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The Urban-Rural Gap: Project-based Learning with Web 2.0 among West Virginian Teachers

Abstract: To overcome the digital divide in West Virginia, schools are urged to integrate emerging information communication technologies (ICTs) such as Web 2.0 and alternative pedagogies to develop students' 21st century skills. Yet, the potential effects of digital divide on technology integration have not necessarily been part of planning for professional development programs. As a first step to identify the potential digital divide between rural and urban school settings, this study examined West Virginian teachers' Web 2.0 access levels-namely, motivation, physical, skills, and usage accesses. Analysis of the survey responses from 161 teachers suggested that the divide persisted at physical and usage access levels, signifying teachers' unique needs and conditions for the use of emerging technologies. While teachers' usage access was observed to be a significant factor for their Web 2.0 associated Project-based Learning (PBL), attending professional development programs seemed to minimally benefit such practices.

Keywords: Project-based learning; PBL; Web 2.0, technology integration; professional development

Background

Project-based learning

The idea of Project-based Learning (PBL) can be traced back to John Dewey (1986), who emphasizes the importance of learning-by-doing and experiencing in authentic learning

settings for preparing “the young for future responsibilities and for success in life” (p. 243). Through educational research and practices, PBL has evolved as a teaching approach that applies sociocultural perspective, which highlights collaboration, discovery, and authenticity in the learning process (Bonk & King, 1998; John-Steiner & Mahn, 1996). The interdependence of learners’ individual thinking processes and social interactions with others is central to this perspective (John-Steiner & Mahn, 1996; Vygotsky, 1978; Wertsch, 1991). Learners participate in various shared activities in a social context while transforming their experiences into inner speech and thinking.

In PBL activities, students gain knowledge and skills through a collaborative extended inquiry process into authentic or real-world questions while developing a product, presentation or performance to reflect their solutions to the questions (Blumenfeld et al., 1991; Buck Institute for Education, 2011). While allowing for student "voice and choice," rigorous projects in PBL are carefully designed to help students learn key academic content, develop technology and communication skills, become inventive thinkers, active problem solvers and digital literate citizens (Mergendoller, Markham, Ravitz, & Larmer, 1996). The research in K12 settings demonstrates that PBL can in fact enhance student engagement (Bernt, Turner, & Bernt, 2005; Liu & Hsiao, 2002; Tal, Krajcik, & Blumenfeld, 2006) and autonomy (Worthy, 2000), help develop the 21st century skills (Ravitz, Hixson, English, & Mergendoller, 2012), increase content knowledge and problem solving skills as well as positive attitudes toward learning (Hernandez-Ramos & Paz, 2009; Mioduser & Betzer, 2008), provide reflective experiences (Grant & Branch, 2005), and increase core curricular academic success (Geier et al., 2008).

Despite such benefits, PBL is not an alternative teaching approach for every instructional situation in K12. While direct instruction may be suitable for basic and procedural skills, PBL is more appropriate for complex learning process promoting higher

order thinking especially if sufficient time can be allocated to preparing students to gain the knowledge and skills for successfully completing the projects (Markham, Larmer, & Ravitz, 2003). Once the appropriateness of PBL is justified, a meaningful incorporation of emerging technologies may potentially contribute to its benefits (Moylan, 2008).

Using Web 2.0 for PBL

Read/write web, or commonly called-Web 2.0, a term referring to various emerging web-based applications, enables users to dynamically create and change content on the web. Web 2.0, however, goes beyond merely applications. Tim O'Reilly, who popularized the term Web 2.0, defines it as a set of principles and practices including trusting users as collaborators and co-developers, harnessing collective intelligence, and innovating with mash-ups across multiple platforms and devices (O'Reilly, 2005).

Such affordances have been gaining attention from educators globally, who see the educational potential of applying Web 2.0 in student-centred pedagogies to help achieve learning objectives (Kingsley & Brinkerhoff, 2011). Web 2.0 applications and practices can facilitate learners to share knowledge and develop products through communicating, ideas sharing and collaborative editing and publishing. Wikis, for instance, are believed to foster joined-knowledge construction, diversity of opinions, and decentralized information through collaborative writing while blogs have been considered as a personal knowledge construction place and a participatory platform facilitating student conversation (Norton & Hathaway, 2008; Rosen & Nelson, 2008). Wikis and blogs may be effective for forming student groups, sharing ideas, and keeping track of the project progress part of inquiry process in PBL. Media sharing (e.g., Youtube) and podcasting tools are also viewed as effective for increasing student motivation, fostering articulation, and promoting self-expression (Albion, 2008; Norton & Hathaway, 2008; Rosen & Nelson, 2008). Such tools allow for the generation and dissemination of digital information (e.g., audio, video, or picture), which can help students in

PBL develop products to display and communicate their solutions and presentations.

Moreover, social networking and virtual worlds are considered useful means to facilitate students' informal interactions (Albion, 2008), and immersive simulations have been explored for their effectiveness on increasing student motivation and inquiry skills (Barab & Dede, 2007). Such features can help facilitate collaboration among students and contribute to their project-based learning process.

Despite such potentials of Web 2.0 in PBL settings, barriers exist particularly for using Web 2.0 in learner-centred teaching (Albion, 2008; Paus-Hasebrink, Wijnen, & Jadin, 2010). For example, due to their limited technology access and usage, teachers may see little connections between these tools and their pedagogical use, and their practice may tend to reflect a traditional way of teaching and assessment (Albion, 2008). As observed in a study, which examined the instructional use of wikis in K12 settings, only a few wiki sites designed by teachers promoted students' collaborative learning, while the majority were considered teacher-centred, providing limited opportunities for enhancing twenty-first-century learning skills (Reich, Murnane, & Willett, 2012). Such issues become even more problematic, particularly if teachers are facing digital divide constraints such as limited technology use, limited infrastructure, or lack of technology skills set upon by conditions including rurality and poverty.

Rurality in education

Research in recent years has convincingly established that the digital divide is associated with more than physical and infrastructural access to information and communication technologies (ICTs). It is also associated with demographics, socio-economic background, adoption motivations, computer literacy and digital skills, culture and attitudes toward ICTs (DiMaggio & Hargittai, 2001; Fox, 2005; van Dijk, 2005). When characterizing the digital divide,

scholars emphasize the importance of contextual factors such as education, societal structures, and physical resources (Amiel, 2006; Swain & Pearson, 2002; Warschauer, 2003). Education research have examined the digital divide mainly in terms of (1) access to hardware, software, internet and technology support, and (2) use of technologies by students and teachers (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008; Reinhart, Thomas, & Toriskie, 2011).

While various studies indicate socioeconomic conditions (Hohlfeld et al, 2008; Reich, Murnane, & Willett, 2012; Swain & Pearson, 2002; Valadez & Duran, 2007) and school affluence (Chapman, Masters, & Pedulla, 2010; Reinhart et al., 2011; Wells & Lewis, 2006) as factors contributing to the digital divide in schools, many others point to the effects of geographic areas on technology access and use. Schools in rural areas both within the US and across the globe have been observed to have limited access to technologies such as computer facilities, adequate student software, and high speed Internet connections compared to those in urban locations (Aduwa-Pgiegbaen & Iyamu, 2009; Mutonyi & Norton, 2007; Palamakumbura, 2009; Trinidad, 2007). Teachers in remote parts of Australia, for example, were also found to lack the knowledge of and experience with emerging ICTs (Trinidad & Broadley, 2008). Even when there appeared to be no differences in teachers' preparation for using computers, as Wood and Howley's (2012) study of Ohio schools found, disparities such as training opportunities and availability of computer resources presented constraints for rural teachers, who used technologies in less sophisticated ways in teaching compared to their counterparts in urban schools.

These studies have pointed out that rurality is one of the pertinent concerns with regard to the digital divide in education. But while salient, rurality nonetheless constitutes only part of a myriad of factors influencing the digital divide. Beyond this lies a set of factors that offers a more nuanced understanding of the digital divide in education.

Digital Divide and PBL-based professional development in West Virginia

van Dijk (2005) proposed that ICT access occurs through four successive stages – motivation, physical, skills and usage. The digital divide can occur at each stage so barriers at each access level should be examined (Figure 1). At the first stage, the user must have the motivation to use digital technologies. Flaws in technology such as lack of user-friendliness, usefulness, attractiveness, affordability or safety may foster mental barriers including lack of interest and computer anxiety among potential users. Next comes physical access in the form of possession of computers and Internet connections or permission to use them and their contents. As infrastructure develops, ICTs become more affordable and pervasive, and more people adopt ICTs. Consequently, the divide in the first two stages (motivational and physical) may narrow and access problems will be more prevalent at the last two stages, with a deepening divide in skills and usage access.

Skills access refers to the possession of digital skills to use the technologies (van Dijk, 2005). Such skills include abilities to operate computers and internet applications; search, select, process and evaluate digital information; and use digital resources strategically to attain goals. Inequalities in social and cultural resources that promote intellectual capacities are among the factors responsible for differences in digital skills. Usage access, which is the number and diversity of applications and usage time, completes the final stage of ICT use (van Dijk, 2005). Increasingly, differences in usage in terms of usage time, usage diversity, broadband and mobile uses, and creative uses are more pronounced. Such differences arise from unequal distribution of temporal, social and cultural resources. Unequal access results in differential degrees of participation or exclusion from several fields in society, including the economy, education, social networks, geography, culture, politics and institutions.

-Insert Figure 1 here-

While van Dijk argues that the divide may narrow at physical and motivation levels, and deepen at skills and usage levels, the digital divide especially at the physical level may not be narrowing for teachers. As the aforementioned studies indicated, physical access is still an issue in rural schools. In West Virginia, a largely rural state nestled in the Appalachian mountains of the United States, the digital divide remains an acute challenge to public schools. The geographic isolation and high level of poverty in the state further contribute to a lack of robust telecommunications infrastructure (Appalachian Regional Commission, 2006; US Census Bureau, 2010). West Virginia ranks among the lowest in the US in terms of the number of internet service providers and broadband access, and to prevent the state from further lagging, it is investing in ICT infrastructure development (Miller, 2011). West Virginian public school teachers have also been urged to integrate emerging information and communication technologies and use alternative pedagogies such as PBL to help develop students' 21st century skills and improve student achievement. In 2005, West Virginia became the second state in the country to apply the framework promoted by the Partnership for 21st Century Skills, putting emphasis on communication skills, critical thinking, and ICT literacy (West Virginia Department of Education, n.d.a).

As part of these efforts, the West Virginia Department of Education has been training over 1200 teachers over the past few years, focusing on project-based learning and incorporating 21st century tools in pedagogy (West Virginia Department of Education, n.d.b). A recent survey examining the effectiveness of PBL professional development programs showed that compared to those having limited or no PBL professional development experience, teachers participating in the PBL workshops extensively reported more teaching of 21st century skills such as critical thinking, collaboration, communication, creativity, and technology (Ravitz et al., 2012). However, the data from the same study also indicated that on average, teachers' technology use in PBL ranged from almost never to a few times, suggesting

that barriers continue to deter teachers from employing technology-enhanced PBL despite the intensity of teacher professional developments.

Research both within the US and across the globe highlight several reasons why, despite professional development opportunities, rural teachers still may not engage technologies in teaching. First of all, existing professional development opportunities may not be easily accessible to rural school teachers, negating the potential impact of these efforts in the classroom. Due to lack of time and funds to attend face-to-face meetings, and limited bandwidth capacity to participate in online options, rural teachers have limited access to professional development programs (Broadley, 2010; Wilson & Ringstaff, 2010). Without adequate participation, rural school teachers may not develop the skills necessary to effectively incorporate technologies in their classrooms.

Second, even with adequate amount of professional development, teachers may have difficulty connecting their knowledge of technology with the subject matter. The content focus in professional development has been observed as one of the key factors influencing teachers' gained skills and knowledge (Garet, Porter, Desimone, Birman, & Kwang, 2001) and there have been a limited number of professional development initiatives providing teachers with opportunities to develop content-oriented pedagogical understanding necessary for meaningful technology integration (Polly & Hannafin, 2010). Some of the programs in the state the second author has attended emphasized pedagogy in isolation of emerging technologies, or focused on technology aside from content and pedagogy. For example, recent professional development opportunities (West Virginia Department of Education, n.d.b) emphasized 21st century tools and digital learners with no particular focus on content, whereas the summer institute in 2008 focused on promoting PBL that reflected a pedagogical stance only.

Third, teachers in rural settings may not be able to apply ideas gained from professional development programs. Insufficient revenue and federal funds for schools more

prevalent in rural settings (National Associations of Counties, 2013; Rural School and Community Trust, 2011) may limit students' access to necessary hardware, software, and network technologies, hindering the implementation of technology-enhanced pedagogies. It is likely that teachers may be hesitant to incorporate these tools if they are constrained by infrastructural problems preventing their and students' adequate access to technology.

Identifying such digital divide constraints and contextual issues as well as the degree to which teachers participate in professional development programs will help find out their needs particular to their school settings. Such knowledge will also contribute to the planning of future professional developments addressing teachers' concerns and attitudes regarding meaningful use of emerging technologies in constructivist practices.

Research questions

This study seeks to measure and compare rural and urban West Virginian teachers' Web 2.0 motivation, physical, skills, and usage access levels in relation to Web 2.0 associated PBL teaching. We present the following research questions:

- RQ1: What are rural and urban West Virginian teachers' Web 2.0 access levels?
- RQ2: How do teachers' Web 2.0 access levels and participation in PBL professional development influence their reported Web 2.0 associated PBL practices?

Method

Instrument

This study engages a survey designed to assess teachers' levels of Web 2.0 access, participation in PBL professional development programs, and use of Web 2.0 associated PBL activities. The survey instrument consisted of Likert scale items. The questions were drawn and developed with the focus of Web 2.0 applications from related studies measuring

motivation in using ICTs, levels of ICT and Web 2.0 skills and usage, physical access, and technology-enhanced PBL (Calibrate, 2008, 2009; Horrigan, 2007; Ravitz, 2007, 2008; Ravitz & Blazeovski, 2010). It also included descriptions of PBL and Web 2.0 comprising definitions and examples to avoid confusion with these terms. The questions were then pretested with a group of middle and high school teachers who provided feedback on the clarity and their understanding of the questions, and their responsiveness to the task demanded by each question. These teachers were chosen for the pretest as they have already implemented PBL and incorporated technology in their practices. The next section discusses the survey measures for each variable.

Motivation access

Motivational access refers to the potential user's inclination to choose, attain, learn, and use new digital technologies, and as the initial stage of ICT access, it affects one's decision to purchase digital equipment, acquire the necessary skills, and use various applications (van Dijk, 2005). To measure motivational access, we asked teachers to indicate how likely they thought Web 2.0 could be used in 10 aspects of teaching (0=Not at all likely, 4=Very likely). These teaching measures were drawn from CALIBRATE (Calibrate, 2008; 2009), a survey research evaluating ICT innovations and teachers' motivation in European countries. They include communication about assignments among students, increasing student motivation, communication between teacher and students, preparation of learning materials, enhancing students' content learning, increasing creative potentials of students, increasing learning opportunities, facilitating group work, assessing students' content learning, and individualized instruction. The 10 items were computed to create a motivation access index (Cronbach's $\alpha = 0.92$).

Physical access

Physical access, a necessary stage for the development and application of digital skills, is the possession of software programs, computer hardware systems, internet services, and other digital devices, or permission to use them and their contents (van Dijk, 2005). To measure physical access level, we asked 3 questions focusing on tool accessibility and resources supporting the use of Web 2.0. The first question asked teachers whether they had access to a list of computer and digital services and equipment at home and at school. We derived the list of 14 tools from Pew Internet's survey (Horrigan, 2007) on Americans' use of the internet. An index for Physical Access-Tools was computed from this list (Cronbach's alpha = 0.86).

We generated the second and the third questions based on Ravitz and Blazeovski's (2010) survey about the impact of online technologies on high school teachers using PBL in their lessons. We re-worded the focus of the original question from "web-based technologies" to "Web 2.0". Also, a distinction was made between computers and internet access as separate factors supporting the Web 2.0 for PBL. These questions asked teachers to indicate their agreement (1=Strongly Disagree to 4=Strongly Agree) with the following statements: computers in school support Web 2.0 for PBL activities and internet access in school supports Web 2.0 for PBL activities. An index for Physical Access-Web 2.0 Support was computed from these questions (Cronbach's alpha = 0.79).

Skill access

Skill access, a necessary condition for using the technology, refers to the user's skills to operate computer and network services, and to access, select, or manage the information in them purposefully (van Dijk, 2005). To measure teachers' proficiency and expertise with computers and the internet, we applied 15 questions from the CALIBRATE survey (Calibrate, 2008; 2009) that asked teachers to indicate whether they were able to perform a series of

computer and internet tasks on their own, whether they needed help, or they couldn't do them. These items were computed to form a skills access index (Cronbach's alpha = 0.96).

Usage access

Usage access, the final stage in the access levels, is the user's actual use of ICTs and includes the number and diversity of applications and usage time (van Dijk, 2005). To evaluate usage, we asked teachers eight questions about their internet and Web 2.0 use habits at work and at home, and the kinds of Web 2.0 activities they engaged in regularly. We also asked teachers if they used Web 2.0 in their teaching. Only a very small percentage – 6.9% - indicated yes. The number was too small, resulting in a heavily skewed variable. Thus, using this a predictor variable was dropped from the analysis.

Four questions, derived from the CALIBRATE survey (Calibrate, 2008; 2009), asked teachers how often they use internet for lesson planning or implementation (0=Never, 5=Several times a day), how often they email their students, how often they receive emails from their students (0=Never, 5=Daily), and how often they engage students in various internet-based activities (0=Never, 3=Several times a week) including individual research on internet, homework using the internet, internet-based group work, online discussion, and online test. An index for Usage Access-Teaching was computed from the 4 questions (Cronbach's alpha = 0.76).

We also asked four questions about non-teaching tasks. Three questions were related to teachers' general ICT usage in non-teaching tasks. The first two of these asked teachers how often they use internet or email in general (0=Never, 5=About once a day) and how many years they have been an internet user (1=Six months or less, 5=More than six years). The third question asked teachers the number of multimedia related tasks (e.g., taking and sharing

video, photo, and the like) they ever do (yes or no). An index for Usage Access-nonTeaching General from these questions was computed (Cronbach's alpha = 0.72).

The fourth question, which was specific to Web 2.0 and focused on non-teaching tasks, asked teachers how often they complete a list of user-generated online content activities in their personal life (0=Never, 4=Daily)-create or work online journal, blog or a webpage, share something online they created such as artwork, photos, stories, or videos, post comments to news groups, websites, blogs or photo sites, take materials they find online (e.g., songs, text, or images) and remix them into their own artistic creation (e.g., movie clips, slide shows, audio clips), visit virtual worlds such as second life, and participate in social networking sites like Facebook. An index for Usage Access-nonTeaching Web 2.0 from these items was computed (Cronbach's alpha = 0.82).

Participation in PBL professional development

Given the increased amount of professional development programs in WV (West Virginia Department of Education, n.d.b) and previous research indicating the influences of such initiatives on teachers' practices (Broadley, 2010; Polly & Hannafin, 2010; Ravitz et al., 2012; Shakeshaft, Sarason, & Shaker, 2004; Wilson & Ringstaff, 2010), we asked teachers how many professional development sessions they attended over the past 5 years that supported their use of PBL (None, 1-2, 3-4, and 5 or more). This included the number of workshop days or parts of days receiving coaching for PBL-related practices.

Web 2.0-associated PBL practices

We measured the dependent variable, Web 2.0-associated PBL practices, by developing a scale using five items from Ravitz's (2008) work reflecting the principles and affordances of Web 2.0 such as collaboration and generation of computer-based products. We asked teachers to indicate how often they engage their students in these practices (1=Never to 5=Very often).

Cronbach's alpha for the 5 items was 0.84.

Procedure

As the goal of the study was to assess the Web 2.0 digital divide between schools and teachers that were presumed to be ready for executing 21st Century pedagogies, we first contacted school principals from all public middle and high schools (N=13) in two West Virginian counties - one urban and one rural – to ascertain that their teachers had undergone professional development for PBL, and that the schools have the facilities to support Web 2.0.

While these were the closest counties to the researchers in distance, the sampling allowed for including teachers from both rural and urban locations of West Virginia to ensure the representativeness of the study. We also excluded elementary schools from the sample because the use of Web 2.0 tools may not be as prevalent in the elementary schools as in secondary schools. We noted that the previous study of PBL in West Virginia (Ravitz et al., 2012) did not include K-3 possibly because there were fewer teachers used PBL in the early grades.

The survey was distributed in October 2009. The principals informed their teachers about the study, with the emphasis that participation was voluntary and anonymous. The schools assisted in distributing paper-based surveys with postage paid envelopes to their teachers. Teachers were also given the option to complete the online version of the survey. The teachers had 3 weeks to complete the survey.

Sample

The response rate was 29%, with 161 teachers from 8 schools participating in the survey. This did not include the responses from two teachers who skipped the majority of questions and answered only the first few survey items. Teachers from three schools completed the online survey (N=62, 24% response rate) while those from the remaining five schools completed the

paper version (N=99, 36% response rate). Four of the schools were identified as rural. We used National Center for Education Statistics' locale code system as a guide for the classification of rural and urban schools, which is based on schools' proximity to an urbanized area (National Center for Education Statistics, n.d.). Schools that were inside an urbanized area (city-small, suburb-small) were classified as urban and those outside an urbanized area (rural-distant, rural-fringe) were considered rural. Based on the school data from West Virginia Department of Education (n.d.c), the socio-economic status appeared to be a key differentiating factor between these categories. On average, 41% of the students were coming from low-income families and 49% were qualified for a reduced or free lunch in rural schools whereas 27% of students were in the low-income category and 35% can benefit from reduced or free lunch in urban schools.

55% of teachers were from urban schools. 52% of the teachers were teaching grades 9 through 12 and 48% were teaching grades 6 through 8. Teaching experience ranged from less than one year to 44 years, with a mean of 13.5 years. The mean age of teachers is 44 and their ages ranged from 22 to 66. 74% of the teachers were female.

Analysis

For the first research question regarding the comparison of urban and rural teachers' Web 2.0 access levels, we used independent *t* tests. We compared urban and rural teachers in terms of an overall aggregated score for each Web 2.0 access level. Whenever the questions measuring an access level consisted of various scales, the aggregation involved standardizing the scores (*Z*) and adding up the individual *Z* scores by following DiStefano, Zhu, and Mindrila's (2009) suggestions on computing factor scores. However, as the multiple *t* tests in such a process increases a Type I error, erroneously rejecting the null hypothesis, the Bonferroni correction (Field, 2005, p. 339) was applied through dividing the critical alpha level by the number of *t*

tests conducted. This yielded 0.00714 as the critical alpha p value for the analysis of the Web 2.0 access levels (Motivation, Physical-Tool, Physical-Web 2.0 Support, Skill, Usage-Teaching, Usage-nonTeaching-General, and Usage-nonTeaching-Web 2.0).

For the second research question regarding the factors predicting teachers' Web 2.0 associated PBL practices, we used a sequential (hierarchical) regression analysis (Tabachnick & Fidell, 2001). We only included the variables that were significantly correlated with the dependent variable. These included motivation access, physical access (both tool access and Web 2.0 support), skill access, usage access (both teaching and non-teaching), and participation in PBL professional development. Gender, age, number of years in teaching, and school location (urban, rural) were excluded due to their weak correlation with the dependent variable. The analysis of distributions led to transformation of some of the variables in order to enhance normality and reduce skewness. Based on Tabachnick and Fidell's (2001) suggestions, a square root transformation on the measure of Web 2.0-associated PBL Practices, and logarithmic transformations on the reflected measures of Motivation Access, Skill Access, and Usage Access-nonTeaching General were applied. Using a $p < 0.001$ as the criterion for Mahalanobis distance (Tabachnick & Fidell, 2001), two outliers among the cases were identified. A close examination of the outliers revealed no data entry error or implausible values. Any further transformation to lessen the effects of these outliers was not applied as it could lead to an excessive compression of the data, which were already transformed previously. One sample *t*-test conducted for each variable showed no significant difference between the mean acquired from all cases and that of all cases except for the two outliers. Thus, the outlier cases were deleted to avoid any distortion in the statistical inferences.

The independent variables-motivation access, physical access, skill access, and usage access had missing values. This was due to aggregation of scores, which could not be computed whenever the participants failed to report information on any individual survey item

of the variable. Dummy variables were then created where 1=reported value and 0=missing value, and one way ANOVA was used to examine the difference in the dependent variable between those who reported and those who did not report information on each independent variable. As the results showed no significant difference between the groups, a listwise deletion of the cases was applied for the subsequent analysis.

The independent variables were entered into regression models hierarchically, given the possible conceptual issues with stepwise procedure raised in the literature (Cohen et al., 2003, p.161). We entered Motivation Access, Physical Access-Tools, and Physical Access-Web 2.0 Support in the first block, and Skill Access, Usage Access-Teaching, Usage Access-nonTeaching General, and Usage Access-nonTeaching Web 2.0 in the second block given van Dijk's assertion that the divide in the first two stages (motivational and physical) will narrow and access problems will shift to the last two stages (skill and usage). The effects of usage and skill access on the dependent variable may be more paramount than those of the first two stages if, as asserted, there is deepening divide mainly in skills and usage access. The participation in PBL professional development was entered in the third block of the regression in order to identify its unique contribution to the prediction over Web 2.0 access levels.

Results

RQ1: Web 2.0 access levels?

Motivation access

Overall, teachers were positive about Web 2.0's use in teaching. The tabulated scores (0=Not at all likely, 4=Very likely), which ranged from 0 to 40, with the mean of 35.6 (SD=6.70), indicated teachers' high motivation access levels. Urban (M=35.03, SD=6.72) and rural teachers (M=36.15, SD=6.69) did not differ in their opinion regarding how likely Web 2.0 tools could be used for various aspects of teaching.

Physical access

Table 1 shows the percentages of teachers who reported access to various computer and Internet equipment and services at home or at school. Overall, teachers had limited access to variety of technologies especially in schools.

-Insert Table 1 here-

We gave one point for every item teachers had access to, and tabulated the scores, which ranged from 0, to 27, with a mean of 10.56 (SD=5.86). No significant difference was found between urban teachers' (M=10.57, SD=7.06) and rural teachers' (M=10.55, SD=3.87) physical access to tools.

Regarding computers and internet for Web 2.0 use in schools, 66.7% of the teachers agreed or strongly agreed that computers in their schools supported Web 2.0 and 64.3% agreed or strongly agreed that internet access supported Web 2.0 use. Around one third of the teachers disagreed or strongly disagreed with these statements.

The tabulated score of the values from these two items ranged from 2 to 8, with the mean of 5.23 (SD=1.29). Overall, urban teachers' Physical Access-Web 2.0 Support level (M=5.72, SD=0.99) was significantly higher than that of rural teachers (M=4.77, SD=1.38), $t(102.19)=4.18$ $p<0.001$. The effect size (Cohen's $d=.79$) was between medium and large.

Skills access

Teachers indicated whether they were able to perform a series of computer and internet tasks on their own (3), they needed a little help (2), they needed a lot of help (1), or they couldn't do them (0). We tabulated the results from the fifteen items into a scale ranging from 0 to 45, with the higher score indicating greater computer and internet proficiency. The mean score was 34.61 (SD=11.25), indicating that teachers are fairly proficient in their computer and internet skills. There was no significant difference between the skill access of urban

($M=35.87$, $SD=10.18$) and rural ($M=33.35$, $SD=12.18$) teachers in overall.

Usage access

Almost half (46%) of the teachers said they use the internet several times a day for lesson planning and implementation, and 22% said they use it almost daily. Online activities for their classes included research (83.8%), group work (56.1%), homework (56.4%), tests (36%), and discussions (18%). Only less than 3% of teachers did not use the internet for teaching purposes and 8.7% never engaged their students in internet-based activities. The aggregated scores from the standardized values indicated that urban teachers' teaching-related usage access level ($M=1.37$, $SD=5.55$) was significantly higher than that of rural teachers ($M=-1.10$, $SD=4.79$), $t(135)=2.787$, $p<0.007$ (Cohen's $d=.48$).

Internet use in general was high, and diverse. 85% of teachers said they use the internet at least once a day. Over 91% of teachers reported they have been internet users for more than 6 years. More than a three quarters of teachers reported they completed majority of the multimedia related tasks (e.g., taking and sharing video, photo, and the like). The aggregated scores from the standardized values showed no significant difference between that urban ($M=.37$, $SD=4.02$) and rural teachers' ($M=-.31$, $SD=4.89$) general ICT usage in non-teaching tasks.

Regarding Web 2.0 user-generated online content, online social networking such as MySpace or Facebook was the most popular, used by 58.3% of teachers. This was followed by posting comments on a website, blog, photosite, or online news group (54.3%). The third most popular activity was sharing something online, such as artwork, photos, stories or videos (51.8%). This was followed by taking materials online and remixing it (38.1%). Working on their own webpage and blogging was the third and second least common activity, with 73.4% and 72.4% of teachers respectively reporting they had never done either. Participating in a

virtual world was the least common activity, with 89.9% of teachers reporting they had never done this before. We tabulated the total number of activities teachers have engaged in and found these ranged from 0 to 7, with a mean of 2.58 (SD=2.12). Regarding the aggregated scores from the values of these questions, no significant difference was found in urban (M=3.00, SD=2.15) and rural teachers' (M=2.16, SD=2.03) non-teaching usage access in Web 2.0 related tasks.

RQ2: Access levels and participation in PBL professional development influencing Web 2.0-associated PBL practices?

For the independent variable, participation in PBL professional development, more than a quarter teachers (28%) reported that they participated in at least 5 or more PBL-focused professional development workshops, and 19% participated in 3-4 sessions. 37% attended 1-2 sessions only, and 16% had never attended any. The number of urban and rural teachers did not significantly differ regarding their frequency of attending PBL professional development sessions $\chi^2(3, N = 144) = .361, p > .05$, indicating that rural and urban teachers had the same amount of PBL professional development opportunities.

For the dependent variable, Web 2.0 associated PBL practices, teachers' aggregated scores had a mean of 11.04 (SD=4.06) within a possible range from 5 to 55. Although there was no significant difference between rural (M=10.54, SD=3.74) and urban teachers (M=11.51, SD=4.31), the average mean score of per item, 2.302, fell between 2=Hardly ever and 3=Sometimes on the scale, indicating that teachers had a minimal level of Web 2.0 associated PBL practices in their teaching.

For the regression analysis, we included in the sequential regression models variables that were significantly correlated with the dependent variable. Table 2 displays three

regression models with independent variables predicting the square root of Web 2.0 associated PBL practices.

-Insert Table 2 here-

In the first model, both Physical Access-Web 2.0 Support and log of the reflected Motivation Access significantly predicted Web 2.0 associated PBL Practices (Adjusted $R^2=.154$, $F(3, 96)=7.02$, $p<0.001$). The negative coefficient for Motivation Access was due to the reflected score of the variable. However, Motivation Access and Physical Access-Web 2.0 Support were no longer significant predictors after the log of Skill Access, Usage Access-Teaching, the log of Usage Access-nonTeaching General, and Usage Access-nonTeaching Web 2.0 were added to the prediction (Model 2). Only Usage Access-Teaching significantly contributed to the prediction, with the adjusted R^2 increasing to .306 ($F(2, 92)=6.24$, $p<0.001$). The addition of the last variable – Participation in PBL Professional Development – to the equation (Model 3) resulted in a slight increment (.025) in the adjusted R^2 . Usage Access-Teaching and Participation in PBL Professional Development were the only significant predictors ($F(8, 91)=4.52$, $p<0.001$). Teachers who had higher teaching-related usage access and participated in PBL professional development more frequently engaged their students in Web 2.0 associated PBL practices more intensively.

The examination of the scatterplots for residuals against each independent variable confirmed their linear relationship with the dependent variable. The scatterplot for residuals against the predicted value also showed that residuals varied at a constant level, meeting the homoscedasticity assumption. Further, the normal q-q plot of residuals indicated that their distribution was acceptably normal.

Discussion and Implications

This study examined West Virginian teachers' Web 2.0 access levels and their influences on

teachers' Web 2.0 associated PBL practices. Findings revealed that rural and urban teachers did not differ significantly in motivation and skills. The differences were in terms of Physical Access-Web 2.0 Support and Usage Access-Teaching. Compared to rural school teachers, urban school teachers reported to have significantly higher level of Physical Access-Web 2.0 Support though both groups reported limited access to various equipment and services, with one third of them indicating computers and internet in their schools did not support Web 2.0-based activities. Urban teachers' usage access level was higher than rural teachers for teaching-related tasks including communicating with their students through emails and engaging them in internet-based activities. These findings differ somewhat from van Dijk's (2005) assertion that the digital divide would narrow at motivational and physical access levels and deepen at skills and usage access levels. Our study shows that the digital divide between rural and urban teachers persists at both physical (Web 2.0 Support) and teaching-related usage access levels.

Both rural and urban teachers were positive about the potential use of emerging Web 2.0 tools in teaching (Motivation Access). Also, unlike the observations in previous research (Aduwa-Pgiegbaen & Iyamu, 2009; Mutonyi & Norton, 2007; Palamakumbura, 2009; Trinidad, 2007), rural teachers in the current study were found to have the same level of access to technologies as urban teachers had (Physical Access-Tool). Nonetheless, rural teachers felt more concerned with school computers and internet access supporting the use of Web 2.0 applications (Physical Access-Web 2.0 Support). This may point out that although access to various technologies may not necessarily be more problematic in rural schools, the quality of high speed internet and computer hardware system with necessary peripherals, which are essential to students generating online content, using multimedia tools, and communicating through Web 2.0, may still pose challenges in such settings.

Regarding skill access, no significant difference was observed between the two groups and teachers were found to be fairly proficient in their computer and internet skills. The state-wide efforts in teacher professional development with the increased focus of 21st century tools and digital learners (West Virginia Department of Education, n.d.b) may have potentially benefited both urban and rural teachers' digital skills. Also, as our analysis showed, both groups did not differ significantly regarding their non-teaching usage, which constitutes user-generated online content activities and multimedia related tasks they completed in their personal lives. Teachers' similar personal participation in such activities thus may have also contributed to their similarly high levels of proficiency.

On the other hand, compared to their urban counterparts, rural teachers have significantly lower level of usage access in terms of communicating with their students through emails and employing internet-based learning activities such as research, group work, or online discussion (Usage Access-Teaching). As van Dijk (2005) articulates, usage access divide tends to be more prevalent than earlier types of ICT access as gaps in motivation, physical, and skill access may come together to impede usage. As found in our study, compared to urban teachers, rural teachers are more concerned with the quality of internet speed and computer systems in schools supporting Web 2.0 use. Thus, they may be less inclined to use the internet in their teaching. Existing research also supports this assertion by indicating that physical barriers likely prevent teachers from incorporating technologies in their practices. (Crook & Harrison, 2008; Lee & Tsai, 2010; Light, 2011; Pan, 2011; Interactive Educational Systems Design, 2009; Trinidad & Broadley, 2008). Figure 2 displays the observed difference among the access levels in relation to teachers' Web 2.0 associated PBL practices.

-Insert Figure 2 here-

Unlike van Dijk's model (Figure 1), where usage and skill access are farther apart (indicating a divide) and physical and motivation access levels are getting closer together, our findings indicated that Usage Access-Teaching and Physical Access-Web 2.0 Support levels are far apart and non-teaching usage and skills access levels are close together (Figure 2). As indicated by grey-dotted arrows, Physical Access-Web 2.0 Support may influence Usage Access-Teaching, while non-teaching usages likely affect skills access. As shown by the black-straight arrows, Usage Access-Teaching and PBL professional development were the only significant factors observed to influence Web 2.0 associated PBL.

Teaching-related usage access as a factor

The levels of Physical Access-Web 2.0 Support and Usage Access-Teaching were much lower for rural teachers than urban teachers, but the regression analysis indicated only Usage Access-Teaching and Professional Development as significant predictors for Web 2.0 associated PBL. The findings lend insight into the significance of the digital divide in terms of teaching usage access. The more often teachers used internet for teaching such as communicating with students and employing more internet-based learning activities, the more intensively they engaged their students in Web 2.0 associated PBL, regardless of their physical access levels. Although physical access is necessary to technology integration, our findings suggested that it did not guarantee teachers' adoption of Web 2.0. What helped them engage their students in Web 2.0 associated PBL practices was rather their regular use of internet for teaching, highlighting the importance of promoting teachers' educational and communicational use of internet applications.

Professional development as a factor

Though professional development was a significant predictor of teachers' Web 2.0 associated in PBL practices, it accounted for less than 3% of the variance in the dependent variable,

indicating its rather minimal contribution to the prediction model. Although professional development programs might be useful for introducing PBL approaches, teachers may still have difficulty operationalizing how to incorporate Web 2.0 in their PBL practices. Further, teachers still faced challenges in making access sufficiently available to students in schools for Web 2.0 projects. Such low level physical access (Web 2.0 Support) may have prevented them from easily putting the ideas gained into action at their classrooms, regardless of their attendance in such programs.

Infrastructure and Contextualized Professional Development

Our findings highlight the importance of better planning and implementation of future professional development programs that acknowledge and address teachers' concerns and access levels that are unique to their geographical settings. Two suggestions based on the literature on rural schools may be relevant here.

First, research indicates the lack of technology resources, support and use are common to rural schools settings, and calls for collaboration between school communities, educational policy makers, universities, and business partners to maximize the effectiveness and efficiency of hardware and network capacity (Hubber, Chittleborough, Campbell, Jobling, & Tytler, 2010; Lyons, Cooksey, Pannizzon, Parnell, & Pegg, 2006; Shaw, 2010). Likewise, we recommend collective action among these stakeholders to equip schools in rural settings with not only the right infrastructure but also the high speed internet and effective computer systems necessary to enable Web 2.0-based PBL activities and communication. Enhancing schools' intranet systems and setting up emerging tools on their local servers may be a less expensive approach if there are budgetary concerns regarding the quality infrastructure for high speed and reliable internet systems. However, as highlighted earlier, sole access to technologies may not guarantee their use in classrooms.

Second, existing studies indicate that rural teachers have limited professional development opportunities (Broadley, 2010; Wilson & Ringstaff, 2010). Our findings showed otherwise – rural teachers had the same amount of PBL professional development experiences as urban teachers. However, teachers benefited from these experiences rather minimally in terms of Web 2.0 associated PBL practices, underscoring a further need for improving the existing professional development programs. Providing sustained development opportunities specific to teachers’ unique concerns may be an effective alternative. Instead of “one-time” workshops that are also commonly designed for larger groups of teachers, as observed in WV, organizing a cluster of teachers who can examine their own teaching over an extended period of time can be an effective method to bring about learning experiences that better relate to teachers’ concerns in their settings (Goos, Dole & Geiger, 2011; Lyons et al., 2006; Wilson & Ringstaff, 2010).

Conclusion & Future Work

This study examined teachers’ Web 2.0 access levels, participation in professional development programs, and their potential influences on Web 2.0 associated PBL practices. The analysis reveals that rural teachers were more likely than urban counterparts to be constrained by physical (Web 2.0 Support) and usage barriers (Teaching related), limiting their Web 2.0 associated PBL practices. Although both groups had the equal opportunities to participate in PBL professional development, teachers benefited from these programs minimally with regard to the use of technologies. Based on these findings and the relevant literature, we suggest the need for a collective action among educators and policy makers to provide enhanced infrastructure, particularly high-speed internet and advanced computer systems that support the use of emerging technologies for PBL in rural schools. Further, we emphasize the importance of providing professional development where teachers carefully

discuss and observe practices in order to meaningfully conceptualize and implement technology-enhanced PBL lessons.

As with any study, ours have limitations. One limitation is the response rate. While a nearly 30% response rate is acceptable for online and classroom surveys, the low numbers limit the certainty with which we can draw conclusions as well as its generalizability. Second, the survey is self-reported and may reflect the perceptions of the teachers more than the actual situations in the schools. Also, students' access is as important as teachers' access for understanding the educational use of technologies but it was beyond the scope of this study to include students in the survey. Thus, future studies collecting data from students to determine their access levels would add to the discussion and suggestions made in this paper. Nonetheless, keeping these limitations in mind, we believe the findings in this study still offer important theoretical and practical insights into teachers' experience and attitudes in relation to the different forms of Web 2.0 access and the role context plays in influencing how effectively they are able to engage Web 2.0 in PBL-enhanced pedagogies.

This study is a beginning effort in examining and addressing teacher professional development programs that may be technologically deterministic and do not enhance or benefit teachers in their teaching practices. With the insights from this study, the next step will be to include more schools in the data set from other regions of West Virginia and largely rural states. Recently developed and implemented technology policies, new infrastructural improvements, and current professional development opportunities in school settings will be worth investigating in such a larger data set regarding how such factors may influence rural and urban teachers' practices. Future studies will also involve qualitative data driven approaches examining such issues as they occur in context to further enhance the understanding of teachers' adoption of Web 2.0 and PBL. Also, future studies may clearly separate internet and non-internet based access. Although all the technology activities

examined in the current survey may involve internet, an explicit way of wording may make a clear distinction in terms of measuring the access levels.

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Table 1. Percent of Participants' Access to Technologies

	Have at school	Have at home	Don't have
Webcam	2.5	26.4	54.1
iPod or MP3 player	4.4	47.8	35.8
Blackberry, Palm or personal digital assistant	5.0	23.9	57.2
Digital video recorder	6.9	30.8	49.7
Audio editing software (e.g. Audacity)	9.4	18.9	57.2
Cell phone with text messaging function	10.7	69.8	15.7
Video camera	13.2	55.4	28.3
Photo editing software (e.g. Adobe Photoshop)	18.2	47.8	29.6
Video editing software (e.g. Movie Maker)	20.8	28.9	44.7
Digital camera	25.2	78.0	7.5
USB Flash drive (memory stick)	47.8	77.4	5.7
Laptop computer	49.7	64.8	10.1
Broadband internet access	66.6	71.1	4.4
Desktop computer	76.1	59.7	4.4

Table 2. Summary of Hierarchical Regression Analysis for Variables Predicting Square Root of Web 2.0 associated PBL Practices (N =99)

Variables	Model 1					Model 2					Model 3				
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>Tolerance</i>	<i>B</i>	<i>SE</i>	β	<i>T</i>	<i>Tolerance</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>Tolerance</i>
<i>Log(Ref (Motiv. Acc.))</i>	-.34	.13	-.26	-2.58*	.85	-.23	.12	-.18	-1.91	.81	-.22	.12	-.17	-1.82	.80
Phys.Acc.Tool	.01	.01	.09	.81	.76	-.01	.02	-.09	-.79	.53	-.02	.02	-.12	-1.03	.52
Phys.Acc.Web2.0 Sup.	.11	.05	.23	2.29*	.86	.05	.05	.11	1.18	.76	.04	.05	.08	.83	.74
<i>Log(Ref (Skill Acc.))</i>						-.03	.14	-.03	-.22	.46	-.01	.14	-.01	-.02	.46
Usag. Acc-Teach.						.06	.02	.40	4.17**	.76	.06	.02	.36	3.82**	.74
<i>Log(Ref(Usag.Acc.nonTeach.Genrl.))</i>						-.22	.19	-.14	-1.19	.48	-.24	.18	-.15	-1.28	.48
Usag.Acc.nonTeach.Web2.0						.01	.01	.12	1.09	.59	.02	.01	.14	1.32	.58
Participation in PD											.11	.05	.19	2.13*	.83
Adjusted R^2				.154					.306					.331	
Adjusted R^2 change				.154					.152					.025	
F for change in Adj. R^2				7.02**					6.24**					4.52*	

*p <.05, **p < 0.001

van Dijk's
model

Participation in Society

Observed
model in
teacher
context