TPCK for Impact: Classroom Teaching Practices That Promote Social Justice and Narrow the Digital Divide in an Urban Middle School

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U.S. schools have long struggled with what has been identified as the “achievement gap.” While the debate ensues in regard to an explicit definition for this phenomenon, research overwhelmingly demonstrates that students of marginalized populations remain on the lower end of most measures of school success. Accordingly, advocates of social justice point to the disparities of resources, including quality teachers, for students in poverty. As a part of this movement, access to appropriate technological resources in schools has become an issue, commonly labeled the “digital divide.” This study reviews evidence of teaching for social justice and impacting the digital divide through the analysis of classroom observations in one year at an urban middle school participating in school reform efforts.

KEYWORDS TPCK, digital divide, social justice, school reform

U.S. schools have long struggled with what has been identified as the “achievement gap.” This gap, measured primarily through scores on standardized tests, is most apparent when affluent versus non-affluent school populations are compared (Lee, 2008). Typically, the schools in rural and urban poverty-stricken areas also demonstrate lower attendance and graduation rates (Marley, 2008). Furthermore, these schools suffer from inadequate funding, lack of resources, and a teaching staff that is often inexperienced or unqualified. In an effort to address these issues, multiple school reform efforts have been introduced to combat the inequities experienced in these lower-achieving schools (Darling-Hammond, 2009; Whittington, 2004; Williams, 2003).
One such reform effort, project GEARUP (Gaining Early Awareness and Readiness for Undergraduate Programs), is designed to increase the number of students prepared for college by improving instruction and increasing and intensifying after-school tutorials, mentorships, and other enrichment programs. GEARUP is a major federal initiative focused on populations underrepresented currently in post-secondary education. This article documents teaching practices in an urban middle school following five years of collaborative restructuring as a part of the GEARUP initiative (Fischer & Hamer, 2004). Collaborative restructuring evolved democratically, as teachers, parents, administrators, community members, and university faculty dialogued and strategized to effect growth in student learning and preparation for post-secondary education.

The reforms at Ravine Middle School (pseudonym), the site for this study, have all been based on what teachers and administrators have identified as student needs. These needs have been documented through ongoing and completed action research projects and literature reviews (Bernauer, 2002; Fullan, Bennett, & Rolheiser-Bennett, 1990). The reform work at Ravine is based on the belief that school change and restructuring can be process-oriented. Researchers have worked to identify the key aspects of process-oriented change. Their analysis positions the work that the Ravine Middle School GEARUP team has engaged in as part of the range of “new” forms of work emerging: professional networks and school/university collaborations that create job-embedded professional development opportunities (Grant, 1997; Guskey, 1998). Teachers at Ravine elected to participate in various types of job-embedded professional development (JPD) as they worked to reach their students more effectively.

As a part of the restructuring efforts of the GEARUP team, issues of equity were explored to determine the most acute student needs related to supporting students in continuing their education. Teachers realized that Ravine students lacked many resources available to their middle-class peers; because of this, students did not feel empowered to pursue post-secondary goals, or even to attempt high-school graduation. From this analysis, the team began offering JPD to support teachers in crafting strategies to empower students to learn and to build democratic classroom environments. Teachers also targeted student access and use of computer technologies as an area of need. The majority of Ravine students are part of low socioeconomic status (SES) and minority populations; research has shown that most of these students do not have home access to up-to-date computers or Internet services (Bull, 2003; Gorski, 2002; Moghaddam & Nadezhda, 2004; Morse, 2004). Ravine teachers created JPD opportunities focused on classroom technology integration as a component of their work to improve instruction and combat the digital divide.

After five years of reform efforts, researchers wanted to determine if, in fact, JPD and other initiatives were impacting student experiences in the
classroom. Survey data collected from teachers, students, and parents over the years indicated that these constituents believed GEARUP was impacting Ravine Middle School in positive ways. State standardized tests and attendance measures provided some confirmation that the school was raising student achievement and participation. Various case studies had provided glimpses into teachers’ classroom strategies (Banister & Fischer, 2006; Banister & Steingraber, 2006; Michalski, Banister, & Hodges, 2005). However, substantive comprehensive data, on what was occurring day-by-day in Ravine classrooms, were lacking. Were teachers delivering academic content in a way that demonstrated pedagogical expertise, with the potential to impact student learning? Had the emphasis on collaborative reform strategies translated to democratic classrooms that promoted social justice? Did these strategies include technology integration experiences that expanded student access and use of digital technologies? The purpose of this study was to examine the relationship between classroom practices related to teachers’ expertise in conveying academic content, creating democratic classroom environments, and effectively integrating technology.

FRAMING THE STUDY

Before rigorous data collection in Ravine classrooms could begin, it was imperative that the researchers agreed upon the elements of classroom instruction that were being targeted for study. Pedagogical content knowledge (PCK), practices promoting social justice, and technology integration strategies (ultimately technological, pedagogical, and content knowledge—TPCK) were central in this undertaking. Researchers believed that these constructs would provide a solid foundation for describing and examining classroom practices, while acknowledging the complexities therein. Because the JPD opportunities chosen by the teachers had focused on pedagogy, social justice, and classroom technology integration, observing their classrooms with these elements in mind seemed prudent. Since technology integration practices provided these urban students with more equitable access and use of digital technologies, the concept of the digital divide was noted as an underlying theme in the social justice framework. The following paragraphs explore the theories of PCK, TPCK, social justice, and the digital divide in more detail.

PCK

In order for students to learn academic content effectively, teachers must know their subject matter. This fact is undisputed, for how could anyone teach something that he or she does not know him/herself? However, research has moved the assumption of what a teacher knows to another level.
Not only do teachers need to be masters of their content (subject matter), but they must also be masters in how to effectively convey that content to their students. This level of expertise is currently defined as PCK (Beattie, 1995; Dawkins, Dickerson, McKinney, & Butler, 2008; Piccolo, 2008; Shulman, 1986, 1987).

PCK is more than a “bag of tricks,” the various teaching methods that a teacher uses as he or she peruses through course content, week-by-week. Rather, PCK entails a scope of expertise that allows educators to critically review what their students need to learn, understand their students’ learning styles, and effectively select and carry out teaching strategies that powerfully convey content to learners (Chauvot, 2008; Dawkins, et al., 2008; Piccolo, 2008). The result of excellent PCK, it is theorized, should be successful student learning. While teacher education experts have continued to focus on PCK as a primary goal of their initiatives, comprehensive research support for student achievement with PCK is inconclusive (Abell, Park, Hanuscin, Lee, & Gagnon, 2009). This is, in part, due to the complexities of schooling and the difficulties in collecting day-to-day descriptive data of teaching practices. Smaller case studies do demonstrate the importance of PCK for effective teaching and learning, but more substantive work is needed to tie student achievement and PCK on a broader scale (Fitzharris, Jones, & Crawford, 2008; VanDijk, 2009). This study sought to document teacher’s PCK as evidenced through observations of classroom teaching practices. In addition, technology integration practices were studied. If teachers demonstrated PCK within their digital technology use, then researchers determined that TPCK was evident. The following paragraphs further explain this concept.

TPCK

As if PCK were not a complex enough construct, researchers interested in the effects of classroom technologies on teaching and learning have added technology to the mix. Identified as TPCK, this entity is described as teacher understanding, not only of subject matter and expertly selected methods of teaching that subject matter to students, but the knowledge of the various digital technologies available to teach the content and how to best select and integrate these technological resources to impact student learning (Mishra & Koehler, 2006).

TPCK adds yet another dimension to identifying effective classroom instruction, arguing that 21st century teaching and learning must reflect compelling uses of digital technologies. In order for teachers to be well versed in TPCK, they must spend time in both learning the mechanics of various technologies, as well as studying how to match specific technology tools to specific learning needs. Such knowledge includes how to use various software packages, peripheral devices, and Web sites, expanding, then, to
effectively selecting those resources that would most powerfully support the
learning goals of the classroom (Angeli & Valanides, 2009). Such expertise
necessarily builds upon a foundation of adequate PCK and requires the ad-
tional technological capabilities to be nurtured in teachers. Advocates of
TPCK do not imply that for every learning goal there exists only one tech-
ology integration strategy that will support that goal (anymore than PCK
proponents would argue that only one pedagogical strategy would support
a certain learning goal), but rather that teachers with TPCK have the ability
to keenly identify multiple technological strategies for a given situation and
then implement a strategy that meets the needs.

Part of TPCK also includes the ability to understand the technological
constraints within a certain teaching scenario, and adjust accordingly. For
example, a teacher determines that students should construct digital con-
cept maps and share these with peers for review and editing, in order to
critically evaluate a specific classroom topic. TPCK would be demonstrated,
not only in this determination, but as the teacher selects content-mapping
resources (purchased software, open source application, or Web-based) and
chooses an environment for peer editing (shared files on the server, wikis,
or inserting digital comments on actual concept map files). In addition, the
ability to transfer from one option to another, based on the availability and
functionality of the digital resources would further exemplify the TPCK of a
teacher. Documenting TPCK in classrooms has followed the trajectory of the
studies of PCK, in that the scope needs to be expanded to make stronger
claims about the impact on teaching and learning (Hofer & Owings, 2008).
The relationship of PCK to TPCK in classroom teaching is also an area where
further research is needed (Greenhow, 2009). For the purposes of this study,
researchers sought to document evidence of PCK and TPCK in classrooms,
in order to determine best practices for teaching in urban settings. Strong
pedagogy, coupled with powerful technology integration experiences, might
provide more equitable learning opportunities for students. In so doing, is-
ssues of social justice would be addressed, including more access and use
of digital technologies. The concept of teaching for social justice, including
impacting the digital divide, is presented in the following section.

Teaching for Social Justice

In addition to the importance of PCK and TPCK to support teaching and
learning, this study chose to also focus on the classroom evidence of teach-
ing for social justice. Because of the GEARUP focus on preparing students to
move on to post-secondary educational opportunities, the need to develop
students’ self-efficacy attributes was paramount. Accepting and valuing stu-
dents’ voices in the constructivist classroom, with the goal of encouraging
critical thought, could result in students who believe in themselves enough to
graduate and build a strong future. While some have criticized the practice of preparing teachers to impact social justice (Grant & Agosto, 2007), proposing that the construct is nebulous and therefore impossible to nurture, a strong contingent of teacher educators have embraced the challenge (Adams, Bell, & Griffin, 1997; Ayers, Hunt, & Quinn, 1998; Darling-Hammond, French, & Garcia-Lopez, 2002; El-Haj, 2003; Michelli & Keiser, 2005; Swain & Edyburn, 2007).

These advocates have outlined the need for empowering students of marginalized populations through creating democratic classroom environments where these students are respected and valued for their unique perspectives and intelligences. Strategies have been developed and practiced within communities of teacher-educators, but, as in the case of PCK and TPCK, studies have not moved beyond small, single-classroom research to demonstrate the wider impact that teaching for social justice may generate (Sleeter, 2001). This longitudinal, multi-classroom study focused on social justice elements found in classroom experiences, and their relationship to PCK and TPCK. Specifically, the researchers posited that appropriate technology integration experiences promote social justice by providing students access and use of digital technologies that are often absent from urban environments. An additional explanation addressing the digital divide as a subset of urban school social justice issues is provided in the following paragraphs.

The Digital Divide: An Outgrowth of the Social Justice Imperative

Finally, this study sought to understand the classroom teacher's impact on the digital divide, a construct that can be characterized as an outgrowth of the social justice agenda. While the exact origin of the term digital divide cannot be determined (Digital Divide, 2005; Foster & Borkowski, 2004), it has been in use for over a decade. Politicians, scholars, educational leaders, policy makers, and activists frequently employ this phrase when addressing issues of empowerment and democracy (Williams & Alkalimat, 2002). These discussions have identified various factors in identifying the digital divide phenomenon, including types of Internet or computer access (both quality and quantity), and available and/or actual uses of these technologies (Angus, Snyder, & Sutherland-Smith, 2003; Atthewell, 2001; Moghaddam & Nadezhda, 2004; Morse, 2004; Solomon, 2002).

Access has been traditionally defined as the right or ability to log on to a computer system or use a computer program. When focusing on access, data are often collected regarding the number of computers present in a certain geographic space (school, library, home, community), the ratio of people to computers, or the number of computers equipped with Internet connections. While the United States, as a whole, statistically surpasses most other nations in these measures, stark inequities have been documented
within its borders. Minority and low SES populations have consistently been shown to have less access to technological resources (Gorski, 2002; Hayden, 2003; Norris & Conceicao, 2004). These inequities are present, regardless of the unit analyzed. Be it home, school, or community, the wealthy and powerful, without fail, enjoy the benefits of more computer resources.

Beyond access, however, lies the reality of opportunity for use in the digital divide debate. Those who collect statistical data on the number of computers and Internet connections oftentimes interpret this information as reflecting progress in narrowing the divide. However, just because computers are present, one cannot immediately assume that they are functional and put to use. Especially in school settings, studies have shown that marginalized student populations receive little or no opportunities to use computer technologies in productive and creative modes (Bull, 2003; Milone & Salpeter, 1996; Swain & Pearson, 2001). As these practices persist, students are being denied experiences that have been shown to increase their chances for meaningful employment and educational opportunities.

PCK/TPCK and Social Justice/Digital Divide: Questions of Synthesis

The constructs of PCK and TPCK, teaching for social justice, and impacting the digital divide combined to form the framework of this inquiry. Because of extensive JPD experienced by much of the faculty at Ravine Middle School throughout five years of GEARUP school reform initiatives, researchers hypothesized that teachers would demonstrate expertise in these areas. Furthermore, relationships between these constructs would be examined to determine possible connections between reformed teaching practices (PCK and TPCK) and the impact on social justice in these classrooms. Specifically, was the issue of the digital divide being impacted in these classrooms? Because each of these propositions suffers from a lack of substantive research based on detailed, repeated classroom observations, this study provided a unique and valuable dataset. Two primary questions guided the study:

• Does the level of the implementation of reformed teaching practices significantly relate to the technology use of urban middle school teachers?
• Does the level of implementation of reformed teaching practices and technology use significantly differ by social justice indicators (high/low)?

CONTEXTUAL LANDSCAPE AND METHODS

Ravine Middle School in the Midwest has many characteristics that make it a unique site for study. Seventy-five percent of the 850-member student body is categorized as “at-risk,” living on poverty-level family incomes. The minority
population of the school is less than 15%, almost equally divided between
African-American and Hispanic groups. However, a significant number of
poor Appalachian families also attend the school. The school receives sub-
stantial Title One funding, because of such a high poverty rate, and these
funds are used to provide a variety of initiatives aimed at facilitating student
success in school.

Since this study sought to capture the complexities of classroom teach-
ners’ expertise in PCK, TPCK, teaching for social justice, and impacting the dig-
ital divide, a mixed-methods triangulation design was utilized. Researchers
carried out multiple classroom observations over an eight-month period us-
ning two types of instruments identified as the “longstop protocol” (LSP) and
the “quickstop protocol” (QSP). Observation data were then converted into
quantitative data for statistical analysis. The following sections describe how
data were converted. In addition, over 500 classroom artifacts (lesson plans,
classroom handouts, student work samples, etc.) were collected and coded
relating to these observation protocols.

LSP

In order to capture detailed data from daily class sessions throughout Ravine
Middle School, a team of researchers randomly visited full class sessions
(43-minute periods) of 23 teachers, completing three to four observation
protocols for each teacher. Randomization was determined by assigning
each teacher a number and then using a digital spreadsheet to generate
a list of random numbers within this range. Teachers were then observed
in this order. Researchers were able to complete six to eight observations
each week, and continued through the random order until it was finished.
Once this occurred, another list of the numbers in a random order was
generated. Eighty nine observations were attempted during the months of
January through April 2008, with 82 LSPs completed. Seven observation ses-
sions were not completed due to classroom constraints (substitute teacher,
exam being given, etc.).

The data collection instrument used during these LSP observations was
the well-established Reformed Teaching Observation Protocol (Gross & Hick-
man 2007) with Social Justice supplement (RTOP+). The original RTOP was
an instrument designed by the Evaluation Facilitation Group of the Arizona
Collaborative for Excellence in the Preparation of Teachers (ACEPT) in 1999.
The RTOP has been shown to be a valid and reliable instrument in measur-
ing teacher practice over the past decade (Maher, 2009; Pilburn et al., 2000;
Pilburn et al., 2001). The adapted instrument was tested by the Teaching
for a New Era (TNE) project in 2007 (Pedulla, Salomon–Fernandez, Miteau,
Jong, & Cochran–Smith, 2007), and contained the items from the RTOP in-
strument with the addition of six items specifically related to teaching for
Researchers chose the RTOP+ to document classroom practices so that evidence of teachers’ JPD (emphasizing PCK and teaching for social justice) might be documented. Additionally, the open-ended response items in the RTOP+ provided data related to digital technology availability and use in the classrooms observed. These responses served as data points related to TPCK.

Ravine researchers were trained to use the instrument by observing the same class session and discussing their results. After four to eight observation and critical analysis sessions, researchers achieved an inter-rater reliability of .70 to .85 and began conducting observation sessions for the study.

The RTOP+ yields scale scores in six areas: (1) lesson design and implementation, (2) content: propositional knowledge, (3) content: procedural knowledge, (4) classroom culture: communicative interactions, (5) classroom culture: student/teacher relationships, and (6) teaching for social justice. Data on technology use and integration within these observed sessions were also captured with the RTOP+ through the descriptive and demographic information retrieved. The RTOP+ contains the directive: Please describe any technology visible in the room (e.g., overhead projector, TV/VCR, computers). Please describe the type and number of computers, if these machines are turned on, if they are being used and in what manner. Also note teacher use and student use of digital technologies throughout the lesson observation.

With this information, combined with the data collected through the QSP observations, each session was assigned a technology integration rating. The following paragraphs explain this work in more detail.

QSP

In addition to observing 82 full class sessions at Ravine Middle School, researchers also completed five-minute “quickstops” in 58 of 66 Ravine teachers' classrooms on a weekly to biweekly basis. In all, 871 QSPs were tallied, with an average of 16 stops per classroom from December 2007 to April 2008. Researchers unobtrusively slipped quickly into classrooms, indicated the technologies in use, the user, and the type of use. The QSP identified various digital technology resources in the classroom, including teacher workstation/projection systems, student computer workstations, digital cameras...
and microscopes, and graphing calculators (See Appendix A). If these re-
resources were in use, researchers also noticed who was using them (teacher,
individual students, student groups) and what software applications were be-
ing utilized (presentation, spreadsheet, word-processing, concept-mapping,
Internet browser, etc.). The QSP data were then entered into an electronic
database for analysis.

Calculating the Technology Quotient
Since each teacher was observed using the LSP and the QSP numerous times,
the researchers sought to generate a value that represented the overall level
of technology use. To do so the researchers generated a technology quo-
tient for each LSP using two values—a technology integration level from
the LSP and an average technology indicator from the QSP. The first value,
the LSP technology integration level (LSP–TIL), was determined for each LSP
session and represents the level of technology integration within that lesson
observed. Essentially, each LSP session was rated based on the level of tech-
nology integration observed. Three levels, ranging from 2 to 4, were used.
Level 2 represents teachers using digital technologies in instructional meth-
ods. Level 3 indicates students using digital technologies during the class
session. Level 4 represents students working on a project using digital tech-
nologies. For example, if during a LSP session a teacher was observed using
the projection system for instruction (level 2) and students were observed
individually using computers or other digital devices to complete learning
tasks (level 3), then the class session would receive a level of 5 (2 + 3). If
students were observed participating in project work that integrated digital
technologies a level of 4 would be indicated. If all three types of technology
integration scenarios were observed in one LSP observation (highly unlikely)
it would be possible for a session to receive a level of 9 (2 + 3 + 4). Other
instruments have utilized a similar leveling system to describe and differenti-
ate the quality of technology integration (Hastings, 2009; Washington Office

The second value used to generate the technology quotient (TQ) was
the QSP Indicator of Technology Integration (QSP–ITI) and represents the
average amount of technology used per quickstop observation. To calculate
this value, QSP data were first sorted using individual teacher identifiers.
Various types of digital technology uses (e.g., SmartBoard, video camera,
projector) in a particular teacher’s classroom were tallied and divided by the
number of visits per teacher. In theory, it would be possible for a teacher
to have up to 10 checkmarks on the QSP (again, highly unlikely), indicating
that the teacher was using the projection system, a SmartBoard, and digital
cameras; and all students were using computer workstations, cameras, and
other digital peripherals.
The technology quotient then combined the LSP–TIL and the QSP–ITI by multiplying these two values (QSP–ITI x LSP–LIT = TQ) such that the TQ is a function of quality of technology integration and variety of technology used. The technology quotients for each LSP instance were rounded to the nearest whole number, with those numbers over 4 being indicated as a “4” for the purpose of analyzing the TQ score with the RTOPS+, which data were gathered on a 4-point scale. Fifteen, out of the 89 LSP sets initially had a TQ raw score over 4.

For example, if a teacher’s classroom was observed 16 times during the study using the QSP and 32 items indicating digital technology use were documented during those visits, the teacher would be given the technology QSP indicator of 2.0 (32/16). If the LSP–TIL for a particular observation was 2, then the TQ for that class session would be 4.0 (2.0 × 2). Of course, with this system, a class session could, theoretically, receive numerical identifiers ranging from 0 to 90; but the realities of classroom life prove this to be highly unlikely. Rather, researchers found that using this quietly construed process actually succeeded in providing comparative data that could reasonably be integrated with the RTOP+ scale for analysis.

These methods yielded a complex and relatively large data set. Considering that each Ravine Middle School teacher taught six class periods a day and engaged in teaching lessons an estimated 170 days that year (additional days spent on testing, convocations, etc.) for a total of 1,020 possible lessons, researchers were able to document three to four complete class sessions (LSP) and 16 quick visits for each teacher. Mathematically, the data was only a fractional representation of classroom teaching during that school year, but the collection comprised a rigorous sampling of teacher work in any case.

RESULTS

In analyzing the data, subscale scores for each reformed teaching practice were created by calculating the mean of respective subscale items: Lesson Design, Propositional Knowledge (PpK), Procedural Knowledge (PcK), Content (PpK + PcK), Communicative Interactions (CI), Student/Teacher Relationships (S/TR), Culture (CI + S/TR), Social Justice, and Technology Quotient. Table 1 presents the items that correspond to each subscale, frequencies, and percentages for subscale intervals, and means and standard deviations for subscales. The subscale of Content combines the subscales of Propositional Knowledge and Procedural Knowledge; this scale is representative of PCK. The subscale of Culture combines the subscales of Communicative Interactions and Student/Teacher Relationships. While the majority of participants fell in the “descriptive” interval (3.00–3.99) for each subscale, most subscale means ranged from 2.50 to 3.00. The subscales of
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**TABLE 1** Descriptive Statistics: RTOP+SJ Subscales and Technology Quotient

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Items</th>
<th>0–.99</th>
<th>1–1.99</th>
<th>2–2.99</th>
<th>3–3.99</th>
<th>4.00</th>
<th>M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Lesson Design</td>
<td>1–5</td>
<td>4</td>
<td>20</td>
<td>15</td>
<td>22</td>
<td>17</td>
<td>2.69</td>
<td>1.12</td>
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<tr>
<td>Propositional Knowledge (PpK)</td>
<td>6–10</td>
<td>3</td>
<td>7</td>
<td>19</td>
<td>36</td>
<td>14</td>
<td>3.02</td>
<td>0.94</td>
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<tr>
<td>Procedural Knowledge (PcK)</td>
<td>11–15</td>
<td>3</td>
<td>20</td>
<td>17</td>
<td>29</td>
<td>9</td>
<td>2.63</td>
<td>1.07</td>
</tr>
<tr>
<td>Content (PpK + PcK)</td>
<td>6–15</td>
<td>3</td>
<td>15</td>
<td>19</td>
<td>36</td>
<td>5</td>
<td>2.83</td>
<td>0.96</td>
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<tr>
<td>Communicative Interactions (CI)</td>
<td>16–20</td>
<td>6</td>
<td>15</td>
<td>27</td>
<td>27</td>
<td>5</td>
<td>2.59</td>
<td>0.97</td>
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<tr>
<td>Student/Teacher Relationships (S/TR)</td>
<td>21–25</td>
<td>1</td>
<td>5</td>
<td>18</td>
<td>35</td>
<td>19</td>
<td>3.22</td>
<td>0.81</td>
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<tr>
<td>Culture (CI + S/TR)</td>
<td>16–25</td>
<td>1</td>
<td>11</td>
<td>24</td>
<td>37</td>
<td>5</td>
<td>2.90</td>
<td>0.83</td>
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<tr>
<td>Social Justice</td>
<td>26–31</td>
<td>1</td>
<td>7</td>
<td>23</td>
<td>30</td>
<td>17</td>
<td>3.11</td>
<td>0.82</td>
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<tr>
<td>Technology Quotient</td>
<td>23</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>15</td>
<td>1.80</td>
<td>1.48</td>
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</table>

Student/Teacher Relationships ($M = 3.22$), Social Justice ($M = 3.11$), and Propositional Knowledge ($M = 3.02$) showed the highest means. The subscale with the lowest mean was Communicative Interactions. The technology quotient was very low ($M = 1.80$), with the majority of teachers using digital technologies in their teaching, but not demonstrating student use of technologies for learning. A correlation matrix (see Table 2) was constructed to examine the relationships among the subscales and Technology Quotient. All correlation coefficients were statistically significant at $p < .01$. Subscales were strongly correlated with one another with most coefficients ranging from .60 to .95, with the exception of correlations with the technology quotient. Social Justice was most related to Student/Teacher Relationships ($r = .730$) and Content ($r = .701$). Interestingly, the technology quotient generated fairly

**TABLE 2** Correlation Matrix of Subscales

<table>
<thead>
<tr>
<th>Subscale</th>
<th>LD</th>
<th>PpK</th>
<th>PcK</th>
<th>Co</th>
<th>CI</th>
<th>S/TR</th>
<th>Cu</th>
<th>SJ</th>
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<td></td>
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<td>Propositional Knowledge (PpK)</td>
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<td>.864</td>
<td>.804</td>
<td></td>
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<td>Procedural Knowledge (PcK)</td>
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<td>.875</td>
<td>.942</td>
<td>.958</td>
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<td>Content (Co)</td>
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<td>.566</td>
<td>.782</td>
<td>.720</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Student/Teacher Relationships (S/TR)</td>
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<td>.673</td>
<td>.783</td>
<td>.771</td>
<td>.722</td>
<td></td>
<td></td>
<td></td>
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<td>Culture (Cu)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Justice (SJ)</td>
<td>.816</td>
<td>.663</td>
<td>.843</td>
<td>.800</td>
<td>.941</td>
<td>.913</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Quotient</td>
<td>.699</td>
<td>.665</td>
<td>.667</td>
<td>.701</td>
<td>.665</td>
<td>.730</td>
<td>.696</td>
<td></td>
</tr>
</tbody>
</table>

Note: all correlation coefficients were significant at $p < .01$. 

...
weak to moderate correlations ranging from .23 to .42. These low correlation coefficients may be due to the technology quotient—what it measures and how it is calculated. Although the technology quotient attempts to capture one’s level of technology integration, it does only represent technology use at a few points in time, whereby the instructor may have implemented an excellent lesson that does not utilize technology. The technology quotient was most related to the subscales of Communicative Interactions \( (r = .417) \), Culture \( (r = .392) \), and Procedural Knowledge \( (r = .380) \). Overall these correlations do support the interrelations between PCK, Social Justice, and TPCK.

Social Justice group differences were also examined with respect to the subscale scores. (All correlation coefficients were significant at \( p < .01 \).) Participants were categorized as low social justice with subscale scores ranging from 0 to 2.99, while participants with subscale scores of 3.00 and greater were identified with high social justice. The \( t \) tests of independent samples were conducted to compare high and low social justice groups. Table 3 presents group means and standard deviations along with \( t \) test results. All subscales revealed significant group differences, indicating that participants with high Social Justice had significantly higher means in all subscales scores when compared to those with low Social Justice. Cohen’s \( d \) was also calculated to evaluate the size of effect for each subscale. All subscales indicate extremely large effects as a result of Social Justice groupings. The subscales of Lesson Design and Content (PCK) showed the greatest effect from Social Justice. The technology quotient also showed significant differences between Social Justice groups. In general, teachers reporting high Social Justice were observed to have a higher levels of implementation of reformed teaching practices and technology use.

### Table 3

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Low ( (n = 31) )</th>
<th>High ( (n = 47) )</th>
<th>( t )</th>
<th>( p )</th>
<th>Cohen’s ( d )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson Design</td>
<td>1.71 .82</td>
<td>3.35 .75</td>
<td>−9.13</td>
<td>.0001</td>
<td>−2.09</td>
</tr>
<tr>
<td>Propositional Knowledge</td>
<td>2.23 .89</td>
<td>3.55 .49</td>
<td>−8.39</td>
<td>.0001</td>
<td>−1.92</td>
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<tr>
<td>Procedural Knowledge</td>
<td>1.74 .73</td>
<td>5.21 .85</td>
<td>−8.04</td>
<td>.0001</td>
<td>−1.84</td>
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<tr>
<td>Content (PCK)</td>
<td>1.98 .74</td>
<td>3.38 .62</td>
<td>−9.07</td>
<td>.0001</td>
<td>−2.08</td>
</tr>
<tr>
<td>Communicative Interactions</td>
<td>1.94 .78</td>
<td>3.02 .83</td>
<td>−5.71</td>
<td>.0001</td>
<td>−1.31</td>
</tr>
<tr>
<td>Student/Teacher Relationships</td>
<td>2.64 .85</td>
<td>3.61 .49</td>
<td>−6.40</td>
<td>.0001</td>
<td>−1.47</td>
</tr>
<tr>
<td>Culture</td>
<td>2.28 .72</td>
<td>3.51 .62</td>
<td>−6.74</td>
<td>.0001</td>
<td>−1.55</td>
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<tr>
<td>Technology Quotient</td>
<td>1.29 1.40</td>
<td>2.14 1.47</td>
<td>−2.60</td>
<td>.0120</td>
<td>−0.59</td>
</tr>
</tbody>
</table>

**Note:** All correlation coefficients were significant at \( p < .01 \).
DISCUSSION

This extensive documentation and analysis of teaching practices in an urban middle school yielded powerful evidence of how exemplary teachers impact social justice and the digital divide. Years of JPD supported the development of these teachers, as they learned to employ sophisticated pedagogical techniques. While teachers were observed to use technology at fairly low levels, technology use showed significantly moderate correlations with several reformed teaching practices supporting the theoretical framework of TPCK and the strong link between pedagogy and quality technology use (Mishra & Koehler, 2006). Several studies support the relationship between a constructivist environment and quality technology use (Moersch, 2001; Wenglingsky, 1998).

A teacher’s commitment to social justice was another factor related to reformed teaching practices, supporting a strong relationship of social justice with PCK and TPCK. As a result, teachers who are committed to empowering students of marginalized populations through creating democratic classroom environments may be more knowledgeable and/or committed to implementing innovative teaching practices. Ravine Middle School classrooms that demonstrated TPCK/ SJ (Social Justice) were interactive and honored student voices. Teachers and students were respectful of one another. Many lessons were inquiry-based, with students participating in activities and conversations about the lesson at hand with interest. Students were not passive observers in the TPCK/SJ classrooms, but were active seekers of knowledge. Further studies of high TPCK/SJ classrooms and student achievement on state standardized tests will be forthcoming, but research to date indicates that active learning environments like TPCK/SJ classrooms promote academic achievement. Since students in the high social justice classrooms were also getting experiences in integrating technologies for learning, digital divide issues of access and use were being addressed.

In essence, the overlapping of these constructs (PCK, Teaching for Social Justice, and Technology Use in the Classroom) provides an avenue to explore the powerful results inherent in this synergy. Figure 1 illustrates how these phenomena intersect to identify a type of teaching that truly impacts the digital divide, while providing students with experiences closely tied to the teaching and learning of key content areas. Firstly, PCK combines with Technology Use in the Classroom to form TPCK. Note that this leaves a portion of Technology Use in the Classroom that might more aptly be described as “technology for technology’s sake.” In other words, it is entirely possible for teachers to be implementing technology tools that are unrelated to curricular learning goals. We would characterize this type of implementation as relatively unimpactful. In addition, Teaching for Social Justice combines with Classroom Technology Use to provide some impact on the digital divide, by at least providing some access or quality of use of the digital technologies
that might not otherwise be experienced by students. This use does not necessarily result in meaningful learning in relationship to core curriculum content. However, when teachers combine TPCK with Teaching for Social Justice, students are challenged to use digital technologies, in truly democratic and empowering ways, to gain knowledge and skills directly targeted as curricular objectives. This type of teaching, that which was nurtured through JPD experiences, provides students with learning opportunities that are content-focused, socially just, and technology-enhanced.

This study focused on classroom data related to teachers’ expertise in conveying academic content, creating a democratic classroom environment, and effectively integrating technology. The findings demonstrate that these three components of teacher expertise are correlated closely with one another. Because of the complexity of the classroom environment, it is difficult to conclude exactly how a teacher manages to craft daily lessons that effectively reach students with content knowledge, while enacting a democratic experience. Why technology integration is often a part of this process is also unclear, but some glimpses into the documented teacher practices found in this study may offer some insights. Following are examples of classroom practices that ranked high in TPCK using the technology quotient (TQ) previously described.

Examples of Classroom Practice

A few of the classrooms observed necessarily demonstrated strong evidence of student engagement, dialogue, and technology use. Among these were the industrial technology classes and the classes held in the media center. These venues, coupled with teachers that expected students to be “intrepid explorers” (Vannatta, 2007), consistently evidenced students working on group
or individual projects that required research, debate, and media creation. Students in these classrooms were using computers to locate and analyze information, discussing their findings, and creating projects and presentations, shared with the class. Beyond these courses, however, science, language arts, social studies, and math classes were also found to include examples of strong TPCK, identified by a high TQ.

A science class was observed during a unit on sound and frequency. Collaborative student groups were using five classroom computers to research presentations on sound, including locating actual sound files to be analyzed and discussed. The teacher, using another computer connected to a projection system, provided direction on research practices and examples of resources. During this observation session, a research assistant noted that “connections were made between sound and music” in response to LSP item 10, “Connections with other content disciplines and/or real world phenomena.”

In language arts classes focusing on the topic of poetry, two teachers were observed presenting poetry vocabulary using their teacher workstation and a projection system. Students were given direction on an assignment to write their own real-life poetry. Students then worked in groups, brainstorming ideas related to real-world situations, specifically related to success in high school and the current job market. With these ideas in mind, students moved to computer workstations to begin to write rough drafts of poems.

A social studies classroom studying “The Crusades” included students creating multimedia slides containing key facts about this event in history. In addition, the teacher, again using a projection system, provided an outline of elements to be included in students’ final presentations. Students worked in cooperative groups during this time, and then presented their slides to the rest of their classmates. The teacher’s lesson objectives included, “Students will be able to explain how the participation of citizens differs under monarchy, direct democracy and representative democracy” (State of Ohio, 2010).

As a final example, a math class worked on the concept of slope, using graphing calculators. The teacher first used the projection system to project a grid on the whiteboard. Students used erasable markers to draw points on the grid corresponding to solution sets for equations; using these points, lines were constructed on the grids and students used the grid segments to calculate the slope. The teacher also used the projection system to provide a brief tutorial on the use of graphing calculators. Students then worked in groups, using the graphing calculators, to complete equations and slope calculations. When asked if she sometimes made changes to the curriculum, the teacher responded, “Yes! I might break this down into more manageable steps. Next I would go deeper into the concept versus the broader . . . to develop more conceptual versus procedural knowledge.”

In summary, the class sessions that received a high TQ/SJ rating were classes in which (a) the teacher demonstrated a keen focus on key concepts of the lesson and kept the students on task; (b) students were working in
groups and actively engaged in dialogue about the lesson concepts; and
(c) digital technologies were being utilized to support the key concepts
identified by the teacher. Certainly other consistencies could be noted, but
these observations support the premise that PCK, democratic classroom de-
velopment, and TPDK are identified in classes noted to have a high TQ
rating.

LIMITATIONS

While this study utilized rigorous data collection methods and a large data
set, there are still limitations that should be noted. No pretest measure was
present in this design. While the GEARUP school reform initiative was in
place for five years, no observational data were available at the beginning of
this endeavor. Therefore, it might be argued that these teachers have been
demonstrating TPCK and socially-just classroom practices for years. If that is
the case (though quite unlikely), and the reform efforts, including the JPD
activities, had no impact on classroom practice, this study still provides a
glimpse into what a TPCK classroom looks like and how such classrooms
impact the digital divide and social justice issues. The complexities of school
life place many obstacles in the way of researchers, and these are limiting
factors. Certainly the instruments used and the artifacts collected represent
only a fraction of what occurs throughout a year of schooling. Researchers
certainly did not see a large portion of the classroom experiences, but ana-
lyzed a powerful sample nonetheless. The LSP required researchers to make
judgments in each classroom, and these judgments could be skewed. Even
with training, it is possible that some researchers scored various classrooms
differently based on their own personal bias, or other invading factors at
the time of data collection. With these limitations in mind, this study still
provides details and substantive data to support the relationship of TPCK
and teaching for social justice.

RECOMMENDATIONS

JPD opportunities afforded through the efforts of Project GEARUP arguably
enabled Ravine teachers to effectively and creatively provide high-quality
instruction to students that impacted the digital divide. To replicate this type
of professional development, teacher-educators and administrators need to
establish democratic and reflective spaces for teachers to examine their prac-
tices and identify areas for attention and growth. Listening to teachers and
supporting their priorities when it comes to professional development should
lead to activities that focus on PCK, TPCK, and social justice among other
needs and interests. Teacher-educators need to model democratic, inclusive
practices and TPCK, so teacher-candidates not only hear the rhetoric, but
actually see these strategies play out. For practicing teachers, resources that support their efforts must be provided. In this particular case, JPD efforts included not only workshops and graduate courses, but also the provision of materials, software, computers, digital peripherals, and long-term professional support (pedagogical and technological). Opportunities for co-teaching, peer observation and feedback, and focus group meetings for reflection supported continued professional development targeting PCK, TPCK, and social justice.

CONCLUSION

Teaching is a complex activity and while good teachers seem to be easily identified by students, parents, and administrators, establishing a “formula” for nurturing a good teacher sometimes seems out of reach. Our best practices must continue to point to good models, analyze those models, and share those models with future teachers. Five years of JPD related to the school reform efforts of project GEARUP were examined through critical observations of classroom practices. Teachers who were observed to be engaging students in collaborative, interactive, dynamic environments were those who demonstrated solid content knowledge and PCK (Beattie, 1995). In addition, these teachers utilized digital technologies to support teaching and learning in their classrooms (TPCK), they promoted social justice and, researchers argue, began to address digital divide issues. These results are compelling and provide a basis for continued research and professional development. They certainly arise from a larger data set than has been collected for most studies of TPCK and social justice/digital divide focused studies. Perhaps TPCK, as a subset of PCK, must be modeled in teacher education programs in order for students to be more prepared to enter their professions in a position to bridge the digital divide.

REFERENCES


APPENDIX A

Quickstop Data Collection Instrument

Classroom Tech Inquiry Quickstop Protocols

Room (#/teacher)_____________________ Date: ____________
Content Area: ________________________ Time: ______________
Current Activity:
Teacher-Centric (one-way lecture)

Interactive (teacher/student exchange)

Group (student small group work)

Individual

Technology in Use (check all that apply):

- Classroom projection system
- PowerPoint
- Web site
- Word
- Excel
- Inspiration
- Video (U.S.? Other?)
- SmartBoard list content area
- Student computers
- Turned on
  - Students using workstations number of students
  - Individually □ in groups
- Laptop cart number of students
- Individually □ in groups

Applications/activities at student computers

- PowerPoint
- Web site
- Word
- Excel
- Inspiration
- Other
- Digital Tech Peripherals
- Digital cameras
- Graphing calculators
- Classroom response (clickers)
- Other

Additional Notes: _______________________

Documenter: _______________________

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