve both computer literacy and technological fluency, the skill set needed goes beyond them. PTD describes the process of youth development in technological settings, and provides a model for how development can be enhanced by promoting certain individual and social assets. For example, positive technological development involves developing competence and confidence regarding computer use. However, it is also important for youth to develop character traits that will help them use technology safely to communicate and connect with other people, and to envision the possibility of making a better world through the use of computers (Ribble, Bailey, & Ross, 2004; Bers, 2008). PTD is in alignment with current ICT standards, such as the *Framework for 21st Century Learning*, that emphasize the integration of both the technical skills of digital technologies and an understanding of the ethical and social issues surrounding the use of such tools (Partnership for 21st Century Skills, 2007).

Theoretical Framework

Positive technological development (PTD) draws on two bodies of work: Papert's (1980) constructionism, which looks at the role of computers in education, and the positive youth development approach proposed by applied developmental science (e.g., Lerner et al., 2005). Following Piaget, constructionism might best be defined as a constructivist philosophy for educational technologies. However, while Piaget's (1953) theory was developed to explain how knowledge is constructed in our heads, Papert (1980, 1993) pays particular attention to the ways

that such internal constructions are supported by constructions in the world, for example through the use of computers. By creating an external object to reflect upon, people are more likely to construct internal knowledge and develop technological fluency in a playful way (Renick et al., 1996). Thus, constructionism is both a theory of learning and a strategy for education.

Constructionism informs PTD by focusing on the design of computational tools for learning (Barab & Squire, 2004; Collins, Joseph, & Bielaczyc, 2004) and by providing guidelines for the development of technologies for exploring issues of self and identity (Bers, 2001; Bruckman, 1998; Bryant, Forte, & Bruckman, 2005).

While historically the computer literacy movement has taken an ethically neutral approach, PTD as a framework for design, implementation, and evaluation takes a stance regarding positive ways for youth to engage with technology. PTD is guided by current research on positive growth in developmental science and developmental psychology. Applied developmental scientists look at cognitive, personal, social, emotional, moral and civic characteristics of young people to study positive youth development (Lerner, Wertlieb, & Jacobs, 2003). The use of the term “positive” connotes the promotion of valued characteristics and activities (i.e., developmental assets) that would lead a young person toward a good developmental trajectory (i.e., development toward improvement of one’s self and society). Researchers in developmental science (e.g., Damon, 2004; King & Furrow, 2004; Larson, 2000; Theokas & Lerner, 2006; Scales, Benson, & Mannes, 2007) contrasts the positive youth development movement as fostering and engendering healthy behaviors with the prevention model that targets risky youth before these behaviors even appear. Recent research by Lerner et al. (2005) frame the various developmental assets into the six “C’s” of positive youth development: competence, confidence, character, connection, caring, and contribution.

Researchers see pathways to promote thriving individuals as the basis for developing personhood and a civil society. Taken together, these characteristics reflect a growing consensus about what is involved in healthy and positive development among people in the first two decades of their lives and the promotion of healthy communities (Scales, 2000). This multi-dimensional framework for thinking about young people's experience is particularly important in today's technology use. As new technologies are developed, young people appropriate them in different ways, even subverting the original intent of the designer, to satisfy their own developmental and contextual needs. Thus understanding the multiple ways in which technology can have a positive impact is an important task for researchers interested in the role of technology in identity construction. While the six "C's" were first theorized to describe the different aspects of young people's day-to-day experiences, the PTD framework extends them to those specific experiences that are mediated by computer technologies.

Drawing upon an interdisciplinary and integrative look at constructionism and applied developmental science, the positive technological development (PTD) framework offers a way to understand positive youth development in a technology-rich context. PTD is both a theoretical construct and a proposed pathway in which opportunities for promoting the six C's are encountered through participation in technologically-rich intervention programs that support positive behaviors through engagement with computers and other innovative technologies (Bers, 2006). The six constructs that compose PTD are defined in Table 1. These constructs form the basis of the Positive Technology Development Questionnaire (PTDQ) for measuring change after an intervention. The PTDQ provides a window into identity in two ways: (1) at the intrapersonal level, by including information regarding an individual's feeling of comfort and skill with the use of technology and her sense of moral compass, and (2) at the interpersonal

level in terms of increased agency that technology can provide towards caring, connecting and contributing to others.

Measuring Factors and Correlates

The Positive Technological Development Questionnaire (PTDQ) was constructed based on the PTD framework to provide a way to measure the multifaceted use of technology in learning contexts in a way that is relevant to the 21st century. To this end, the PTDQ uses an applied developmental science approach while drawing on existing theories regarding technological fluency and literacy. Understanding that youth development is contextualized and multifaceted, the PTDQ is framed by the six C's as proposed by the applied developmental sciences framework and brings together existing technological literacy and fluency constructs in a way that appreciates the inter-relatedness among the different constructs in the context of technology use.

Currently there are a number of measurements proposed to assess individuals' "technological abilities" in a variety of ways depending on the particular theoretical framework from which the measurement is created. Some measurements are designed to assess an individual's ability to operate the computer and the Internet. For example, Turner, Sweany, and Husman's (2000) Computer Interface Literacy Measure evaluates students' ability to navigate the graphical user interfaces of basic operating systems, standard applications, and the Internet. However, as computer technologies develop and new tools and paradigms emerge, knowledge in basic operation may not be enough. Bunz (2004) extends on mere interface literacy to include network-based technologies as part of what is deemed important "technology skills." His Computer-Email-Web (CEW) fluency scale is developed with the understanding of the importance and pertinence of Internet technologies in young people's lives. The PTDQ draws

and adapts these measurements and, using the vocabulary of the applied developmental science approach, frames these constructs as *technological competence*. For example, the PTDQ proposes statements such as, “I am able to create or design projects on the computer from an idea to a finished work,” on a 5-point Likert scale.

Cassidy and Eachus (2002) go beyond basic operation to include self-efficacy (or self-efficacy beliefs) to be a necessary component for successfully using computer technologies to complete tasks. Their Computer User Self-Efficacy (CUSE) scale has been widely used to help educators identify students who may have difficulty engaging with technologies in their learning environments. The PTDQ adapts the constructs and items from this work and frames them as technological confidence defined as the assurance or consciousness of one's powers of reliance on oneself to learn and accomplish certain tasks using technologies, rather than the ability to know how to do them now. An example confidence scale item is, “I feel confident that I can learn how to use a new computer program.”

The increase of both technological competence and technological confidence are evaluated in most educational programs that focus on promoting technological fluency and computer literacy. However, most recently, with the surge of Web 2.0 technologies and the emphasis on collaborative and cooperative learning paradigms, researchers started to focus on social aspects in learning with and about technology.

Scholars in the field of computer-mediated communication (CMC) began to develop constructs and measurements that focus primarily on the Internet as a unique social phenomenon. Rather than evaluating uses of standard computer usage such as word processing or computer programming, CMC scholars focus on networked-based uses of computers to mediate communication and peer relationships (Herring, 2002) and have developed constructs such as

Internet Social Capital (Williams, 2006). By evaluating technologies as tools to bridge relationships and bond with others, Williams and others (e.g., Kraut et al., 2002) found that contrary to common criticism of Internet communication (e.g., Putnam, 2000), online bonding or online in-group activities do not predict insularity. Furthermore, there is a strong and significant positive relationship between bonding with similar in-group online peers (such as peers through video games, interests and hobbies, etc.) and bridging to make contact with people unlike oneself and meeting new people. Spitzberg (2006) developed the computer-mediated communication questionnaire (CMC) to measure knowledge about uses of networked computers for CMC purposes as well as levels of motivation. CMC scholars argue that in today's technology-rich environment, not only are computer technologies used for computation and processing tasks, but they are also tools for connecting and bonding with others. Using the applied development science vocabulary, we frame these constructs in our PTDQ as *technological connection* and *technological caring*. While the connection items focused on one's use of technologies to affiliate with others and participate in affinity groups, the caring items focused on building emotional ties with other individuals and using technologies to show signs of care and assistance. For example, items such as, "I use the computer to be part of different groups and communities" is used to measure the connection construct, whereas items such as, "I use the computer to learn more about the people who I care about" and "I am part of a virtual community on the Internet where I give and receive advice" are used to measure caring.

Finally, Jenkins et al.'s (2006) work on New Media Literacies (NML) illuminates a new set of skills to the healthy social and educational development of today's young people. Competencies such as collective intelligence and appropriation are argued to foster "good" uses of technologies to promote community involvement, and competencies such as judgment and

negotiation promote “good” decision-making. In a related study, Gardner’s (2008) GoodPlay project also taps into the various ethical dimensions in the digital media experiences of today’s youth, and primarily focuses on aspects such as authorship, participation, identity, credibility, and privacy. While there is no existing scale that specifically measures these constructs, our PTDQ frames these ideas as *technological contribution* and *technological character*, respectively. The contribution dimension includes items such as, “I can give back to my community using my computer and/or my computer skills,” and the character dimension includes statements such as, “I do not engage in behaviors that I think are bad when using computers.”

We have previously piloted the PTDQ for evaluating robotics-based educational interventions with young children and their parents (Bers, 2008, 2007; Chau & Bers, 2006) and for measuring developmental trajectories in young adults’ attitudes and use of technology for engaging in community activities (Chau, 2006). This chapter presents a study assessing the validity of the hypothesized six C’s structure behind the PTDQ and supports the findings with qualitative data.

We first present a confirmatory factor analysis (CFA) to examine the hypothesized structure of the PTDQ. CFA is factor analysis method that allows researchers to test whether a proposed theoretical factor structure is supported empirically. Here, the proposed structure is a six-factor structure (i.e. the six C’s). By applying CFA to the PTDQ, we are able to examine whether the six C’s “exist” within the PTDQ as well as the strength of the factors as individual, but interrelated constructs.

Following the CFA, we examine gender differences in the relationship between the six C’s and youths attitudes towards technology. Given the evidence in the literature that points to

potential gender differences in students' attitude towards technology use, we were interested in providing a working example of how the PTDQ could supplement previous work and help understand how males and females differentially experience enjoyment regarding their use of technology. The goals of this second analysis are twofold. First, to further the process of validating the PTDQ by examining its relationship with other constructs related to technological development. Second, to demonstrate the utility of the PTDQ in applied settings as a tool that can be used to evaluate differential positive uses of technology by youth .

Method

Participants

The Positive Technological Development Questionnaire (PTDQ) was administered to 188 undergraduate students enrolled at a liberal arts university in Northeast United States. The study recruited freshman students during orientation as they registered for orientation activities to participate in a questionnaire survey as part of a study to examine the extent to which computer and related technologies can facilitate social and civic engagement on campus (Bers, 2007; Bers, 2008). All participants volunteered to complete the survey questionnaire without incentives.

In the current analysis, only questionnaires with 90% completion (i.e., 24 out of 27 questions answered) were included to optimize the validity of the results. These criteria left us with a total of 186 participants. The final participant group was comprised of 103 (55.40%) females and 83 males (54.60%) and ranged in age from 17-24 with a mean age of 19 ($M = 19.01$, $SD = 1.74$). The sample was 62.9% Caucasian, 8.4% Asian American, 5.4% Latino American, 5.4% African American, and 17.8% bi-racial or other. Among the participants, 15% were engineering students, 81% students of Arts and Sciences, and 4% undecided. In order to

minimize selection bias, recruitment specifically targeted students enrolled in a variety of orientation programs including a technology-based civic engagement program (19.35%), a fitness program (38.71%), an outdoor exploration program (9.68%), and others (32.25%).

Measure

The PTDQ is comprised of 27 items that tap into the six C's (caring, character, competence, confidence, connection, and contribution) of positive technological development. Participants were given the instructions, "Below are some statements about your attitudes towards technology. Please let us know how much you agree with each statement." Participants respond to each item statement using a 5-point Likert scale where a response of 1 indicated strong disagreement with the statement and a response of 5 indicated strong agreement with the statement. As a scale, sum scores of the 27 items may range from 27 to 135. For this current sample, sum scores on the PTDQ ranged from 49 - 134, with an average total score of ($M = 89.72$, $SD = 20.54$). This reflected an item average of 3.25 for the sample, indicating that this sample does not represent the floor of the scale. Potential limitation to the generalizability of this study is addressed in the Discussion. The full PTDQ is presented in Appendix A.

In addition to this questionnaire, participants also completed a standard demographic questionnaire including age and gender, as well as a nine-item scale that addressed various aspects of math, science, technology, and engineering activities. Of this nine-item scale, because the current study primarily focuses on students' use of and attitudes toward technology, only the item, *enjoyment in technology use* ("I enjoy using technologies and computers") is included in this analysis.

Results

Statistical Validation of the PTDQ

A series of confirmatory factor analyses (CFA) were conducted using the software package, MPlus 4.1 (Muthén & Muthén, 2007) to examine the validity of the theorized six C's model of positive technological development thought to underlie the PTDQ. Model fit was assessed using four fit statistics: chi-square (χ^2), Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). A non-significant χ^2 value suggests a good model fit. However, because χ^2 is highly sensitive to sample size, the ratio of χ^2 to degrees of freedom (df) was used to evaluate the model. A χ^2/df value between 2 to 3 indicates good model fit (Carmines & McIver, 1981). RMSEA scores < .05 suggest "good" fit, scores between .05-.08 suggest "moderate fit," and scores between .08-.1 suggest "adequate" fit (Brown & Cudeck, 1993). On both the TLI and the CFI, values > .9 indicate good model fit (Hu & Bentler, 1999).

Factor analysis typically involves testing a series of models, using the findings from each model to inform modifications of subsequent models. Examples of modifications that may be made in this process include deleting questionnaire items all together, or moving individual questionnaire items to be associated with a different factor. All model modifications should be based both on data and on theory. For example, a questionnaire item that read, "I know how to make computer projects (e.g. images, animations, songs, videos, robotic constructions) to express things that I value," was associated with "character" in our original model. Results from the CFA, however, suggested, that this item was a stronger predictor of "competence." As a team, we determined that such a modification to the questionnaire would make sense theoretically, and moved this item to be connected with competence.

In our CFA procedure, 5 items from the PTDQ were demonstrated to be significantly associated with several factors, rather than with a single factor. As such, these items were

removed from the model, and the questionnaire. The final model of the PTDQ presented in this paper (see figure 1) includes 22 items. The CFI and TLI fit indices of the final model suggested good model fit ($\chi^2/df = 2.134$; CFI=.901; TLI=.882; RMSEA=.078). A thorough review of the results did not suggest additional changes that would both improve model fit and hold up theoretically. The CFA procedure is based on the tenants of regression analysis and its output can be similarly interpreted (Kline, 2004). For example, item four is associated with “caring” and has an R^2 value equal to .336. Following the same procedure you would use to interpret a regression analysis, it can be deduced that item four accounts for 33.6% of the variance in the construct, “caring.” A complete report of individual item means, standard deviations, standardized beta coefficients and R^2 values can be found in Table 2.

To further test the reliability of the model structure suggested in the final CFA model, Cronbach’s alpha coefficients, which measure the internal consistency of a scale, were calculated for each of the six C’s (Cronbach, 1951). The alphas for character ($\alpha=.735$), competence ($\alpha=.904$), confidence ($\alpha=.892$), connection ($\alpha=.813$), and contribution ($\alpha=.814$) all exceeded .70, suggesting “good” internal consistency. The alpha for the caring scale ($\alpha=.608$), suggested a “fair” internal consistency. Please see Appendix A for a complete list of questionnaire items and their corresponding and final factor association.

Gender Differences in Technology Use

After the confirmatory factor analysis procedures established a measurement model, participants’ data were aggregated to provide six sub-scores of PTD. Ordinary least squares (OLS) regression analyses were conducted to examine the moderating effect of gender differences on the relationship between the six positive technology development constructs and participants’ enjoyment of technology use.

Among female participants, the overall regression model was statistically significant, $F(6, 87) = 7.89$, $p < .001$, $R^2 = .40$. Among the six C's, only the confidence scale significantly predicted female participants' enjoyment of technology use (see Table 3). This significant positive association between female participants' technological confidence and their enjoyment using technology, when controlling for all other Cs, suggested that despite variations in female participants' level of competence in technology, their confidence made the largest contribution to their reported enjoyment. This finding is consistent with literature cited earlier in the introduction regarding the importance of the confidence factor when understanding women and technology, and echoes works by researchers such as Bannert and Arbinger (1996), Cassell and Jenkins (1998), and Cooper and Weaver (2003) that suggest female students' attitudes and relations toward technology could be largely attributed to the extent to which they could realize and recognize their technological abilities and skills.

The regression model for male participants was also statistically significant, $F(6, 54) = 8.54$, $p < .001$, $R^2 = .49$. Whereas only the confidence factor was a significant predictor of enjoyment of technology use among female participants, results showed that character, competence, connection, and contribution factors were all highly predictive of male participants' enjoyment of technology use (see Table 3). These results indicated that there is a significant moderating effect in the relationship between the six Cs and enjoyment of technology use. Caring was not found to be a predictor for either males or females. These results might be due to several reasons that will be discussed in the future work section.

Guiding Program Development

This section presents a case study to illustrate how the PTD framework can be used to implement a particular technology-based youth program to reflect the various factors associated

with positive youth development. The Active Citizenship through Technology (ACT) was a pre-orientation program designed for incoming freshman to a northeastern university (Bers, 2008) to explore issues of civic engagement and community. Students came together for three days and used the Zora virtual environment (Bers, 2001) to create a campus of the future, engage in exploration of the role of the university in promoting civic engagement with the community, and build a peer-social network before the stress and demands of the academic year begin. The ACT program is designed so students, in the process of developing their campus of the future, can first learn about the real campus by interviewing faculty, students and administrators, and then discuss how they could improve its facilities, its policies and curricular offerings, and explore the relationship between their campus and the local neighborhoods and communities. The goal is to immerse youth in a high-tech playground where they can acquire civic knowledge and skills, as well as experiment with civic behaviors and democratic participation.

The design of the intervention was informed by the PTD framework and activities were implemented to address each of the C's of the theoretical model. In terms of **Competence** and **Confidence**, students used the Zora tools to create a virtual campus similar to the ones they know, with spaces such as the Mike Jonas Student Center, the Math and Science Building, the Orwell Language Hall, the Winifred Mandela Library, and the Jumbo Appetite, a dining hall where "themed meals are served and a suggestion box [is provided] where requests for particular food can be made." But the students have also developed virtual exhibits to educate students, faculty, and community members about issues of concern to all. In terms of **Connection**, students used Zora to find peers who were interested in similar issues and together they created their Zora projects - virtual exhibit halls to display information, research and ideas about an area of interest. For example, a student was interested in the arts and invited other participants to

collaborate with her to create the Art and Community House. The following log excerpt shows the Zora-supported collaborative process they engaged in to build the house:

Mary: Arts are slowly disappearing in schools

Tom: Because it's mostly money oriented, the arts don't bring as much as football games

Brittany: I know that certain school districts on long island have had to cut out arts programs

David: It is the same here

Mary: Why did they cut the budgets?

Brittany: There just wasn't enough money coming in from the state I guess for funding

Mary: but why couldn't they just cut the other stuff as well?

David: spending too much on other things...they figure its easier to get rid of the public art education

Mary: it's really sad that politics has infiltrated the school system

David: there are plenty of private places but people have to pay more and obviously they don't like that

Alex: so what are we doing?

Danny: earth to jenny: politics and public schools are obviously linked

Tom: Now that some of us have a topic that fire us up, what should we do? Go off and build and make our case house?

Mary: who wants to work with me on the arts?

Brittany: let's put pictures of art and theater and music up.

The resulting Art and Community House contained 58 objects, including 19 message boards each with a piece of information regarding funding, school, and the arts (e.g., results from Gallup

polls, statistics about slashing of funding in various states, and various venues in which the university could take action in bringing arts and music to the community and its citizens); 17 photographs and images of various types of arts and related subjects (e.g., a child playing the piano, a ballerina, the logo for Americans for the Arts, a local community performance space) each accompanied with a description; as well as various 3D objects such as music notes and dancing characters to populate the room. Figure 2 illustrates a screen capture of the Arts and Community House in the Zora virtual environment. As shown by this example, students were able to connect with each other based on shared interests and engage in a collaborative project.

In terms of **caring**, students were active in online chat. For example, the Zora Activity Log recorded 3612 lines of chat over the three days. They discussed issues such as student life, policies/rules for graduation, Internet, administration, and student services. Following is an excerpt of a conversation in which students discussed funding for students' clubs, showing their caring about the well-being of the community.

Peter: Are we going to have fun student clubs? Do clubs have to give back to the community?

Melanie: If you are giving back to the community, should you get more money?

Alan: Should we fund the clubs?

Peter: Every year, they give their proposal...then they decide...and get their permission.

David: If you are giving back to the community, you should get money. Why put money into clubs?

Peter: If it lasts then that is good; but if you are new, you start-off with the minimum amount.

In terms of **character**, students used Zora's values dictionary feature to think about personal and moral values that their virtual campuses of the future should cherish. For example, they logged 36 values entries and 80 definitions in the values dictionary. Some of the values were academic curiosity, defined as "keeping your mind open to diversity in learning," integrity, defined as "keeping to ones morals," tolerance, defined as "the ability to not allow differences to get between you and others," and trust, defined as "knowing that others will not take advantage of your vulnerabilities."

In terms of **contribution**, students proposed recommendations of how their future virtual campus could make an impact in the socio-economic situations in the neighborhood communities. For example, some students chose to focus on the relationship between the local town police and the university police by interviewing police officials to understand better if and how the surrounding communities benefit from the campus police. Based on this information, participants created a virtual exhibit hall called the Police case study. This house contained 23 objects, of which there were four message boards at each of the corners to represent four discussion topics. At each corner were related images and photographs as well as 3-D objects to provide visual support for the discussions. The topics included a comparison of salaries between the university and public police forces. This discussion topic was accompanied by statistics and graphs about salaries as well as graphics and text images displaying the types of jobs and roles at each of the police forces. In another corner was a discussion about jurisdiction for on campus violations such as "dealing with alcohol [abuse] on campus." To illustrate an example, participants included photographs of beer cans and the game *beerpong* to accompany this topic,

as well as a 3-D structure illustrating the game in action. There was also a topic about how the two forces can work together to address university students' violations in the community such as noise and complaints by community citizens. Images of recent news photographs were displayed along with the message board to provide some relevance of the topic and the pertinence to these particular students. Finally, a display about the types of crimes that students have committed on campus and in the neighborhood communities accompanied by charts and web links was created in the last corner.

Other students chose to focus on the role of the universities, in particular the education, child development and psychology departments, to provide childcare and educational opportunities for members of the surrounding communities. The resulting virtual public house (Fig. 3) was called *No Preschooler Left Behind* and had a welcoming description, "We believe that kids should be allowed to keep their arms and legs to get quality childhood education." Besides police and early education, some students chose to do research about public interest issues such as the impact of comprehensive exams in the learning environment and state-mandated curriculum, and the positive impact that athletics programs and art education programs can have on a local community. Instead of writing ideas and results of their research in a paper or action plan, they used Zora to develop a virtual exhibit to teach others about their findings. For example, the high-stake testing MCAS house was populated by a series of five images of bar graphs and accompanying message boards to discuss about differences in standardized test score results in the five communities neighboring the university. There was also a *Test Your Knowledge* corner where questions from recent standardized tests were posted and visitors were encouraged to try out some of these test questions and comment their thoughts about the test. In

another corner of the house a participant linked from an external website a video presentation about the standardized testing practice as well as web links to official web pages of the state.

The ACT pre-orientation program provides an example of how the PTD theoretical construct can guide the design and evaluation of an intervention program aimed at engaging youth in using technologies in positive ways. While ACT focuses on providing opportunities to use the Zora virtual environment for civic engagement with college students, other programs developed within the PTD framework can utilize the PTD constructs to put their own values-in-practice while utilizing a wide range of technologies.

Discussion

This chapter reports an effort to theorize and validate a new instrument that measures positive technological development. The PTDQ aims to bring the multifaceted approach of applied developmental science to our understanding of the role that technology may play in the lives of individuals, in particular with regards to their own self improvement and contributions to society. Both dimensions, the intrapersonal and the interpersonal are important to consider in an integrated way when thinking about identity. While it is indeed needed that young people become technologically fluent, especially in today's technology-rich and technology-dependent society, our goal is to extend beyond an ability to use technology to also focus on using technology to make positive contributions to the development of self and of society. The six C's of positive technological development, as we have conceptualized here, provide a framework for supporting this work and the PTDQ provides a way to measure change after an intervention. As the fields of education and new areas such as cyberpsychology start to tap into the potential of new technologies to provide or augment programs aimed at helping young people construct their

sense of identity, the PTD framework and its derived instrument present new opportunities for conceptualizing programs to support differential positive uses of technology by youth and differential ways to evaluate success and failure of the interventions with regards to each of the desired domains of impact, represented by the six C's.

Results from the confirmatory factor analysis support the validity of the hypothesized six C's structure of the PTDQ. In addition, the Cronbach's alpha scores calculated in alignment with the final model structure ranged from .608 to .904 and support the reliability of each of the six individual scales that make-up the PTDQ. Furthermore, the second set of regression analyses illustrated the utility of the PTDQ for examining the multidimensionality of technology use when measuring participants' enjoyment or attitudes about technology. Results showed that among females, confidence is a highly significant predictor of enjoyment of technology use. On the other hand, when considering the male sample, character, competence, connection, and contribution were all strong predictors for enjoyment. By examining the individual facets or factors the overarching construct of positive technological development, this analysis was able to identify sources of gender difference in students' attitudes toward and engagement with technology. Results for these analyses further add to the current discussion about the sources and bases for gender differences, digital divide, and participation gap. By identifying relevant social and personal factors (connection, caring, character, and contribution) in addition to the traditional cognitive factors (competence and confidence) that are typically accounted for by the literacy and fluency frameworks, this study illustrates and further supports the multifaceted nature of the relationship between technology and youth development. Further research and in-depth analyses are needed to examine how these developmental factors may influence actual

usage of technology, and in turn, how variations in youth technology use contribute to different developmental outcomes.

One limitation to the present study is the relatively small sample size ($N=186$). While the current findings suggest preliminary support for the proposed six-factor structure of the PTDQ, it is thought that future examinations of the PTDQ using larger and more diverse samples will further substantiate the six C's model of positive technological development. This particular sample also reported relatively high average total score ($M = 89.72, SD = 20.54$), indicating a mean of 3.23 at the item level. Not only might social desirability effects have contributed to students reporting higher scores, the use of a college student sample also limited the generalizability of this study to the other populations. In addition, because the goals of this study were mainly to assess the PTDQ, participants were not asked to report in detail their actual technology use such as time spent using technology; types of activities engaged with technology other background variables such as classes taken that might have influenced their attitudes; etc. These are important variables to consider when measuring attitudes and enjoyment.

By integrating constructs from the applied development science literature with the educational technologies and the computer mediated communication literatures, the PTDQ can be used by educational technologists, and experts in youth development and communication media researchers to understand the various ways in which technologies can promote positive youth development. The PTDQ can be used to measure change from before to after a technology-rich educational intervention and can guide the development of a technology-rich curriculum to explore the six dimensions of positive technological development. While the present confirmatory analysis demonstrates the validity and reliability of the PTDQ for the college-age youth described above, in order to understand how young people are using

technologies for their psychosocial development, it is best to integrate the use of the PTDQ with qualitative methods for data collection that provide ethnographic insights into young people's ways of thinking about technology in their lives.

Future Directions

The work presented in this paper introduces the research construct of Positive Technological Development and the validation of an instrument to evaluate it. PTD is an attempt to develop a theoretical framework that integrates both psychological and sociocultural dimension of identity. Thus the emphasis is on investigating both intrapersonal characteristics that might impact the use of technology (such as competence, confidence and character) and interpersonal ones (such as caring, connection and contribution) that situate the individual within a larger social context. The PTD framework acknowledges the cognitive aspects of technology use such as skills, fluency, and decision-making, as well as contextualizes the use of technology within a social and civic ecology, promoting relationships and civic actions. In addition to shifting the discussion of youth development and youth technology use from the deficit paradigm to a positive and asset promotion discourse, this study also highlights the necessity for researchers to look at technology use through a multi-dimensional lens. Not only did the analysis reveal the utility of a measurement that could help partial out factors contributing to variances and gender differences in technology use and attitudes, it also identified places for education, intervention, and promotion. For example, results from this study called attention to the relationship between female enjoyment of technology use and their technological confidence, despite varying levels of competence. It is our hope that future work in the area of technology and identity will help shift away the public discourse from deficit models that depict youth's use of technology as associated with negative personal and social outcomes.

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Tables, Figures, and Appendix

Table 1. *Definitions of the Six C's of PTD.*

Table 2. *Descriptive Statistics, Standardized Structure Coefficients, and R² values for the Final CFA Model.*

Table 3. *Regression Analysis for Predicting Enjoyment of Technology Use with the 6Cs of PTD by Gender.*

Figure 1. Final structural model of the six C's of PTD (Model 4).

Figure 2. A virtual house in the Zora environment about bringing drama into the community.

Figure 3. A virtual house in the Zora environment about educational issues in the community.

Appendix A. *The Positive Technological Development Questionnaire (PTDQ).*

Table 1. *Definitions of the 6 C's of PTD.*

<u>Definitions</u>	
Competence	An ability to use technology, to create or design projects using the computer in order to accomplish a goal, and to debug projects and problem-solve.
Confidence	A sense of oneself as someone who can act and learn to act successfully in a technology-rich environment and find help when necessary and have perseverance over technical difficulty,
Caring	A sense of compassion and willingness to respond to needs and concerns of other individuals, to assist others with technical difficulties, and to use technology as means to help others.
Connection	Positive bonds and relationships established and maintained by the use of technology.
Character	Awareness and respect of personal integrity and moral and social values while using technologies in responsible ways and an ability to express oneself using technology.
Contribution	An orientation to contribute to society by using and proposing technologies to solve community/social problems

Table 2. *Descriptive Statistics, Standardized Structure Coefficients, and R² values for the Final CFA Model*

Initial		Standardized				
Item #	Factor	M	S.D.	Beta Coefficient	Z-Score	R ²
1	Caring	3.31	1.02	0.311	0.00	0.097
4	Caring	2.50	1.41	0.579	4.56	0.336
8	Caring	2.92	1.12	0.588	5.30	0.346
18	Caring	3.10	1.21	0.581	4.95	0.338
3	Character	3.65	1.12	0.695	0.00	0.484
17	Character	3.38	1.13	0.793	12.79	0.629
22	Character	3.46	0.97	0.572	8.54	0.328
9	Competence	3.34	1.25	0.781	0.00	0.610
11	Competence	2.76	1.29	0.752	12.05	0.566
12	Competence	3.04	1.35	0.871	15.80	0.759
15	Competence	2.97	1.41	0.853	16.55	0.727
21	Competence	2.96	1.26	0.787	12.94	0.619
2	Confidence	3.76	1.05	0.804	0.00	0.646
10	Confidence	3.87	1.12	0.869	14.65	0.756
16	Confidence	3.68	1.10	0.906	16.22	0.821
5	Connection	3.08	1.44	0.679	0.00	0.461
13	Connection	2.09	1.25	0.631	7.85	0.398
19	Connection	2.88	1.21	0.700	9.26	0.489
6	Contribution	3.67	1.18	0.714	0.00	0.509

Comment [CC1]: This table is very comprehensive. I wonder, what would be the disincentive for putting the entire instrument in an appendix? There are only 26 items, right? It would certainly fit.

7	Contribution	3.97	0.91	0.579	8.75	0.336
14	Contribution	3.02	1.25	0.862	11.66	0.744
20	Contribution	3.82	1.05	0.622	8.41	0.387

Table 3.

*Regression Analysis for Predicting Enjoyment of Technology Use with the 6Cs of PTD by**Gender*

Variables	B	SE B	β
Male Participants			
Caring	.23	.18	.22
Character	.71	.22	.52**
Competence	-.35	.17	-.39*
Confidence	.27	.20	.21
Connection	-.38	.16	-.34*
Contribution	.38	.19	.34*
Female Participants			
Caring	.21	.18	.17
Character	.20	.19	.15
Competence	.001	.13	.001
Confidence	.32	.19	.35**
Connection	-.06	.13	-.05
Contribution	.13	.13	.12

*Notes. $R^2 = .46$ for male participants; $R^2 = .40$ for female participants.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Comment [bjf2]: Reported earlier as .35

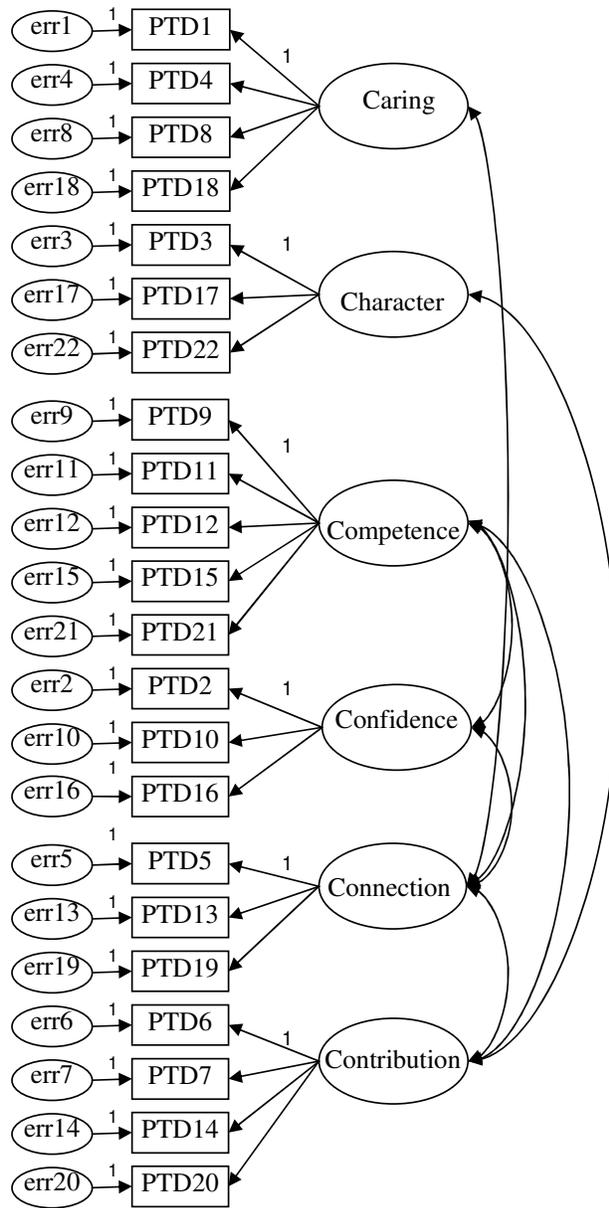


Figure 1. Final structural model of the six C's of PTD (Model 4)



Figure 2. A virtual house in the Zora environment about bringing drama into the community.



Figure 3. A virtual house in the Zora environment about educational issues in the community.

Appendix A. *The Positive Technological Development Questionnaire*

-YOU AND TECHNOLOGY-

Below are some statements about your attitudes toward technology, please let us know how much do you agree with them on a rating scale from 1 (strongly disagree) to 5 (strongly agree).					
	Please circle One				
1. When working with someone on the computer, I make sure that they understand everything I am doing.	1	2	3	4	5
2. Learning about technology is easy for me.	1	2	3	4	5
3. I can express my ideas, my values, and myself by using the computer.	1	2	3	4	5
4. I am part of a virtual community on the Internet where I give and receive advice.	1	2	3	4	5
5. I have met new people through the use of computers.	1	2	3	4	5
6. I can imagine ways of using technology to make the world a better place.	1	2	3	4	5
7. I believe that by using new technologies people can find new ways to contribute to their communities.	1	2	3	4	5
8. It is important for me to teach others the things that I already know about computers.	1	2	3	4	5
9. I am able to create or design projects on the computer from an idea to a finished work.	1	2	3	4	5
10. I feel confident that I can learn how to use a new computer program.	1	2	3	4	5
11. I can debug or fix computer projects or programs when something goes wrong.	1	2	3	4	5
12. I know how to make computer projects (e.g., images, animations, songs, videos, robotic constructions) to express things that I value.	1	2	3	4	5
13. I have found support groups on the Internet.	1	2	3	4	5
14. I can contribute to my community using my computer and/or my technical skills.	1	2	3	4	5
15. I know how to make or design my own projects with computers (images, animations, songs, robotic constructions).	1	2	3	4	5
16. I feel confident that I can figure out how to use new features of a program on my own.	1	2	3	4	5
17. I am able to learn computer applications that help me express myself in different ways.	1	2	3	4	5
18. I use the computer to learn about the people who I care about.	1	2	3	4	5
19. I actively use the computer to be part of different communities.	1	2	3	4	5

-YOU AND TECHNOLOGY-

20. I can imagine positive ways to use computers for our society.	1	2	3	4	5
21. I have an advanced understanding of how a computer works.	1	2	3	4	5
22. I feel good about myself when using the computer	1	2	3	4	5

Removed Items

##. Because of my technical skills, I can connect with people in many different ways.
##. I use computers to connect with other people who think and feel the same way as I do.
##. I know that I can figure out how to create or design projects on the computer from an idea to a finished piece of work.
##. I know how to use the computer as well as, or better than my peers.
##. I know what is good and bad behaviors regarding the use of Internet.