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Professional Development Rewired: A Case Study of TIMS Approach

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Abstract:*This paper presents a case study of a technology-enhanced professional development strategy and demonstrates how an extended workshop approach, based on tutorials, instructional modeling, and support (TIMS), was used for professional learning at a school site. Data collection procedures included a pre-survey, a recorded focus group, individual interviews, a post-survey, and previous district historical survey collection and analysis regarding professional development sessions. Overall, the results indicate that the TIMS approach is an effective form of professional development delivery, which focuses on providing live modeling, attending to lesson relevancy and student needs, as well as being content-specific. Implications regarding implementing technology-focused professional development initiatives are discussed.*

Keywords: professional development, technology integration, K-12 teachers

1. Introduction

Researchers and educational practitioners recognize that technology can bring considerable benefits to student learning when used appropriately and effectively (Giilbahar, 2007; Kim & Hannafin, 2011). Digital learning experiences and skills have advanced modern K-12 teaching and learning as youth are more influenced by the internet and other ubiquitous mobile technologies (Carr, 2011; Clary, Kigotho, & Barros-Torning, 2013). Research has shown that the modern tools that students are familiar with may have tremendous potential of gaining student interest and inducing attitudes and engagement toward learning (Chou, Block & Jesness, 2012; Rau, Gao, & Wu, 2008; Walling, 2012). As supportive wireless network capabilities, mobile technologies, and digital learning expectations continue to spread, it provides K-12 educators tremendous opportunities to design technology-rich learning environments and integrate digital tools into their classrooms. Despite the increasingly easy and affordable access to technology, teachers frequently struggle with effective technology integration into their teaching practices due to multiple intrinsic and extrinsic challenges (Crompton, Burke, & Gregory, 2017; Hutchison & Reinking, 2011; Hwang & Tsai, 2011). Research evidence suggests that teachers from either public or private schools are often sluggish with adopting technology into their teaching. As a result, technology is being under-utilized in the classroom environment (Ditzler, Hong, & Strudler, 2016; Giilbahar, 2007; Hayes, 2007; Hinostroza, Khlaif, 2018; Labbe, Brun, & Matamala, 2011). Particularly, keeping up with the technology growth is challenging, and new technologies keep emerging (Dubé & Wen, 2022).

One of the crucial factors contributing to teachers' reluctant technology adoption is due to insufficient and inadequate teacher professional development (Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, & García-Martínez, 2020). Unfortunately, even when professional development (PD) opportunities are available, participating in PD may not lead to effective technology integration (Martin, Kragel, Quatroche, & Bauserman, 2019). A well-designed, effective training program can boost teachers' confidence and competence in utilizing technology (Chaipidech & Srisawasdi, 2021; Harris & Hofer, 2011; Overbaugh & Lu, 2008; William, 2017). However, cases have been often found where ineffective, old-fashioned PD training persists. For example, a top-down approach that requires teachers' seat time outside their typical teaching schedule was found common (Liu, 2013). Such an approach to teacher training may cause isolation from teachers' daily teaching practices, and therefore it is unlikely to bring forth effective change in their classroom teaching practices (Diaz-Maggioli, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001; Yang & Liu, 2004). Meanwhile, technology-focused PD sessions tend to be more challenging in practice, as they aim to serve a dual purpose: to strengthen teachers' content knowledge of the subject matter, as well as advance their skills and knowledge to keep up with the latest technological developments and tools (DeMonte, 2013; Johnson et al., 2013). These outdated practices and new challenges suggest the need to further examine the nature of today's PD and the continuous effort to research and improve the quality and effectiveness of teachers' professional development focusing on technology integration.

2. Literature Review

High quality or effective professional development is a type of teacher training "which results in improvements in teachers' knowledge and instructional practice, as well as improved student learning outcomes" (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009, p. 3). Results from a national survey of 1,027 mathematics and science teachers suggested that successful PD activities are characterized by the following indicators: a) focusing on knowledge of the subject; b) promoting active learning; and c) fostering coherence with other learning activities (Garet et al., 2001). Additionally, structural factors, such as the format of PD activities (i.e., workshop vs. study group), the makeup of teachers (i.e., whether teachers are from the same school, grade, or subject), and the duration of the activity are all attributable to the success or failure of PD.

Similarly, Desimone et al. (2002) specifically stated the characteristics of "high quality" PD, including a) a strong focus on content, b) familiarity with how students learn best, c) participating in active learning communities, d) providing teachers with opportunities to lead, and e) collaborations within departments within the same school. Merchie et al. (2018) proposed an extended framework that placed emphasis on the facilitator's skills, competencies, and feedback. These characteristics were confirmed in a recent article; planning an effective teacher PD program should include a consideration regarding the school context, how the school administrators should play a role, and the alignment with the teachers' pedagogical needs that can ultimately help address the students' learning needs (Martin et al., 2019).

2.1 Existing Models of Professional Development

Several conceptual models of PD provide insights into how PD affects change in teachers and students. For example, Guskey's (1986) sequential *model of teacher change* postulated that the ultimate change in teachers' beliefs and attitudes derived from a) PD focused on a prescribed product or outcome, b) teachers' continual efforts in changing their classroom practices and c) changes seen in student learning outcomes. In Guskey's (2002) later work, he modified the model, suggesting that a change in instructional practice teacher often precedes their changes in beliefs and attitudes, while making a difference in student learning would be the ultimate change in his model. Clarke and Hollingsworth (2002) proposed a PD model, the Interconnected Model of Teacher Professional Growth, which again highlights the interconnectedness between changes in the external domain (i.e. PD training), the domain of professional practice (i.e. the classroom), and the personal domain (i.e. knowledge, beliefs and attitudes of teachers). These models in the arena of PD reinforce the importance of viewing teachers as progressive change agents. This allows teachers to have time and space to make changes in their practice so that they can observe how these changes influence their students, which ultimately leads to a shift in teachers' attitudes and beliefs. However, these general PD models fail to provide specific guidance on supporting teachers' technology PD endeavors.

2.2 Teacher PD for Technology Integration

Extant research has demonstrated that teacher PD focusing on technology integration often includes numerous challenges (Fernández-Batanero et al., 2020). The most significant barriers when implementing professional development sessions with a focus on technology include time and inadequate resource access (Fang,

Chan, & Kalogeropoulos, 2021; Kopcha, 2012). Technology-focused PD activities are often constrained by the school districts' logistical and financial limitations. Therefore, a quick demonstration type of PD workshop approach is commonly selected to meet the ever-changing nature of digital technologies. Unfortunately, the workshop approach is often criticized as it merely promotes the use of the tools taught rather than enhances a true sense of technology-enriched learning and instruction focused on specific content areas (Carlson & Gadio, 2002; Hutchison & Woodward, 2018; Trucano, 2005). Teachers who learn via a workshop approach reported difficulties in transferring skills learned during the workshop into their own classroom teaching in that these skills learned at a workshop were often taught out of a proper instructional context such as a classroom (McKenzie, 2001), overlooking the needs to cover the pedagogical aspects (Fernández-Batanero et al., 2020). Additionally, research has demonstrated that teachers' advanced technical skills and competence do not necessarily equate to their teaching practices with technology in the classroom (Luo, Lee, Muljana, & Shah, in press; Jaipal & Figg, 2010; Mishra, Koehler, & Kereluik, 2009). Therefore, in order to conduct an effective technology-focused PD, it is critical to design activities that not only involve teaching technical skills but also enable teachers to understand the pedagogies and to practice what they learn in their own classroom (Fernández-Batanero et al., 2020; Hu, Yuan, Luo, & Wang, 2021).

Prior research also identifies critical components and factors for an effective technology-focused PD. In a meta-analysis of 20 empirical articles, Gaytan and McEwen (2010) developed a framework for evaluating the impact of PD based on empirical evidence found in the studies, which contains a) feedback from participants, b) participant learning, c) organizational support, d) changed instructional practices, and e) student impact. Proposing a collaborative PD model named *technology user groups,* Parette et al. (2013) acknowledged the following attributes of a successful technology PD: a) allowing time and space to practice learned skills, b) providing on-site support and facilitation, and c) cultivating a learning community of teachers.

The *Technological Pedagogical Content Knowledge* (TPACK) model is a well-adopted framework to help understand technology integration for education, especially in a K-12 education context (Koehler & Mishra, 2009; Mishra & Koehler, 2006; Koh, 2019; Schmid, Brianza, & Petko, 2021). The TPACK model centers on the interplay and connectedness of three primary forms of knowledge required for successful technology integration: content knowledge, pedagogical knowledge, and technological knowledge. Building off of TPACK research, Jaipal and colleagues developed a TPACK-based Professional Learning Design Model (TPLDM) for technology workshops, consisting of four content-focused learning activities to help teachers plan and implement technology-enhanced instruction (Figg & Jaipal, 2012; Jaipal-Jamani & Figg, 2013). The TPLDM model involves: a) setting the context and goal by modeling a technology-enhanced activity, b) fostering conversations around pedagogical issues, c) cultivating technical skills via brief tool demonstrations, d) creating opportunities for teachers to collaboratively design learning activities tailored to their own content areas.

Hutchison and Woodward (2014) proposed the Technology Integration Planning Cycle (TIPC) as a tool for guiding teachers to focus on the instructional goals before selecting the technological tools. A few years later, Hutchison and Woodward (2018) used

TIPC as a framework to develop a new PD model on technology integration, called the TIPC Model of Professional Development. This model is aimed to support teachers in prioritizing instructional goals over the tools, identifying the contributions of the tools, potential barriers to tools integration, potential changes as a result of using the tools, as well as understanding their own roles in facilitating instructions through technology integration (Hutchison & Woodward, 2018).

2.3. Purpose of the Study

Grounded in the seminal TPACK model and Jaipal-Jamani and Figg's (2015) TPLDM approach, the TIMS approach exemplifies a constructivist approach to learning by doing. It consists of various implementation phases, including Tutorials, Instructional Modeling, and Support (TIMS). Within the TIMS approach, modeling is a key component as it distinguishes itself from TIPC, which focuses on technology integration planning rather than implementation. Technology-infused lessons are demonstrated in a live classroom while the teacher observes. Pedagogical dialogue is constantly present during the sessions. The facilitator also offers additional support throughout the rest of the lesson implementation as needed by the teacher.

While the extant literature provides ample frameworks and recommendations to guide PD activities, PD in practice is still inundated with varying issues and often not well received by teachers. Building upon the existing literature surrounding general PD practices and technology-focused PD, this study sought to advance our current understandings of how PD activities can be a positive stimulus for changes in teacher attitudes and perceptions as well as their classroom practices. This study illustrates how the TIMS approach was implemented at a particular public school, where the PD opportunities have not been well received. This study was guided by the following research questions:

1. What were teachers' initial perceptions and attitudes regarding professional development?

2. How may the implementation of using the TIMS approach have changed the initial perceptions and attitudes among middle school teachers toward traditional professional development?

3. What were the essential components of the TIMS approach as reflected by teachers?

3. Method

We employed a multiple-methods case study research design, aiming to gain insights into participants' experience and perceptions of the PD activities designed via a TIMS approach at a particular school site (Yin, 2009). A multiple-methods case study provided a deeper and more comprehensive investigation into the research questions, especially through multiple sources of evidence (Yin 2009). In this study, we collected perception surveys, focus group, individual interviews, and historical survey data to answer the research questions.

3.1. Context of the Research Site

This study was conducted at a rural public school located in the southeastern U.S. Approximately 26% of all students are considered "low-income" and receive free or reduced lunch. In terms of racial or ethnic makeup, the majority of students (75%) are Caucasian, 11% are Black, 9% are Hispanics, 2% are Asians. About 10% of students have learning disabilities. The student-to-teacher ratio is 17:1, and 86% of teachers have three or more years of teaching experience.

3.2. Profile of Participants

The participants included seven teachers that taught similar grade-level students (See Table 1). The participants were intentionally selected through an internet-based survey, aiming to have a broad inclusion of teachers representing varying subject areas and experience levels.

Table 1 Overview of Participants

Participant Pseudonym	Year of Experience	Subject Area Taught	Grade Level Taught
Janet	1	Social Studies	7
John	6 in science & 2 or 3 in math	Science	7
Margret	2	Science	7
Lucy	20	Language Arts	6
Joan	4	Social Studies	7
Judy	15	Science	6
Mary	6	Social Studies	7

3.3. Professional Development Activities

The professional development activities via a TIMS approach took place over a four-week time period at a particular school site with a diverse population. Below we described the four phases of the professional development activities.

Phase 1 (Tutorial): Teachers received a brief tutorial video demonstrating the particular app (Typorama), which was presented within the lesson. The seven-minute video reviewed a summary of app components and highlighted possible classroom organization and pedagogy suggestions such as grouping students into teams, how to collect student work, and the completed examples. All teachers watched the video on their own time prior to the facilitator's modeling sessions.

Phase 2 (Instructional Modeling): A digital facilitator entered teachers' classrooms, each of which had 25-28 students. The digital facilitator modeled the lesson during each teacher's classes while teachers observed the lesson. For example, in each teacher's classroom, the digital facilitator modeled a lesson called "The Meme Challenge." The goal of this lesson was to assist students with a content vocabulary review and deepen their understanding of the social and cultural contexts of certain vocabularies. Teachers were given ten cards, which each listed 8-10 content-based vocabulary review terms and/or words. For instance, one card reads "potential energy: potential energy is the greatest at the top" while showing the top of a rollercoaster. Students were placed in groups of four and asked to create memes to demonstrate their understanding of the term or word by using iPads or cell phones to accomplish this task. When the timer sounded, each team received a different card with new words and/or phrases. When the class was over, points were tallied, and the winning team was announced.

Phase 3: The teachers taught precisely the same lesson content and procedures while implementing the same digital technology as demonstrated by the facilitator without the facilitator being present. Five teachers taught the lesson in all three of their other classes

for an hour each. The other two teachers only taught it to one of their other classes due to last-minute school-wide scheduling and time constraints.

Phase 4 (Support): The facilitator offered additional support throughout the rest of the lesson implementation as needed by the teacher. The process of executing the lesson by the teachers occurred over a one to a two-day timeframe. Throughout this time, support was offered if needed for technical issues. Additionally, support was provided for one week after the study to assist with the development of tools and ideas for implementation for the following school year.

3.4. Data Collection

The researchers first recruited participants from the same school based on the following criteria: a) teachers who taught in the same district for at least one year, b) teachers who teach grades six to eight, c) teachers who have attended at least one professional development within the past year, and d) teachers who have implemented less than five new digital tools within the past year. Pre-surveys were distributed via Google forms, and all seven teachers provided their responses in the pre-surveys. The researchers were able to locate two sets of historical survey data pertaining to two PD sessions conducted in the past year from the same school district.

In the next four weeks, the digital facilitator visited all seven of the teachers' classrooms and conducted the PD activities in a TIMS approach as described previously. A focus group session with five participants was held in the design room of the school and lasted 45 minutes. Individual, face-to-face interviews were conducted with the seven teacher participants. Each individual interview was conducted in each teacher's own classroom and lasted between 20-30 minutes. All interviews and focus groups were audio-recorded. Post-surveys were distributed at the end of the PD session.

3.5. Data Analysis

The pre- and post-surveys included primarily Likert-scale questions regarding their perceptions about PD, their familiarity with the technology applications, and several open-ended questions helping participants reflect on their PD experience and inquiring about their prospective use of what they learned. Pre- and post-surveys were analyzed using descriptive statistical analysis. Responses to open-ended questions were used to triangulate with the interview data. Document analysis was used to analyze the last year's survey data to provide more corroborating historical evidence for the first research question. The survey items were adapted from previous years' survey developed by the elementary school where one of the researchers worked. The eight items Likert-scales on pre- and post-survey were almost identical, except that phrases about the TIMS approach were added to the statements in the post-survey. The pre-survey included two open-ended items that inquired about their perception of PD activities in general, while the post-survey included one item asking for their overall impressions and feedback regarding the TIMS model.

Nine questions were included in the individual, semi-structured interview protocol. The first question was designed to understand each teacher's own teaching methods and values within their classroom. The second set of questions pertained to an overall experience with previous professional development experiences. The third set of questions addressed the TIMS approach experience, which each teacher underwent during the study. The last set of questions elicited ideas for change. The focus group protocol consisted

of seven questions that asked participants to reflect on their experience of the TIMS workshop and prospective applications of what they learned from TIMS.

To identify patterns and themes in teacher perceptions, an open coding analysis approach (Corbin & Strauss, 2008) was employed to generate coding schemes for the analysis of qualitative data. The preliminary coding stage involved identifying key concepts and ideas that corresponded to the research questions with regard to examining whether teachers' perceptions of PD changed after their experience of the TIMS approach and what made the TIMS approach successful (if the participants believed so). This coding structure allowed for identifying and interpreting salient themes, such as the positive effects and constraints associated with the TIMS approach. Lastly, we were able to identify themes and patterns by comparing each participant's focus group and interview responses. The data was consolidated to represent responses, which related to: (a) the importance of content-specific professional development, (b) focusing on student needs and lesson material relevance, and (c) modeling the use of technology and providing ongoing support (See Table 2). We utilized triangulation, reflexivity, and thick description to enhance the trustworthiness and credibility of the data. Multiple data sources were collected, and multiple methods were used to collect data in this study (Lincoln & Guba, 1985; Patton, 2002).

Table 2 Excerpts from Teacher Interviews

Excerpts from the teacher interviews	Themes and categories
"The most difficult thing about PDs is trying to modify what you learn to fit your own content." "PDs need to be content-based and right now they are not." "With regard to PD, "I need more sessions specific to my content. PD in my district is not very beneficial."	Content-specific
"This lesson was differentiated in that all students felt comfortable participating." "Students remained on-task and focused throughout the entire lesson. They loved the immediate feedback." "This PD was very effective because of how applicable it was in the classroom. I like how relevant it is especially for students because it applied to social studies curriculum."	Student needs and lesson relevance
"I prefer that style of watching the modeling of technology lessons before I teach." "With this type of PD I feel like the instructor cares about me more." "I feel like I am being trained instead of introduced." "I worry about teaching things from PD's, but seeing it in action this time made it more doable for me." "I liked being able to see somebody else doing the lesson. That convinced me to do the lesson the rest of the day."	Modeling and support

4. Results

4.1. Teachers' Initial Perceptions and Attitudes

Participants reported their general perceptions of PD activities in the pre-survey. When asked "During the 2016-17 school year, in how many professional development sessions have you participated?" the majority of participants (75%) responded that they participated in one PD session. Before entering their TIMS experience, none of the participants reported prior familiarity with the app Typorama. Table 3 provides participants' responses when asked "To what extent do you agree with the following regarding professional development?"

Table 3 Means and Standard Deviations of Pre-survey

Items	*N*	*M*	*SD*
I often learn pedagogical techniques and strategies that can be easily applied to my own teaching.	7	3.14	1.35
I am often able to apply what I learn into my own teaching.	7	3.00	1.29
I have been motivated to attend workshops offered in my profession.	7	3.29	1.25
The professional development offered in my profession pertains to my needs with regard to student support.	7	2.71	.76
The professional development offered in my profession demonstrates lessons which allow my students to become highly engaged.	7	2.57	.79
The professional development offered in my profession has allowed me to easily increase concept mastery among my students.	7	3.14	1.35
The professional development offered in my profession highlights specific, useful digital tools.	7	3.29	1.11
When I am informed that I will be attending a professional development opportunity or workshop, I become excited and enthusiastic.	7	2.29	1.604

Note. 1 = strongly disagree; 2 = disagree; 3 = neutral; 4= agree; 5 = strongly agree

According to the pre-survey, participants' initial perceptions and attitudes regarding PD activities tended to be either neutral or negative. These survey responses echoed their responses in the open-ended questions. When asked to use their own words to describe their overall impression of PD, one participant stated, "a lot of times the professional development offered in the district is nothing new. It is material I have already learned." Participants also recognized the many challenges with implementing what they learned from PD. For example, one participant commented,

[…] but there is no time to implement anything learned because this usually occurs right in the middle of your own plans. There is never any money for professional development. This concept has seemed to be placed on the backburner within our field. Anytime we do attend a workshop, it's mainly to check off a box to earn CEU Credits. Nobody is checking behind us to make sure we implement what we have learned."

The interview and focus group data showed that the majority of teachers in this study disfavored the PD activities provided

by the school district. Overall, teachers' initial perceptions of the general PD activities provided by the school were presented as a "lack of or poor implementation strategies." Five out of the seven teachers expressed that professional development sessions rarely provided the "how to" and often resorted to a simple, general explanation of the program or tool.

When delving deeper into their feelings regarding previous professional development experiences, we noticed excessive non-verbal cues and "bodily reactions" (Hycner, 1985), which exhibit additional powerful insight. When asked, "What is professional development like here at your school or district?" The body language and facial gestures told an extremely clear story. Janet immediately replied with loud laughter, while John rolled his eyes, smirked, inhaled, and then exhaled, followed by a long pause. Each of the teachers had their own reactions to this question, which showed evidence of frustration and abandonment. When asked what the most challenging aspect of professional development was, Janet stated,

Sometimes professional development can be theoretical and very little presentation of the applicability of it. So, it's really hard to understand for some professional development cases, okay… where… where or what could I do with this? Great idea, but how does it work?

Teachers also felt forced to attend PD activities. As John stated, "I don't feel that we should go out of our way to gain a Continuing Education Unit for something that should be provided to us." In this statement, John addressed the process of gaining credits, in which teachers needed to renew their licenses every five years or whatever credentials their state requires. Teachers' responses indicated that the school districts did not provide enough resources for teachers to accomplish this task. Therefore, teachers were left to seek out their own, free professional development opportunities that were difficult to find.

Survey responses were triangulated with historical data we gathered from two past surveys conducted as previous year's PD evaluation in August and March. When asked "What other feedback do you have to offer?" Out of the 200 participants in the August Survey, 3% of participants expressed a negative attitude, making comments such as "dissatisfied," "how will we?," "a waste of time," and "not helpful." Approximately 33% of participants expressed a positive attitude, making comments such as "Thank you!" "beneficial," and "helpful." About 10% of participants suggested improvements, and 55% of participants either typed "none" in this section or left it blank. In the March Survey, 13% of participants expressed a negative attitude by sharing negative comments, 20% expressed a positive attitude, 24% suggested improvements, and 44% either typed "none" in this section or left it blank. Although the August survey alluded to a more positive tone, the historical survey largely echoed the interviewees' responses that the teachers were generally neutral or negative about PD provided by the district.

4.2. Teachers' Perceptions and Attitudes After the TIMS Approach

Participants reported their perceptions regarding the PD activities using TIMS approach in the post-survey. When asked again about their familiarity with the app, Typorama, 66.7% of respondents rated a four, and 33.3% rated a five. Table 4 provides participants' responses when asked "To what extent do you agree with the following regarding the TIMS Approach to professional development."

Evidently, participants favorably viewed the TIMS approach. Participants expressed excitement and enthusiasm and reported high motivation when learning via a TIMS approach. They also believed that their students were highly engaged in the activities supported by the TIMS approach.

Table 4 Means and Standard Deviations of Post-survey

Items	*N*	*M*	*SD*
I was able to apply pedagogical techniques and strategies to my own teaching.	6	4.17	1.60
I was able to apply what I learned into my own teaching.	6	4.00	1.55
After the model lesson, I was motivated to teach the content to my students.	6	4.33	1.63
The TIMS Approach pertained to my needs with regard to student support.	6	4.17	1.60
The TIMS Approach lesson allowed my students to become highly engaged.	6	4.33	1.63
The TIMS Approach has allowed me to easily increase concept mastery among my students.	6	4.00	1.55
The TIMS Approach highlighted specific, useful digital tools.	6	4.17	1.60
When I am informed that I will be attending a TIMS Approach Professional Development Opportunity or workshop, I will become excited and enthusiastic.	6	4.33	1.21

Note. 1 = strongly disagree; 2 = disagree; 3 = neutral; 4= agree; 5 = strongly agree

The Likert-scale survey responses were confirmed by positive responses to the open-ended questions. As one participant stated, the TIMS approach showed all the components that made for a superb and effective PD, and it was how PD should have been. Participants also recognized several essential components in the TIMS approach. For instance, one participant stated the importance of watching videos first and then being supported along the rest of the PD activities, which helped build their confidence and understanding. One participant highlighted the importance of modeling,

I think teachers would be more likely to use a resource if they see someone else doing it first. That's typically my issue with trying new resources. I worry about how classes and individual students will behave with the resource and I talk myself out of it. However, being thrown into the lesson with this model allows you to see the pros, cons, uses, and potential speed bumps.

Another participant emphasized the role of the facilitator along with the importance of the facilitator's modeling,

I liked the fact that the digital facilitator was able to come in and model the lesson to one of my classes. It is one thing to sit in a room and show teachers but when you go into the classroom things can be different. Some of the iPads had issues and kids had questions that I'm not sure I would have been able to answer right away. With the facilitator close

by to model one of the lessons, I felt confident to do the rest on my own.

Among the interviews and focus group data, all the teacher participants expressed their enjoyment and excitement toward this type of training. They welcomed and appreciated the four components: Tutorial, Instructional Modeling, and Support. When asked to describe the overall experience with the TIMS Workshop, Janet stated, "Seeing it right then and there as I mentioned that was an issue with other PD workshops. Ah…I like how relevant it was especially to students." John shared the same comment, "I felt like it was easy enough for me to implement, and as far as prep work for me, if I were to do this with another set of words or another idea, there is very little prep work involved."

4.3. Essential Components of the TIMS Approach

4.3.1. Content-specific. The importance of ensuring that the PD is content specific is a major theme that emerged from the qualitative data, including interviews and the focus group. Five participants identified with this theme. For example, both science teachers during the interviews stated that they were more than willing to participate in professional development activities pertaining to literacy, but they believed that they should be afforded quality PD in science at least once a year. They reported that although school systems required content-based PD, they were far more challenging to access. They believed that school systems should have moved away from the "credit for seat time" professional development and moved towards more meaningful and effective sessions, which were proven to increase student achievement. When asked what professional development was like at their school or district, Janet responded in the following way,

There didn't seem to be as much professional development for social studies curriculum and a question a lot of social studies teachers had, but there was nothing to help social studies teachers with was to encourage literacy and to improve upon literacy for students between the low and middle ranges.

John responded,

Science specific, content specific. That was the best professional development I have had in my 7 years of having professional development. Most of the time, you sit in a room and you either discuss something that somebody else did, but you don't see it, there's no tactile learning, there's no visual implementation.

Both John as a science teacher and Janet as a social studies teacher expressed their concerns about a lack of content-specific PD provided by the school district and highlighted the importance and the need for such content-specific PD.

4.3.2. Focusing on student needs and lesson relevance. The second theme emerged from teachers mentioning the needs of their students, which varied from academic to social to the material. For example, Judy noticed that some of her high achieving students had paired up with other high achieving students. Therefore, during the next lesson, she was going to assign specific groups, where both high, low, and average achieving students were equally represented within each group. This would minimize any one group dominating the entire activity. Joan, a social studies teacher, realized that when students started to see that they could just list the definition to achieve a certain amount of points, she knew this was not working to excel her advanced learners and that this was not enough of a challenge for them.

Teachers' responses suggested that they believed activities covered in the PD workshop accommodated students' needs on an individual basis. Margret, a science teacher, stated that "this lesson was differentiated in that all students felt comfortable participating." She further articulated that these activities allowed students to highlight technology skills and utilize a medium, which they knew and felt comfortable. John highlighted the importance of addressing students' individual needs and ensuring the relevance of instructional materials,

I don't like giving the kids busy work. But yet, I can't move them forward in their material because I don't want the substitute to teach them wrong. I want the kids to move forward with the curriculum, but they are kind of placed on pause because I'm not out there in the classroom because I'm on a professional development. So I want the professional development to be useful, relevant, and helpful to me and my students if I'm being pulled out of the classroom.

It is evident throughout these interviews that these teachers demanded relevance for their students. They knew and understood how their students learn. Several teachers indicated that any professional development session, which did not pertain to making learning more accessible to their students while also addressing differentiation strategies, was simply a "waste of time."

4.3.3. Providing modeling and support. One of the most prominent themes is that teachers believed that what truly made the TIMS approach successful was that they were able to model the lesson as they received the training, and that ongoing support was available to them when they implemented the lesson in their own classrooms. Six out of seven teachers commented that observing the technology facilitator teaching a lesson using the technology application in their classrooms before they taught the lesson was an enormous stimulus for them. Having the technology facilitator model the lesson and showcase it to the teachers helped teachers feel reassured that the technology lesson would also work for their own classes.

With modeling and support, teachers felt that the PD did not simply present them with a tool to use but also engaged them in the thoughtful and intentional process of problem-solving. Mary commented, "to see you work out the glitches was so beneficial instead of being told how to do something, trying it out, failing, and then never wanting to implement technology again." As Judy, a science teacher, concluded, "I feel like I am being trained instead of introduced." Likewise, John stated, "Once I saw you (facilitator) demonstrate the lesson in class, I knew that I could teach this myself. I also thought, "How can I make this easier for my students in the future, such as using Chromebooks instead of cell phones and iPads."

The continuous support provided by the technology facilitator created "a safety net" which prompted teachers' continuous interest and aided in sustaining their efforts in implementing the technology lesson into their own class. As Mary commented, "I like that I had a life preserver – If I needed you to come back into my room to assist I had that option." Teachers often attributed their own success of implementation to the modeling and support. For example, teachers believed that if the technology facilitator did not model this lesson first, they would not have done this with their own class.

5. Discussions

Our findings revealed that teachers tended

to initially perceive PD activities provided by the school district unfavorably. Several reasons received resonation from the teacher participants. First, PD activities should serve a legitimate and meaningful purpose rather than being a forceful requirement to "check the box." The automatic linkage between attending a PD workshop and receiving continuing education credit was perceived as detrimental to teachers because they did not receive the type of meaningful learning experience that they expected to receive; instead, all they did as to fulfill the state licensure renewal requirement so that they can proceed with an updated teaching license. This was a structural or systemic problem that needed attention from the policymakers or high-level administrators. This particular problem represents an instance of a typical problem that is historically existing in prior research (Diaz-Maggi¬oli, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001; Yang & Liu, 2004). Teachers depict such ineffective PD activities as "a waste of time" (Dehghan, 2020). If teachers fail to perceive the value and benefits from attending the PD workshops, the chances that they will actually modify their teaching practices in the classroom based on instructions received from the PD activities will be fairly slim. As Merchie et al. (2018) have described, an effective PD program that provides a meaningful learning experience should be aligned with teachers' goals and self-identified needs and interests.

Our findings reinforced TIMS components that enabled a successful technology PD. First, the teaching of technology needs to be contextualized in a content-specific area that considers the content to be taught (Garet et al., 2001; Guskey, 1986; Merchie, Tuytens, Devos, & Vanderlinde, 2018; Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016). Linking the technology to the content area provides teachers a specific disciplinary space for them to apply and make sure of the technological knowledge in a given context (Fernández-Batanero et al., 2020). Second, it is critical to consider students' needs and relevance (Keller, 2009; Martin et al., 2019; Merchie et al., 2018). Teachers unanimously agreed that the use of technology is to facilitate and enhance student learning. Regardless of technology of any kind, the goal of its implementation is to benefit student learning. The PD that fails to demonstrate direct relevance to student learning or attend to their individual needs is considered unserviceable for teachers (Merchie et al., 2018). To sum up, PD shall align with teachers' context and needs, as well as students' learning needs (Martin et al., 2019).

Last but not least, what differentiated the TIMS PD approach from others was that the technology facilitator modeled technology use in the live classroom and continued to provide support outside of the PD. As teachers observe the technology facilitator, they learn how to problem-solve technical glitches and teach with technology during the teaching practice (Rienties, Brouwer, & Lygo-Baker, 2013) and regard the facilitator's expertise or competencies (Merchie et al., 2018). Having access to the technology facilitator during the implementation phase in their own classrooms was an immense advantage for the teachers. The facilitator's meaningful feedback also plays an imperative role (Anto & Coenders, 2019; Lohman, 2020). Teachers prefer personalized feedback that addresses their concerns to improve their learning and practices (Cheng & So, 2012; Morrison, 2014; Merchie et al., 2018; Van den Bergh et al., 2015).

6. Implications to Teacher PD Practitioners

Our findings suggest that teacher PD for technology integration should continue

following existing suggestions by focusing on the content, teacher needs, student needs, and lesson relevance (Desimone et al., 2002; Figg & Jaipal, 2012; Garet et al., 2001; Jaipal-Jamani & Figg, 2013; Martin et al., 2019; Merchie et al., 2018). Therefore, teachers participating in the PD will likely be able to make sense and apply what they have learned from PD in their own classroom setting. Our findings further reiterate the crucial role of live modeling of technology integration in teacher PD. Modeling pedagogical practices as well as providing guidance and feedback should be facilitated within teacher PD (Barlow et al., 2014; Bodzin & Park, 2000; Yang & Liu, 2004). The TIMS approach is unique but resonates with existing literature; the tutorials and instructional modeling help teachers make sense of the technology integration into their own classroom context. The modeling performed in the live classroom leads to continuous support, sustaining teachers' interest and intent of technology integration. This specific type of modeling is rarely seen in existing literature but can offer impactful benefits for future technology-integration PD.

Our findings offer insight into how PD should be implemented in the K-12 setting. It suggests that this PD format initiates desired participation and a flow of new ideas for implementation among teachers. The one or two week-long process, as opposed to many weeks, allows teachers to implement the session material instantaneously while enhancing the material throughout the year. Additionally, our findings provide additional evidence validating the theoretical base of active learning components in successful professional development regarding technology integration (Hew & Brush, 2007).

7. Conclusion

The findings provide insights into teachers' perceptions and experience with the rewired professional development via a TIMS approach. Their perceptions of technology-focused PD changed as a result of the elements in the TIMS approach, which modeled, engaged, and motivated teacher participants. Participants reported their frustration of teachers towards a traditional professional development approach that was initiated by poor, ineffective presentation methods. The study demonstrated a teacher-centered professional development strategy, which focused on teacher needs and provided continuous modeling and support throughout different phases of implementation. This type of professional development strategy not only enabled teachers to see the value in learning new concepts, but also provided sufficient resources and support for present and future implementation. We believe the TIMS model can be applied to various types of technology-based PD designs and scenarios, especially in the K-12 setting. The model places a strong emphasis on instructional modeling and ongoing support, which is often lacking in PD workshops seen in the K-12 environments.

There are several limitations to this study. First, participants in our sample were recruited from one school district, and therefore the generalization of the results is limited. The findings of our study may only apply to a population similar to our sample and context. Second, as a qualitative, naturalistic inquiry, the researcher's role and positions might have influenced participants' responses. Third, this study only examined immediate, post-intervention responses and perceptions of teachers; an investigation of the long-term impact on teachers' practice and beliefs was not part of this study.

We have the following recommendations for future researchers. First, we recommend that future researchers replicate the TIMS approach with alternative samples and contexts

to further validate the impact of this approach on teacher practices and beliefs. Additionally, an experimental study that compares the TIMS approach with a traditional PD approach as a control group will provide further insights into the effectiveness of this approach. Unobtrusive methods such as observing teachers implementing the lesson after they have observed the model lesson would be another means to validate the TIMS approach. Lastly, further efforts should be made to scrutinize the long-term effects of any PD training on K-12 teachers.

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