

EXAMINING THE EFFECT OF ONLINE PROFESSIONAL DEVELOPMENT
ON TEACHER IMPLEMENTATION OF THE KINDERTEK® APP AND ONLINE
DATA DASHBOARD

by

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DISSERTATION ABSTRACT

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Title: Examining the Effect of Online Professional Development on Teacher

Implementation of the KinderTEK[®] App and Online Data Dashboard

In response to COVID-19, instructional and professional development delivery methods have rapidly and drastically become altered. Online professional development (OPD) has excellent potential to bring about significant change of instructional practice in adult learners. Although current research of OPD shows promise, there is limited academic study on the effect of adult responsiveness. The focus of my study is on the effects of OPD (embedded video modules as part of the KinderTEK[®] digitally delivered math intervention program) on teacher actions. My study presents results of 47 classroom teachers who participated in OPD modules and analyzes their actions pre and post OPD. Findings as determined by this study, include significant effects for participants pre and post OPD, in addition to multiple participant variables which were analyzed to ascertain moderating effects. This study provides promise in the growing body of work on OPD in relation to adult responsiveness.

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CHAPTER I

INTRODUCTION

In the ever-changing world of education, teachers are asked to implement new training and instructional techniques at a rapid pace. To stay connected and deliver high quality and relevant instruction to students, our education system is required to stay increasingly flexible and innovative in how new evidence-based instructional techniques are acquired and delivered.

Professional development has long been proven valuable in supporting educator job growth and student outcomes (Guskey, 2002). Teras and Kartoglu (2017) define professional development as “activities that are intended to engage professionals in new learning about their professional practice” (p.192). The days of one-off workshops are being challenged, not only by travel and financial limitations, but also in accordance with research recommending professional development which is job embedded over time to meet the individual needs of participants (Bolt, 2012; Gurkey, 2000).

Over the past decade, delivery models for the majority of professional development has remained stagnant with face-to-face methodology being the primary mode of delivery, despite classroom pedagogy having shifted toward a digital approach (Bolt, 2012). The traditional method of teachers attending a sit-and-get or one-time out-of-state workshop is being rapidly changed to a shift using online professional development (OPD) out of necessity. Current research, though limited in scope, is showing positive outcomes for teachers who engage in OPD (Barton, Whittaker, Kinzie, DeCoster & Furnari, 2017).

With a shift of professional development delivery in the field of adult learning, it is imperative to research the effect OPD has on participant implementation. In implementation of evidence-based curricula to enact change in both instructional practice and student outcomes, fidelity is key (Barton, Whittaker, Kinzie, DeCoster, & Furnari, 2017). According to Durlak and DuPre (2008) “accurate interpretation of outcomes depends on knowing what aspect of the intervention were delivered and how well they were conducted” (p.328). Barton, et al. (2017) note that higher gains in student skills are in direct relation to teachers’ fidelity of implementation with the program associated with OPD.

My study focuses on the effects on teacher behavior of OPD experienced through embedded video modules offered to educators as part of the KinderTEK[®] digitally delivered math intervention program. Participants involved in KinderTEK[®] projects conducted by the Center for Teaching and Learning (CTL) at the University of Oregon were invited to participate in two OPD modules which were structured in a webinar format and embedded with immediate opportunities for content interaction. I am using extant data from two such studies conducted by CTL during the 2018-19 school year: an efficacy study and a dissemination study.

My primary interest in this project is to further research in the area of OPD. Using a quantitative study, I explored the relationship between OPD modules delivered in a user-friendly video-based format, and teacher actions that followed. I examined if use of these modules resulted in stronger implementation fidelity on the part of the adult participants. To reiterate, this study did not examine the effect on student outcomes, but instead focused on the effects of OPD on adult behaviors.

Literature Search, Review, and Selection

In searching for prior research on OPD, I initially utilized the digital databases of Educational Resources Information Center (ERIC), Google Scholar, and the University of Oregon library to locate recent literature that was relevant to my study. I also reviewed the bibliographies of related studies on the topic of OPD to identify additional sources pertinent to my research. To focus my study on current research on OPD, I constrained my search to the years 2000-2020. Through the search I found literature applicable to OPD in academic and non-academic settings such as business or medical training.

To ensure I chose articles which would be most relevant to my study, I began by reading abstracts as well as reviewing the research questions of each article to determine whether there was information that provided a foundation for research on the topic. Articles that did not provide additional context for my study were not used. When possible, I focused on the school environment, but being that my work is centered on adult behavior, I found articles from a variety of settings in which adults learn were informative. I reviewed articles and selected studies that took place in both rural and urban locations to examine the impact of online professional development in a variety of locales.

My selection process narrowed the pool of potential sources to 13 key peer-reviewed articles. I found eleven articles that focused primarily on an education-centered professional development setting, and two articles focused outside of the education field. The articles selected represent a variety of settings, samples, research designs, and research analysis on the topic of OPD for adult implementation outcomes.

Summary of Literature Review

“Online professional development (OPD) has great potential to improve teacher quality by improving teachers’ knowledge and instructional practices, with the ultimate goal of improving student achievement” (Masters, De Kramer, O’Dwyer, Dash, & Russell, 2010, p.355). There are many reasons, including our current shift to an online format in the era of COVID-19, as to why OPD is increasingly sought after and depended on.

In traditional models of professional development, there are ongoing challenges of providing high quality trainers and ongoing training opportunities to educators outside of large urban communities. (Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009; Hunt-Barron, Tracy, Howell & Kaminski, 2015; Erickson, Noonan & McCall, 2012). According to the America Counts Staff (2017), approximately 60 million people, or one in five Americans, live in a rural community. With 19% of the population living in 90% of the geographical area of the United States (US Census Bureau, 2017), teachers who work in these areas have limited access to high quality opportunities available to their urban counterparts. In my study on KinderTEK[®], study sites are located in urban and rural areas within multiple states.

Benefits of Online Professional Development

In their study of effects of OPD on rural teachers, Uptis and Brook (2017) reported staff valued OPD-facilitated collaborative opportunities they normally did not have due to their location. For teachers who are subject-specific specialists in both rural and urban settings, the world of OPD enhances the capability for interaction with colleagues who have expertise and offers the opportunity to virtually connect with job-

alike teachers as well as higher education institutions (Erickson, Noonan, & McCall, 2012; Hunt-Barron, et al., 2015). The personal and social connections that OPD delivers through online interactions “were the greatest factors in participants’ learning and satisfaction with OPD” (Hunt-Barron, et al., 2015).

Regardless of geographical location, there are other benefits. Particularly, content experts are no longer bound to provide professional development in person. This leads to increased opportunities and improved accessibility for participants to access training which would have previously been cost prohibitive or not available locally (Vu, Cao, Lu, & Cepero, 2014; Dede, et al., 2009).

OPD offers the additional benefit of flexible scheduling. This increases access for adults for whom the rigidity of traditional professional development is an obstacle (Dede, et al., 2009; Dash, Magidin de Kramer, O’Dwyer, Masters, & Russell, 2012) and stretches typical PD spending to benefit more and more diverse teachers without interrupting classroom instruction. “The need for professional development that can fit with teachers’ busy schedules, that draws on powerful resources often not available locally, and that can create an evolutionary path toward providing real-time, ongoing, work-embedded support has stimulated the creation of OPD programs” (Dede, et al., 2009).

Characteristics of Successful OPD

One characteristic of successful OPD is that it is teacher-centered in delivery and relevant to the everyday experiences of participants (Uptis & Brook, 2017). In their study they found a teacher-centered approach has the potential to produce transformative change that results in a “changed and improved practice” (Uptis & Brook, 2017, p.96).

Teras and Kartoglu (2017) found in their study that authenticity of context, “providing purpose and motivation for learning” (p.195) and authentic tasks which are real world, complex, and long-term help to provide an effective electronic-learning environment.

For OPD to be successful, Barron, et al. (2015) notes participants must value the professional development and show engagement in the content. By doing so, they are more likely to transfer their learning into instructional practice. For OPD to have lasting impact, participants need to see how time spent in professional development will directly impact their knowledge and, in turn, lead to increased student learning (Barron, et al., 2015). For participants to stay engaged with the content, it needs to be designed in such a way that moves the teacher toward implementation of the targeted practice (Vu, et al., 2014).

Another key to successful OPD is connectedness and peer support during and after the training (Carter-Ching & Hursh, 2014; Barron, et al., 2015; Erickson, et al., 2012; Teras & Kartoglu, 2017). If working professionals collaborate over new methodology, curriculum, or delivery techniques, it improves the likelihood of content implementation (Uptis & Brook, 2017). Teaching is an isolating profession even for teachers within the same building or district, especially where there may be only one or two teachers at each grade level or content area which limits collaborative opportunities. OPD can be helpful, if not critical, in giving staff access to professional support and enabling them to form networks of colleagues to collaborate with beyond the training (Uptis & Brook, 2017).

Characteristics of Successful Participants

As with successful OPD, adult learners who find greater success and increase their skills through OPD also have common characteristics, whether studied in context of professional development research or more broadly in adult learning theory (Teras & Kartoglu, 2017). Vu, et al., (2014) note individuals who complete OPD are self-disciplined and determined to complete the training. Successful participants take information back to their classroom for immediate implementation. In OPD the learner is responsible for completing tasks and implementing program materials without direct, in-person oversight by a trainer. If the participant shows strong self-discipline, the barrier of time management and lack of personal contact is not an obstacle (Vu, et al., 2014).

The OPD format has a heavy reliance on independent study; to be successful, learners must utilize strong problem-solving skills and be self-motivated enough to work through productive struggle without giving up. They also must have the willingness to collaborate with others in an online forum, especially for support. In a study by Vu, et al. (2014), it was found that if successful participants in OPD were not able to find the answer or solution to their problem by themselves, they would reach out to others via online forums or reviewing the lectures to gain the needed information. Learners with strong problem-solving skills, and who seek out collaborative opportunities can find success in OPD (Vu, et al., 2014).

Challenges to OPD

In contrast to the attributes of successful OPD and participants there are challenges that exist. The literature documents multiple challenges to the OPD delivery model. In multiple studies (Barton, Whittaker, Kinzie, DeCoster & Furnari, 2017;

Renninger, Cai, Lewis, Adams & Ernst, 2011) there was a high attrition rate of participants who did not complete the study which included OPD. It was noted that initial interest was high, but that as time progressed, interest and motivation waned.

Without direct human contact and immediate feedback, continuing to sustain motivation can be challenging for some teachers (Chen, 2011; Barton, et al., 2017). Due to the off-site and independent study nature of the course, many participants struggle to stay on track.

Somewhat counter-intuitively, learners' technology proficiency is not a barrier to online learning. Uptis and Brook (2017) found that if OPD training is relevant to instruction and is engaging, teachers will actively seek ways to advance their own technology skills in order to gain the needed information. A more common challenge is OPD requires consistent and stable access to the internet. If minimum technology thresholds can't be met, educators won't even attempt OPD; if they start and then experience consistent or even intermittent technical difficulties (e.g., with logging in, video streaming, or firewalls) they will become frustrated and are less likely to complete the OPD (Barron, et al., 2015). With an increased online presence in daily school routines and structures, technology infrastructures are growing at a rapid pace. Given the increased integration of technology within schools this obstacle should be minimized in coming years.

Results of OPD

The aim of professional development is to “improve teacher quality by improving teachers' knowledge and instructional practices, with the ultimate goal of improving student achievement” (Masters, et al., 2010, p.355). My literature review supports the

view that if OPD content is relevant to the participants and integrates opportunity for collaboration, there is potential for successful outcomes. As found by Polly, Martin, Wang, Lambert & Pugalle (2015), “teachers felt that their participation in the professional development program and their use of the formative assessment system was leading to student learning, which has been shown to increase teacher buy-in and quicker adoption of emphasized pedagogies” (p.285). The same team and other researchers have documented improvement in instructional practice that result from OPD by measuring whether the amount of time spent in that practice increases. In multiple studies, (Polly, et al., 2015; Upitis & Brook, 2017; Vu, et al., 2014; Barton, et. al. 2017) it was noted that there was a strong correlation between the OPD received and the amount of time spent in various programs which were being studied.

Outcomes of OPD are measured in other ways too. A study by Teras and Kartoglu (2017) showed improved decision making due to participation in an OPD course teaching those skills and Polly, et al. (2016) noted that online learning participants gained confidence in their practice and were able to see an immediate impact of the OPD they participated in by implementing the concepts learned. In turn, implementing key elements from OPD theoretically leads to an increase in fidelity of program implementation. My study focuses on the effects of KinderTEK[®] OPD, as determined by examining teacher interaction with the teacher reporting and management features.

Theoretical Framework

“Fidelity of Implementation is of key importance in interpreting if outcomes are a true reflection of an intervention’s effect” (Barton, et al., 2017, p.189). As noted in my literature review, engagement in OPD has the potential to influence outcomes for

teachers' acquiring instructional skills, which in turn can impact student results. To analyze the effect of OPD on adult learners, I chose *implementation fidelity* as the theoretical framework for my study, utilizing the work of Carroll, et al. (2007) "A Conceptual Framework for Implementation Fidelity".

The framework of *implementation fidelity* as described by Carroll, et al. (2007) is the degree to which the program or treatment is implemented, and whether it is delivered as intended. Carroll's research focused on implementation fidelity in medical interventions, but the recommendations are transferrable to educational settings as well. For the purpose of my study I focus on the key characteristic of *participant responsiveness*. *Participant responsiveness* as detailed in Carroll et al. (2007) is to what degree the respondent is engaged in the prescribed program. The authors found if participants are enthusiastic about the program stronger fidelity of implementation followed. For the purpose of my study fidelity will be measured by participant engagement with teacher features including reports and management features in the KinderTEK[®] app (described below).

KinderTEK[®]: A Context for Studying OPD and Implementation Fidelity

KinderTEK[®] is a technology-delivered math intervention that is specifically designed for the needs of early learners. It is an engaging, game-based iPad app which focuses on kindergarten level skills related to foundational numeracy and number sense. The program is intended to be used independently by students and has the potential - if used with fidelity - to provide a differentiated way to meet their specific instructional needs.

KinderTEK[®] is adaptative in its design, which means students' experiences can vary depending on their knowledge base and actions as they use the program. For students who already have mastery of content, the program accelerates; in contrast, for those who are still acquiring skills, the program has built-in re-teaching opportunities to help students gain foundational skills.

For students, the engagement is high. Built-in games give students chances to win virtual prizes and they unlock new activities as they master concepts. In addition, students receive meaningful academic feedback, building confidence as they encounter increasingly difficult content. These act as key motivators for students to engage in the program as they are learning math.

Teachers who use KinderTEK[®] with their students have the opportunity to use the program in many ways, including as a Tier II math intervention for select students or with all students in their classrooms (e.g., in lieu of a worksheet during math center activity). The KinderTEK[®] program is not intended to replace core instruction, but to supplement student learning in foundational numeracy.

The “pro” version of KinderTEK[®] gives teachers the ability to view student progress and mastery, as well as make changes to students' KinderTEK[®] experience through the app itself and through an online data dashboard. This is a robust system with detailed reports which allows programming to be customized for students based individualized needs. All actions taken by students and teachers are logged by the KinderTEK[®] app and online data dashboard. The logged actions by teachers are what were used in my study to measure the effect of OPD.

Research Gap, Study Purpose, and Research Questions

My review of the effects of OPD on teacher program implementation revealed a gap within the research. In currently published studies on OPD the primary focus is on student outcomes, not teacher interaction with OPD and the direct effect on adult behavior in an educational setting. Though current research indicates there are positive outcomes (Polly, et al., 2015; Upitis & Brook, 2017; Vu, et al., 2014), the research does not closely focus on outcomes for adults, specifically in analyzing the relationship between interaction with OPD and interaction with program features which is the focus of the OPD. Current research is limited on whether OPD has a positive association with adult implementation fidelity.

Given this gap in the research, I focused my study on adult behavior. My work is designed to investigate whether interaction with the OPD led participants to put into action what they were taught. The two research questions I address are:

RQ1. Does completion of the KinderTEK[®] digital professional development modules, which was a requirement for participants in the efficacy study and highly encouraged for those who were in the dissemination study, have an impact on educators' KinderTEK[®] program implementation? For purposes of my study, program implementation focuses on classroom teachers and includes (a) logging into the app's manage users' section or the online data dashboard, (b) checking student score reports, (c) changing settings, and (d) exploring the app.

RQ2. Does KinderTEK[®] program implementation (defined as in RQ1) differ based on teacher characteristics? Specific characteristics of interest are (a) Comfort with using iPads, (b) previous experience using digital individual based learning programs, (c)

interest in using KinderTEK[®] customization options, (d) interest in in-app teacher reports and management, (f) Wi-Fi strength and stability, (g) highest level of education, (h) number of years in the profession, and (i) type of KinderTEK[®] study.

CHAPTER II

METHODS

My quantitative study aims to understand if teacher viewing of KinderTEK[®] OPD modules is significantly related to teachers' use of KinderTEK[®] program features (i.e., numbers of actions taken within the system). Analyses consisted of a paired *t*-Test and one-way ANOVAs.

Study setting

For my study I used extant data provided by CTL to investigate whether the KinderTEK[®] OPD modules have an impact on participant behavior. CTL provided me with data from two studies conducted during the 2018-19 school year (an IES funded efficacy study and an OSEP-funded dissemination study). I describe each below.

Efficacy study

Purpose and participants. During the 2018-19 school year, 45 teachers from Oregon and Pennsylvania participated in an ongoing IES-funded efficacy study (Strand Cary, M., Clarke, B., & Shanley, L., 2017) focused on using KinderTEK[®] as a math supplement for all students. Participating teachers within each school were randomly assigned to implement KinderTEK[®] in conjunction with their core math instruction (15-minute sessions, 5 times per week) or engage in business as usual. Both treatment and control groups were to teach lessons from their curriculum; treatment students were to use the KinderTEK[®] app during independent student worktime. The study took place during the second half of the school year and lasted approximately 12 weeks. As described in my participants section only KinderTEK[®] teachers were eligible for inclusion in my study.

Study procedures and relevant data collection. Before being randomly assigned to the KinderTEK[®] condition, participants had signed study consent forms. Once they were assigned to use KinderTEK[®], teachers engaged in an initial OPD module embedded within a Qualtrics survey data system. The Qualtrics system logged completion. To streamline data collection, a survey of teacher demographics, KinderTEK[®] knowledge and interest and proficiency with technology was appended to the beginning of the OPD module.

When participants were assigned to the treatment condition and equipped with the KinderTEK[®] app and login information, they were encouraged to explore KinderTEK[®] features and the system logged user actions. They were asked not to have their students use the app until they had completed OPD; compliance could be monitored through the KinderTEK[®] system. After the initial OPD module (OPD1) teachers were asked to begin implementation of the KinderTEK[®] app with students. Throughout implementation, teachers' use of the app (i.e., "manage users" section) and online data dashboard was logged, and teachers could return to PD anytime.

One month after program implementation began, teachers were asked to complete a second OPD module (OPD2) that covered in more detail the reports offered in the app and through the online data dashboard. Again, this was delivered through Qualtrics and completion was logged. At the conclusion of the study teachers completed a survey which was used to gather participant perceptions of the KinderTEK[®] program.

Dissemination study

Study purpose and participants. During the 2018-19 school year, 45 educators from across the United States participated in an OSEP-funded dissemination study of

KinderTEK[®] (Strand Cary, M., & Clarke, B., 2014). The study focused on how teachers used KinderTEK[®] and on resulting student outcomes when teachers self-selected into the study and were given full choice of how to utilize the program. CTL put out an open call to recruit administrators and teachers interested in using KinderTEK[®] with their students. The participants ranged from teachers who had used the program previously to teachers or other staff who had no prior experience with KinderTEK[®]. Included in the dissemination study were school administrators, instructional coaches, as well as kindergarten and preschool teachers. Though a variety of administrators, coaches, teachers and aides completed some or all of the OPD and may have been involved in implementation, my study focuses only on the 24 KinderTEK[®] users who identified as classroom teachers.

Study procedures and relevant data collection. Once district, school, and teacher-level participation agreements and consents were signed, teachers were asked to complete an intake survey (similar to the one embedded in the efficacy study's OPD1) and invited to roster their students in the KinderTEK[®] program. They were encouraged to complete the OPD modules and begin using KinderTEK[®] for any purpose with any grade student (e.g., intervention for K-3, supplement in K-1, center activity, etc.) and as often as they wished (e.g., daily, weekly, monthly, etc.). Throughout implementation, teachers' use of the app (i.e., "manage users" section) and online data dashboard was logged and they could return to the PD anytime. Teachers were asked, but not required to complete a post-survey at the end of the school year.

Sample

CTL provided data for 69 adult participants across the two studies. My focus was only on classroom teachers using KinderTEK[®] thus I excluded 21 cases (i.e., two instructional coaches, eight educational specialists, and one school principal). Because my second research question focused on teacher characteristics, I next excluded eleven teachers who did not complete the initial teacher survey. My initial analytic sample included 48 classroom teachers, all who had participated in OPD1. After running initial analytics, I removed one outlier from the sample. As seen in the boxplot figure 1 this participant was an anomaly within the dissemination study. After consulting with CTL, it was confirmed the user had extensive previous use and knowledge of the KinderTEK[®] program and her participation in my study had the potential of skewing results. Thus, my final analytic sample included 47 teachers (23 efficacy and 24 dissemination).

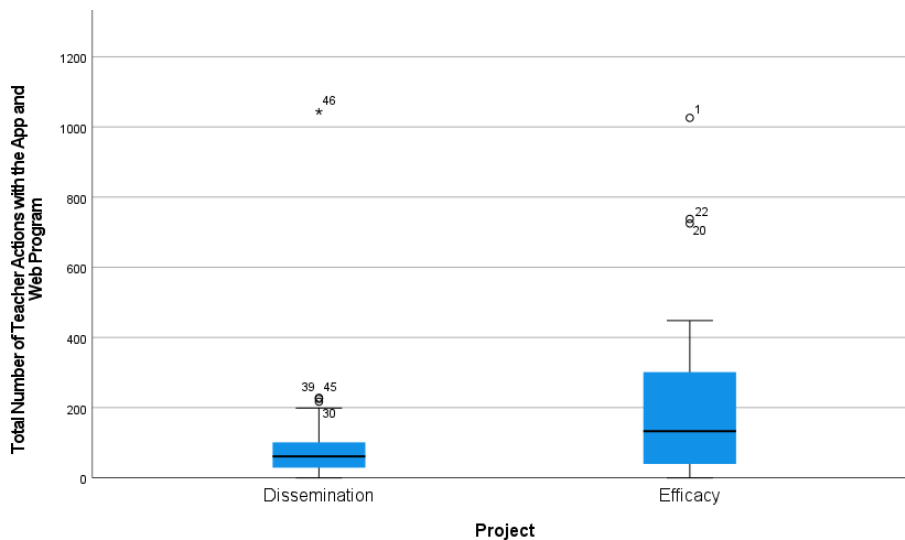


Figure 1: Boxplot including the outlier as part of the dissemination study.

My study participants drawn from the efficacy study includes teachers from both Oregon ($n = 9$) and Pennsylvania ($n = 14$). Having a sample group on the west coast and east coast has the potential to provide a diverse population. The Oregon locations are in both suburban and rural settings, while the schools in Pennsylvania are identified as urban. Altogether they represent 19 schools. Each of the participating classrooms had 11-30 students at the time of initial implementation. Participating schools showed interest in being included in the KinderTEK[®] efficacy study in response to direct soliciting or personal connection through CTL. The study sites had adequate technical support, including Wi-Fi capabilities in place to support the use of the “pro” version of KinderTEK[®] (available as *KinderTEK Research* on the Apple App Store).

The sample drawn from the dissemination study includes 24 classroom teachers who chose to participate with no specific parameters around their participation. In this group there are 15 schools which are located in Hawaii ($n = 4$), Oregon ($n = 7$), Washington ($n = 1$), Iowa ($n = 5$), North Dakota ($n = 1$), Kansas ($n = 3$), Missouri ($n = 1$), Wisconsin ($n = 1$), and Nebraska ($n = 1$). 23 of the classroom teachers in the dissemination study taught kindergarten, with one teaching first grade.

The initial teacher survey captured demographic information on all participants. In the efficacy study, all but one was new to the KinderTEK[®] program, all identified as female, and all but two were Caucasian. For education level, 59% of the efficacy teachers held master’s degrees. They varied widely in their teaching experience from first year teachers to 25 years in the classroom ($M = 12$). In the dissemination study, 22 of the 24 participants indicated they were new to KinderTEK[®]; two had some experience with the program from previous use. As in the efficacy study, all identified as female. These

participants were more diverse than those in the efficacy study with three identifying as Native American, three as Asian, and one as Pacific Islander. A master's degree was held by 57% of the dissemination study participants and experience varied from two to thirty-two years ($M=12$) in the profession.

Variables of Interest and Data Sources

The KinderTEK[®] research team provided me with four types of de-identified extant data related to teachers' (1) participation in OPD modules, (2) use of KinderTEK[®] analytics (i.e., reviewing student data and modifying student app settings), (3) self-reported characteristics and (4) study context (i.e., efficacy or dissemination; school information). Through my study I used provided extant data to answer my two research questions as to whether participation in KinderTEK[®] OPD modules had an effect on the total number of teacher actions with the app and web program and whether different teacher characteristics acted as moderators of teacher program use.

For RQ1, the independent variables (IV) in my quantitative study is teacher participation in OPD during the 2018-19 school year. For RQ2, the IVs are multiple teacher characteristics (self-reported in the survey completed during OPD1). The dependent variable (DV) for both questions is "implementation" (i.e. logins and actions taken by participants within both the KinderTEK's manage users section app and the web dashboard). Specifically, implementation scores for each teacher were calculated by summing (a) logging into the app's manage user section, (b) checking student score reports on the app or online dashboard, (c) changing settings using the app or dashboard, and (d) exploring the app.

Implementation occurring prior to OPD1 (preOPD1) and following OPD1 (postOPD1) were compared to answer RQ1. Total number of teacher actions with the app and web program postOPD1 were used to answer RQ2.

Data Analysis Plan

As noted in my literature synthesis, research supports the use of OPD in increasing participant engagement as teachers gain clearer understanding of program implementation. I examined whether the KinderTEK[®] OPD modules increased teacher implementation fidelity of management and data review (i.e., the extent to which participants engaged with the analytics section of the KinderTEK[®] pro app and online dashboard.) For my analysis I chose analytic strategies that measured whether two or more populations were significantly different: paired *t*-test (RQ1) and one-way ANOVA analysis' (RQ2). All analyses were conducted using Statistical Package for the Social Sciences (SPSS).

Paired t-Test

For RQ1, I hypothesized there would be a statistically significant impact of OPD. As Guskey (2002) noted, professional development has a positive impact on teacher actions in program implementation. I began by calculating descriptive statistics (table 2). I then conducted a paired *t*-test to compare preOPD and postOPD. I used SPSS to calculate my *t* value, degrees of freedom, and *p* value. For purpose of this analysis the alpha level was set at .05.

One-Way ANOVA

Regarding RQ2, I hypothesized there would not be a statistically significant impact of teacher characteristics with limited exception. I hypothesized Wi-Fi strength

and stability would impact program use. As noted by Barron, et. al. (2015), if Wi-Fi is not stable frustration can lead to weak participation.

Additionally, I hypothesized type of study (efficacy and dissemination) would show statistical significance. Although my study did not focus on teacher accountability versus choice a study by Barton, et al. (2017) found when teachers had mandates and oversight by administration, they performed with higher fidelity of implementation.

Last, I hypothesized the participants who completed OPD2 would utilize the teacher dashboard at a statistically higher level than those who did not. According to (Vu, et al., 2014) effective OPD is designed in such a way that moves the teacher toward implementation of the targeted practice. OPD2 directly relates to how to use features within the app and web, which in turn should increase teachers' use of dashboard features.

To test my variables in SPSS and increase statistical power I combined all teacher app and web event counts across both studies to measure all participant actions post OPD1. In addition, and on guidance from committee members, I used the data dictionary accompanying the survey data to re-scale many of the survey responses from scales of 5-point to 3-point Likert scales. This was done in order to increase samples within each scale point for meaningful ANOVA analysis.

To answer RQ2, I conducted multiple one-way ANOVA analyses to test whether various teacher characteristics of (a) comfort with using iPads, (b) previous experience using digital individual based learning programs, (c) interest in in-app teacher reports and management, (d) Wi-Fi strength and stability, (e) highest level of education, (f) number of years in the profession, and (g) type of KinderTEK[®] study, and (h) participation in all

OPD modules would be significantly related to implementation. As seen in table 1, I summarized the survey data into a format that allowed to review trends between the two studies and multiple variables.

For most analyses, I was able to test the null hypothesis using Levine's Test of Homogeneity, but in several cases I instead used Welch's *t*-Test for Unequal Variances. When using Welch's test, I referred to Games-Howell for post hoc analysis, and when using Leven's test, Tukey was used. For all analyses, to determine statistical significance, the alpha level was set at .05.

Table 1

Summary of Study Participant Characteristics

Participant Characteristics	<i>N</i>	Total Percent	Efficacy Study <i>n</i> (%)	Dissemination Study <i>n</i> (%)
Total participants	47		23	24
Wi-Fi Stability	46			
Stable	28	61%	16 (71%)	52%
Unstable	18	39%	7 (29%)	48%
Previous experience with tech-based programs	46			
None	6	13%	4 (17%)	2 (8%)
Occasional	7	15%	2 (9%)	5 (21%)
Frequent	33	72%	17 (74%)	16 (71%)
Interest in program customization	47			
Low	5	10%	1 (4%)	(4) 16%
High	42	90%	22 (96%)	(20) 84%
Comfort with iPad	47			
Limited	2	4%	1 (4%)	1 (4%)
Somewhat	6	13%	0%	6 (24%)
Comfortable	39	83%	22 (96%)	17 (72%)
Complete PD2	47			
No attempt	23	50%	1 (4%)	(22) 92%
Partial	5	10%	4 (17%)	1 (4%)
Complete	19	40%	18 (78%)	1(4%)

CHAPTER III

RESULTS

In this chapter, I report the results organized by research question, and report my findings along with the descriptive statistics.

RQ 1: Does participation in OPD modules impact teacher use of in-program features?

Values for implementation Pre-OPD and Post-OPD are presented in Table 2. The means of the groups were statistically significant different in relation to each other, $t(46) = -4.98, p = .001, d = 1.01, 95\% C.I. [-211.83, -89.92]$. The mean for post-OPD ($M = 155.32, SD = 211.10$) was statistically significantly higher than pre-OPD ($M = 4.45, SD = 13.45$). Thus, teachers who participated in KinderTEK[®] OPD implemented in-program features significantly more after OPD1 than before they engaged in OPD1.

Table 2

Descriptive Statistics for Pre and Post OPD

	<i>N</i>	Mean	Median	Min.	Max	<i>SD</i>	Skewness	Kurtosis
Pre-OPD	47	4.45	0	0	77	13.45	4.12	19.23
Post-OPD	47	155.32	77	0	1026	211.10	2.53	6.99

RQ 2: Does KinderTEK[®] program implementation differ based on participant characteristics?

Comfort with using iPad

In investigation of variables in RQ2, all participants were grouped together, regardless of their level of participation in OPD (i.e., teachers who completed the survey in OPD1 and teachers who completed OPD2). There was not a statistically significant difference among the three variables associated with iPad comfort (*limited, somewhat,*

and *comfortable*) as determined by a one-way ANOVA, $F(2, 44) = .25, p = .78$. A Tukey post hoc test revealed having an increased comfort level with iPads did not produce a statistically significant difference in increased implementation between iPad comfort levels, as self-reported by participants. Although there was not a significant difference, *comfortable* ($M = 165.21, SD = 227.78$) and *limited* ($M = 125.00, SD = 141.42$) showed higher engagement than *somewhat* ($M = 101.17, SD = 83.73$). When running this data set with and without the outlier the significance did not change. Descriptive statistics are presented in Table 3. A graph of the means is presented in Figure 2.

Table 3

Descriptive Statistics for Comfort with iPad

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
Limited	2	125.0	25	225	141.42
Somewhat	6	101.17	29	217	83.73
Comfortable	39	165.21	0	1026	277.78

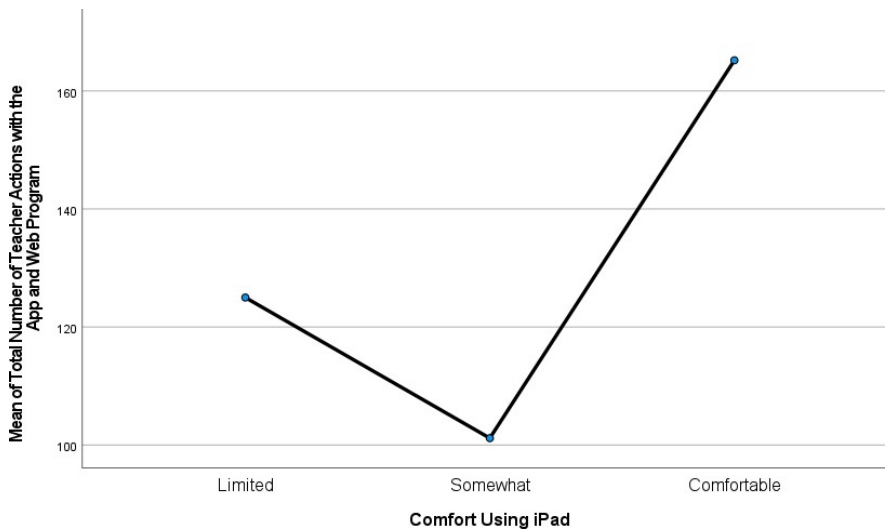


Figure 2. Mean by group of levels of comfort using iPad.

Previous Experience Using Digital Individual Based Learning Programs

There was not a statistically significant difference between the three groups (*none*, *occasional*, and *frequent*) as determined by a one-way ANOVA, $F(2, 43) = 1.31, p = .28$. A Tukey post hoc test revealed that those with *frequent* ($M = 184.45, SD = 240.67$) experience using technology-based programs did not implement statistically significantly more than those whose experience was *none* ($M = 105.33, SD = 87.43$) or *occasional* ($M = 52.00, SD = 87.43$). This analysis was run with and without the outlier; but the significance did not change. Descriptive statistics are presented in Table 4. A graph of the means is presented in Figure 3.

Table 4

Descriptive Statistics for Previous Experience with Technology Based Programs

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
None	6	105.33	39	225	87.43
Occasional	7	52.00	0	219	78.05
Frequent	33	184.45	0	1026	213.23

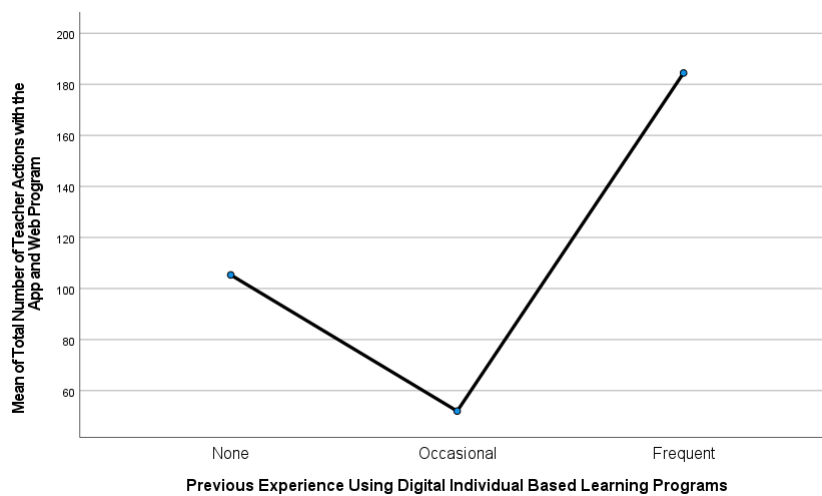


Figure 3. Mean by group of previous experience using digital individual based learning programs.

Interest in In-app Teacher Reports and Management

There was not a statistically significant difference among the two variables associated with interest in in-app teacher reports (*high* and *low*) as determined by a one-way ANOVA, $F(1, 45) = .18, p = .67$. The mean for the *low* interest group ($M = 193.60, SD = 297.89$) showed slightly higher engagement than *high* ($M = 150.76, SD = 202.82$). Again, results with and without the outlier did not differ. Descriptive statistics are presented in Table 5. A graph of the means is presented in Figure 4.

Table 5

Descriptive Statistics for Interest in in-app reports

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
Low	5	193.60	42	725	297.89
High	42	150.76	0	1026	202.82

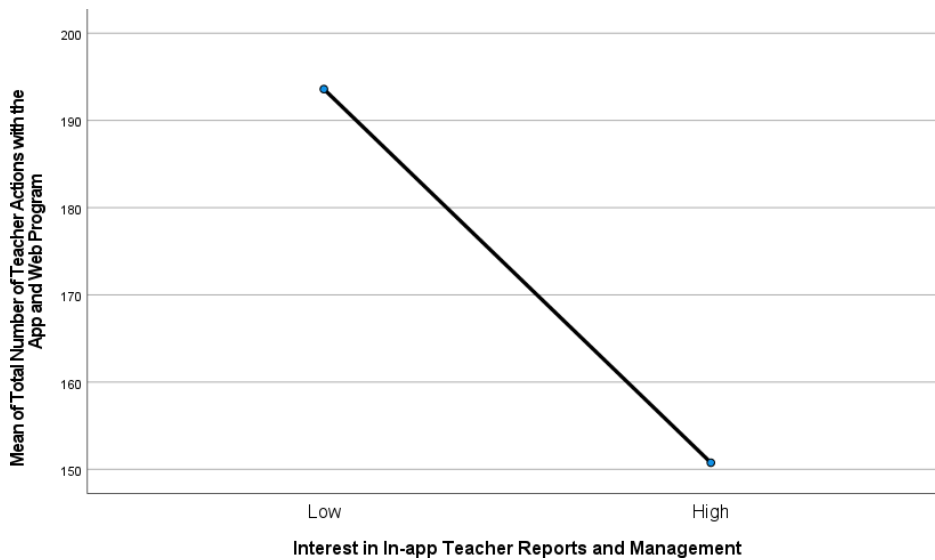


Figure 4. Mean by group of interest in in-app teacher reports and management.

Wi-fi Strength and Stability

There was a significant difference among the two variables associated with Wi-Fi strength and stability (*stable* and *unstable*) as determined by a one-way ANOVA.

According to Welch's *t*-Test $F(1, 36.39 = 5.07)$, $p = .03$, the mean for the *stable* group ($M = 209.48$, $SD = 254.75$) was significantly higher than the *unstable* Wi-Fi group ($M = 87.06$, $SD = 99.76$). Again, inclusion of the outlier did not affect the results. Descriptive statistics are presented in Table 6. A graph of the means is presented in Figure 5.

Table 6

Descriptive Statistics for Wi-Fi Stability

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
Stable	27	209.48	0	1026	254.76
Unstable	18	87.06	0	365	99.76

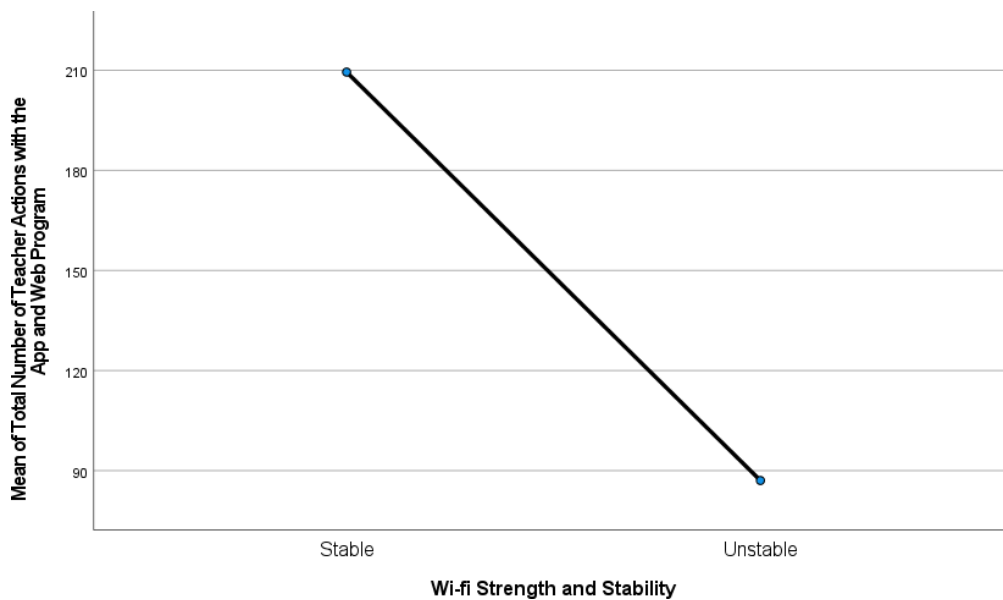


Figure 5. Mean by group of Wi-Fi strength and stability.

Highest Level of Education

There was not a statistically significant difference among the two variables associated with levels of education (*bachelor's* and *master's degree*) as determined by a one-way ANOVA. According to Welch's *t*-Test $F(1, 34.68) = .46, p = .50$, the mean for the *bachelor's* degree group ($M = 120.47, SD = 69.94$) showed slightly lower engagement than participants with a *master's* degree ($M = 153.18, SD = 237.74$). When running this data set with and without the outlier the significance remained the same. Descriptive statistics are presented in Table 7. A graph of the means is presented in Figure 6.

Table 7

Descriptive Statistics for Levels of Education

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
Bachelor's Degree	15	120.47	29	228	69.94
Master's Degree	28	153.18	0	1026	237.74

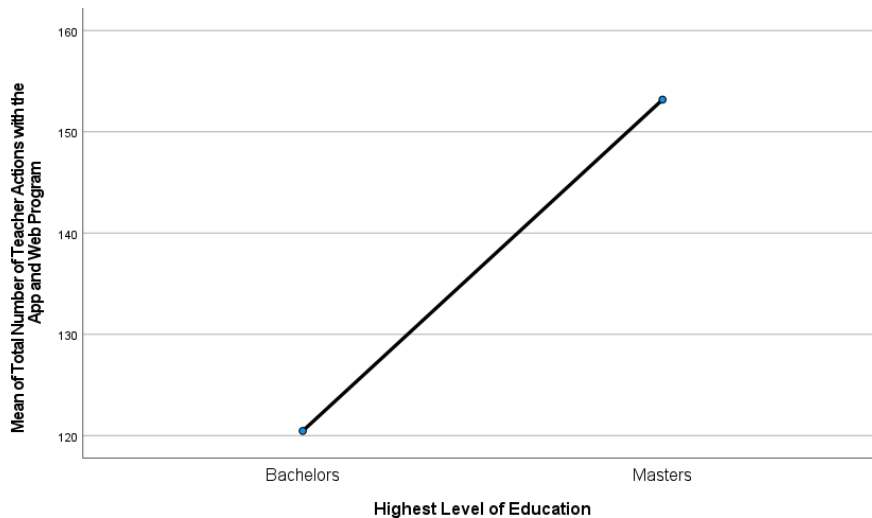


Figure 6. Mean by group of highest level of education.

Number of Years in the Profession

There was not a statistically significant difference among the four variables associated with length of time in the profession (*0-5, 6-10, 11-15, and 16+* years) as determined by a one-way ANOVA, $F(3, 38) = .56, p = .64$. The mean for the group of teachers who have taught *0-5* years ($M = 127.62, SD = 198.20$) showed higher, but not statistically significant, engagement than the group of those who were *6-10* years ($M = 66.67, SD = 59.74$). The teachers who had taught for *16+* years ($M = 195.88, SD = 292.45$) showed the strongest engagement with program elements followed by those who taught for *11-15* years ($M = 154.14, SD = 118.56$). Inclusion of the outlier in the analyses did not change the results. Descriptive statistics are presented in table 8. A graph of the means is presented in Figure 7.

Table 8

Descriptive Statistics for Years in the Profession

Years	<i>N</i>	Mean	Min.	Max	<i>SD</i>
0-5	13	127.62	0	738	198.20
6-10	6	66.67	0	177	59.74
11-15	7	157.14	8	365	118.56
16+	16	195.88	0	1026	217.45

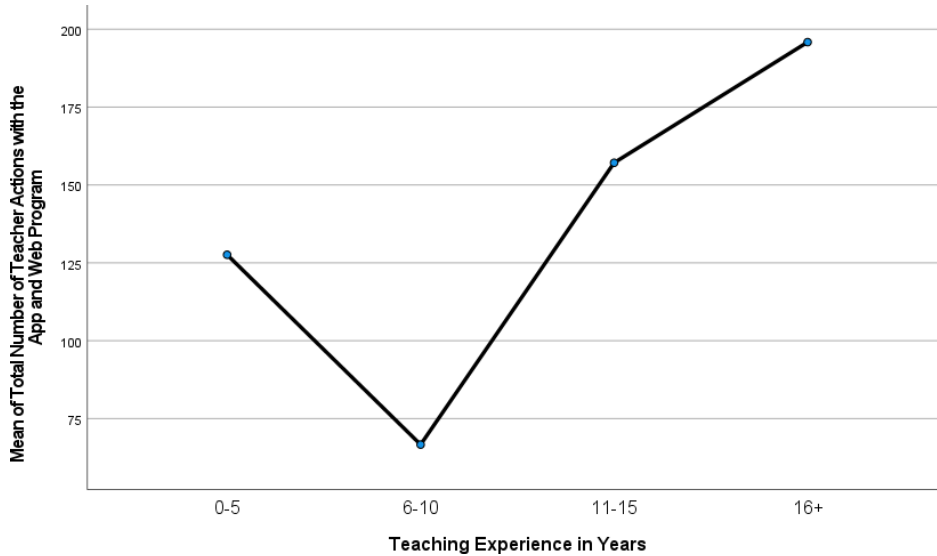


Figure 7. Mean by group of teaching experience in years.

Type of KinderTEK® Study

There was a significant difference among the means of the two variables associated with type of KinderTEK® study (*efficacy* and *dissemination*) as determined by a one-way ANOVA. According to Welch's *t*-Test $F(1, 24.96) = 6.56, p = .017$. The mean for the *efficacy* study group ($M = 232.65, SD = 274.54$) is significantly higher than the *dissemination* study group ($M = 81.21, SD = 72.90$). When running this data set with the outlier included in the sample there was no statistical significance with this variable.

Descriptive statistics are presented in Table 9. A graph of the means is presented in Figure 8.

Table 9

Descriptive Statistics for Type of KinderTEK® Study

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
Efficacy	23	232.65	0	1026	232.65
Dissemination	24	81.21	0	228	72.90

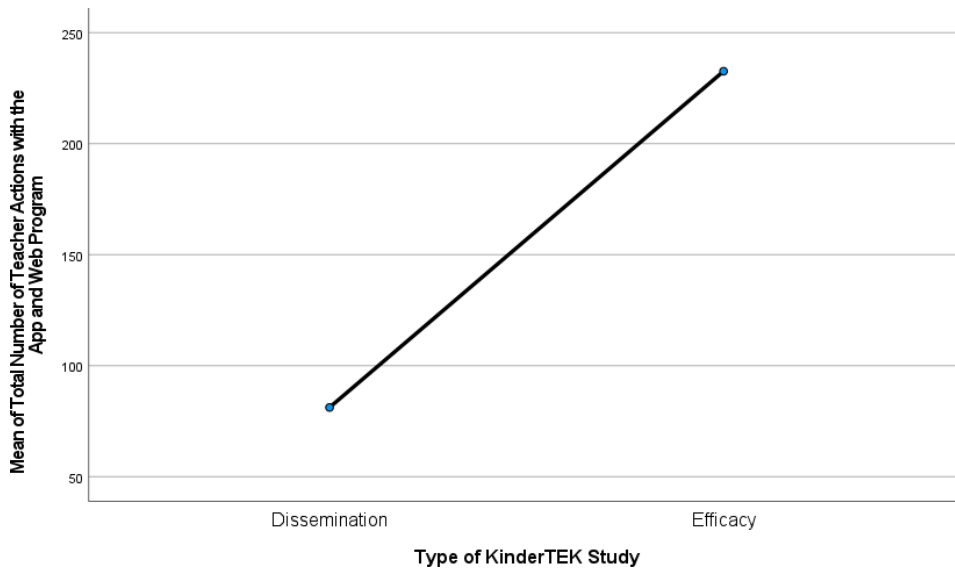


Figure 8. Mean by group of type of KinderTEK[®] study.

Completion of OPD Module 2

There was not a statistical difference among the means of the three variables associated with completion of OPD 2 (*no attempt*, *partial*, and *complete*) as determined by a one-way ANOVA, $Welch F(2, 9.53) = 3.39, p = .08$. A Games-Howell post hoc test revealed the group of teachers who completed the module in full ($M = 247.21, SD = 289.77$) was not significantly different ($p = .06$) from participants who made *no attempt* ($M = 117.63, SD = 210.97$) and the participants who participated partially ($M = 164.80, SD = 165.51$) did not have statistical significance with the others ($p = .69, p = .53$). Inclusion of the outlier did not change the results of this variable. Descriptive statistics are presented in Table 10. A graph of the means is presented in Figure 9.

Table 10

Descriptive Statistics for Completion of Professional Development Module 2

	<i>N</i>	Mean	Min.	Max	<i>SD</i>
No Attempt	23	77.35	0	228	76.33
Partial	5	164.80	25	448	165.51
Complete	19	247.21	0	1026	289.77

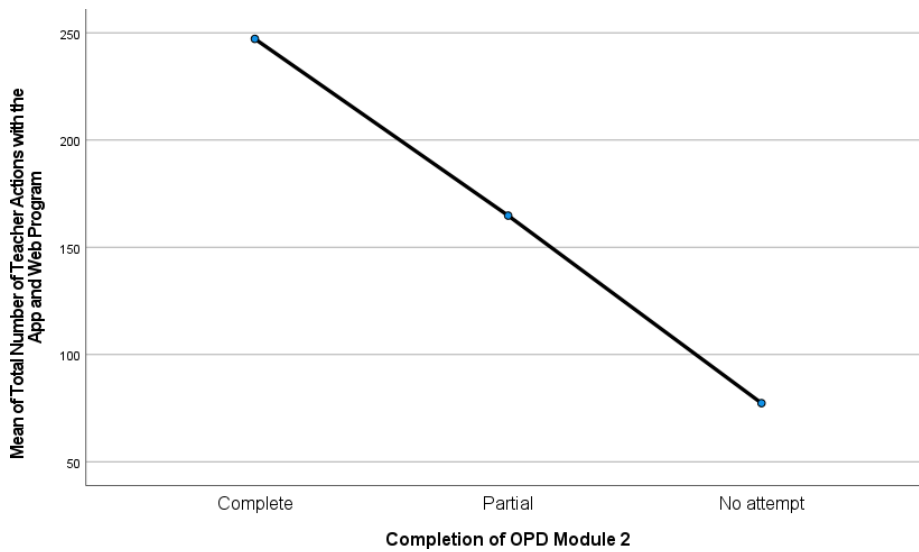


Figure 9. Mean by group of completion of OPD2.

CHAPTER IV

DISCUSSION

In this chapter I focus on: (a) a summary of the findings, b) discussion of results by research question, (c) discussion of the study limitations, (d) future research, as well as (e) implications for practice, (f) followed by a conclusion of the study.

Summary of Findings

The purpose of this study was to ascertain if there were effects on teacher behavior based on OPD received through embedded video modules within the KinderTEK[®] digitally delivered math intervention program. Researchers have noted this mode of delivery is showing promising outcomes with participants both in and out of educational settings (Barton, et al., 2017 & Teras & Kartoglu, 2017).

My primary interest in this project was to fill a research gap in the area of OPD and further study in this topic. Using a quantitative study, I explored the relationship between OPD modules, which are delivered in a user-friendly video-based format, and teacher actions that follow. I examined if use of these modules resulted in stronger implementation on the part of the adult participant, as measured by teacher actions in the web and app reporting and management systems. This study did not examine the effect on student outcomes but instead focused on effects of online professional development on the teachers tasked with providing instruction to students.

Research Question One

The first research question focused on whether KinderTEK[®] OPD modules increased teacher engagement through (a) logging into the app's manage users section or the online data dashboard, (b) checking student score reports, (c) changing settings, and

(d) exploring the app within the app and web program in KinderTEK[®]. The data clearly showed evidence of there being a significant difference in the means between the total number of teacher actions with the app and web program pre-OPD1 ($M = 4.45$) and post-OPD1 ($M = 155.32$). The relationship of adult actions in relation to online professional development is established in literature, (Barton, et al., 2017; Teras & Kartoglu, 2017) there is clear evidence of an impact on participant behavior. These results confirm positive outcomes on adult behavior through online professional learning.

Research Question Two

The second research question investigated whether the effects of OPD differ based on specific teacher characteristics. When running analytics for RQ2 a challenge emerged. As seen in table 10, the total number of teacher actions with the app and web program were not normally distributed. Coupling this with a small sample size, especially when comparing subgroups of teachers within the sample led to a violation of homogeneity of variance in multiple data runs. Due to this, not all analyses were conducted using Levene's Test of Homogeneity. Particularly when running analyses with multiple variables, I instead used Welch's Robust Tests of Equality of Means.

When examining the characteristics of my participants against the frequency of which they interacted with the teacher features within KinderTEK[®] a pattern emerged. As noted in chapter three, there was not a statistically significant impact between most variables. However, certain variable means revealed trends. Notably, participants (a) with higher technology comfort, (b) who had previous experience with technology-based programs, (c) with higher levels of education, and (d) who spent the longest time in the profession, had the highest mean number of actions. Such a trend was not evident for

teachers who indicated they had high interest in KinderTEK[®] program features. They had a lower level of engagement with the program features than those who showed lower initial interest.

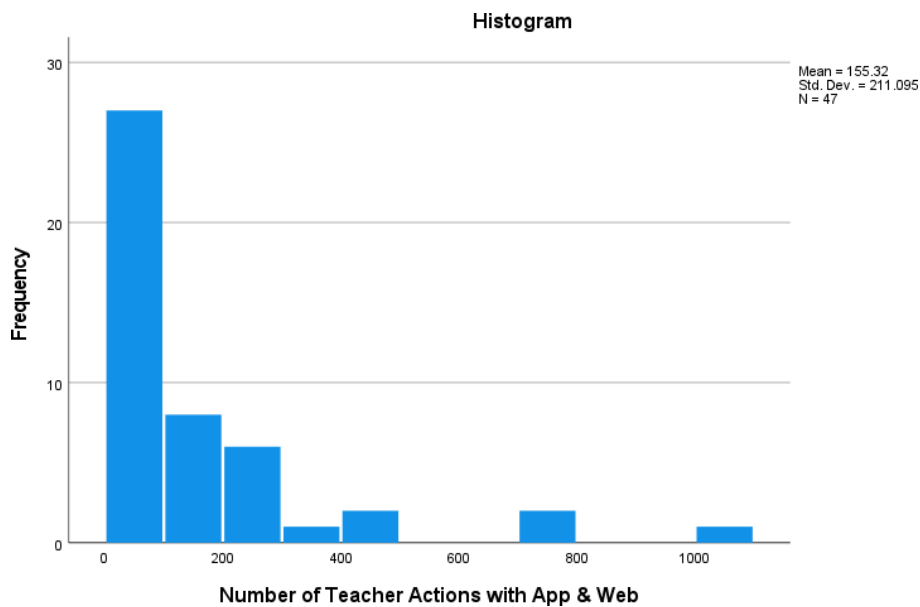


Figure 10. Distribution of number of teacher actions with app and web displaying right-skewed histogram.

Internet stability and Wi-Fi connectivity impacted teacher actions. This parallels literature cited in Chapter 1 that showed if minimum technology thresholds can't be met, participants will become frustrated and are less likely to complete the OPD. In my study, it seems likely that unstable Wi-Fi connectivity potentially led to frustration on the part of teachers, which may have affected their ability to participate fully in the OPD, which in turn effected implementation.

The last variable exhibited how type of study (efficacy or dissemination) impacted the actions of the teacher. When directly analyzing if teacher choice (dissemination) or a more directed program (efficacy) had an effect, it became clear the participants who were part of a more regimented study took significantly more actions

within the app and web dashboard. As seen in figure 11, even though both studies had participants who did not engage with the teacher features, both the mean ($M = 232.65$) and median ($Mdn = 133$) are higher for the efficacy teachers.

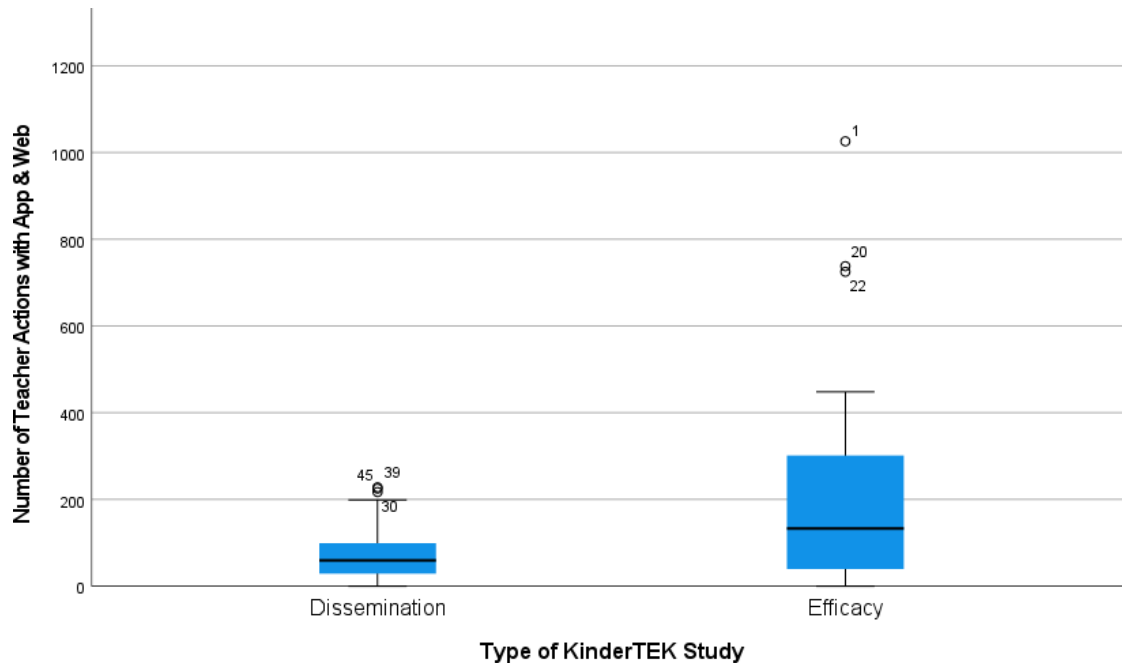


Figure 11: Boxplot displaying distribution of total number of actions taken between the two study groups.

In order to better understand the effectiveness of OPD, the last variable I analyzed was completion of the second OPD module. The OPD2 module specifically focuses on the teacher app and web features. The mean of for teachers whose OPD2 was *fully complete* ($M = 247.21$) was over 3 times greater than the teachers who made *no attempt* at OPD2 ($M = 77.35$), thus I was surprised to find this was not statistically significant. As the boxplot in figure 12 displays the spread of scores for *fully complete* is visibly greater than *no attempt*. In addition, there were three *fully complete* participants who took over 700 actions during study participation.

Additionally, as shown in Table 1, I discovered a noticeable difference in

completion of OPD modules based on which study teachers were part of. Of those in the efficacy study (which by design had more direction), 96% completed (either fully or partially) OPD2. In contrast, the same could be said of only 8% Of teachers in the dissemination study.

In addition, three teachers (2 dissemination, 1 efficacy) reported in the initial survey they had previous experience using KinderTEK[®]. I discussed this complication with committee members who are part of the KinderTEK[®] study. Given my study’s small sample size, and to keep my data consistent, I decided to keep these teachers in my analytical sample. For those reasons, this analysis is measuring whether the OPD which was offered to both study groups influenced their actions, regardless of their prior exposure to online or in-person KinderTEK[®] professional development.

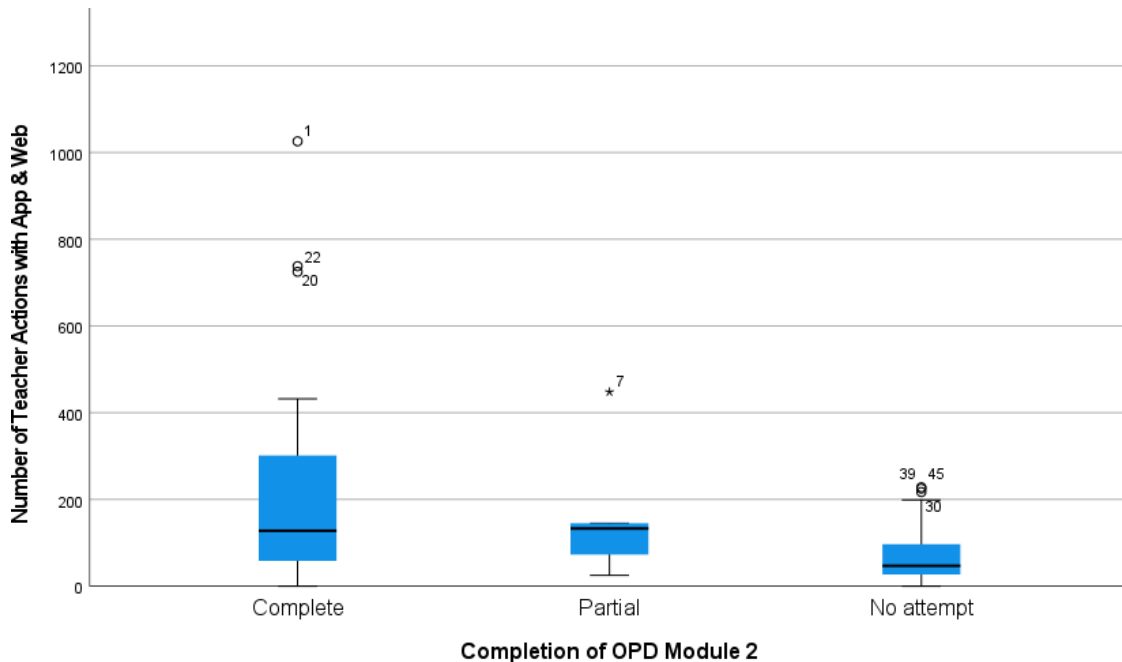


Figure 12: Boxplot displaying distribution of total number of actions taken between the groups of participants based on their level of OPD2 completion.

Validity and Limitations

Babbie (2014) emphasizes, “a good measurement technique should be both valid (measure what it is intending to measure) and reliable (yielding a given measurement dependably)” (p.153). Validity, in general, is whether the study is accurately measuring what is intended (Sedlack & Stanley, 1992). Creswell & Creswell (2018) focuses on two types of threats to validity, (a) internal and (b) external. Internal validity as defined by Wiersma and Jurs (2005) is “controlling extraneous variables, selection procedures measurement procedures, and the like” (p.105). Creswell & Creswell (2018) note that threats to internal validity come when the variables “threaten the researcher’s ability to draw correct inferences from the data about the population in an experiment” (p.168).

My study had a number of limitations. One of the largest threats to both internal and external validity was the small sample size ($N = 47$). Although the sample provided sufficient power to conduct statistical calculations, a larger sample size may have led to different study findings. In addition to a small overall sample, when analyzing teacher characteristics for statistical significance within individual variables, several of the subgroups numbered in single digits (e.g., interest in program customization, *low* $n = 5$ versus *high* $n = 42$). Consequently, the imbalance of participant group numbers has the potential to affect outcomes due to a limited amount of variance within the data set for running an ANOVA analysis.

Additionally, in this study there are three potential threats to internal validity to be considered (a) selection, (b) study attrition, and (c) instrumentation (Creswell, 2014). In the initial survey participants overwhelmingly showed interest in using the KinderTEK[®] program in their classrooms. In the dissemination study the 24 participants volunteered

to participate and showed active interest in using the product. If taken to a real-world context this may not be the case with future voluntary or district-directed users of KinderTEK[®], which could along with a sample size of 47 limits generalizability.

In the efficacy study, site administrators agreed to participate in the study and all participating kindergarten teachers were invited to participate. Within each school, those who agreed to participate had an equal opportunity to be selected as KinderTEK[®] teachers. To eliminate bias in conditional assignment, random selection was completed by a methodologist at Oregon Research Institute after teachers had agreed to participate.

With the passing of time (school year) there are “events which can occur that unduly influence the outcome” (Creswell & Creswell, p.169) this could include attrition of participants not completing the intervention due to illness, or a change of placement, even extreme weather conditions or frustration over a lack of Wi-Fi stability. According to the KinderTEK[®] research team, no participants officially withdrew from either study, however unofficial attrition may be at play. Only 50% of participants completed the second OPD module and seven teachers had ten or fewer web or app logins during their participation in the study. Since my study focused solely on adult actions, I did not examine data to see if student actions within the program mirrored those of the instructor.

For my study I used extant data from CTL. Similar, but not identical surveys were administered to the efficacy and dissemination teachers. In selecting survey questions for analysis, I considered both relevance to the RQs and comparable question type, scale, etc. In some instances, I re-scaled data to make the data comparable. Consequently, the analyzed data could have been skewed.

Another limitation of my study is that calendar time (and usage by students) is confounded with OPD provision. In my study OPD1 was given as an introduction to the KinderTEK[®] program, ideally before any implementation occurred. It overviewed everything about the app, including the teacher app or dashboard functions. Between OPD1 and OPD2 a month passed where participants had full use of the KinderTEK[®] program. Teachers were instructed in the efficacy study to have students use the program at this time. OPD2 was offered at this time so that teachers had real student data to explore during and after the OPD (i.e., so that the OPD would be more relevant). OPD2 does seem to have prompted more implementation: minimal actions were taken by teachers until after OPD2. To keep the sample size as large as possible, however, I grouped all teacher actions after OPD1. If more teachers had done OPD2, I would have expected an even greater effect of OPD.

External validity threats “arise when experimenters draw incorrect inferences from the sample data” (Creswell & Creswell, p.169). In my study, to control for threats to external validity, there are multiple geographical locations within the KinderTEK[®] study including urban, suburban, and rural, in addition to two cities on opposite coasts of the United States. Additionally, only participants assigned to implement KinderTEK[®] received the KinderTEK[®] online professional development modules. With care taken to limit both internal and external validity threats, I am hopeful that the results of this work will add to the growing body of research on a newer theory of professional learning.

Future Research

Due to the current circumstance of COVID-19, the use of OPD has accelerated and many traditional in-person professional development workshops are suddenly relying on digital platforms. A gap exists in the existing literature about the effectiveness of OPD on teacher program implementation. There is a limited body of current research that has a focus on teacher actions. Future study with an increased sample size has the potential to lead to outcomes, which may be of future importance in the research of OPD.

Another future area of study could be to compare the actions of the teachers with how the KinderTEK[®] program was implemented with students. In particular, it would be useful to test whether teachers who have higher fidelity, as defined in my study, have stronger program implementation with their students. More advanced research could examine as a mean across months, the effects on students, and conduct further analysis of pre and postOPD2.

In addition to research on OPD, it would be useful to explore participant choice as it relates to program implementation. Results of my study indicated when teachers had increased oversight in their participation stronger implementation occurred. Since many of the participating teachers had similar characteristics (teaching same grade level, high levels of enthusiasm, demographic, etc.) the variable of choice could prove important for future research in the study of OPD.

Furthermore, another area of future research could be to examine if implementation of program is stronger after having time to be immersed in the program prior to relevant OPD. Specific to KinderTEK[®], studying if teacher familiarity – and student usage - of the program prior to OPD2, and having the opportunity for immediate

application of content learned during the OPD is what triggers full implementation. Indeed, my initial intent had been to examine “before OPD1”, “between OPD1 and OPD2”, and “after OPD2”, but so few teachers completed OPD2 and so little implementation occurred between OPD1 and OPD2, I decided not to pursue for this dissertation.

Practical Application

Due to a pandemic, the world changed. During the course of my dissertation, the means by which instruction and professional development are delivered altered drastically. This brought an increased need for practical application around the topic of online learning. An immediate application for practice is to take the characteristics of successful OPD and embed those principles into action for both adults, and students who find themselves suddenly learning remotely.

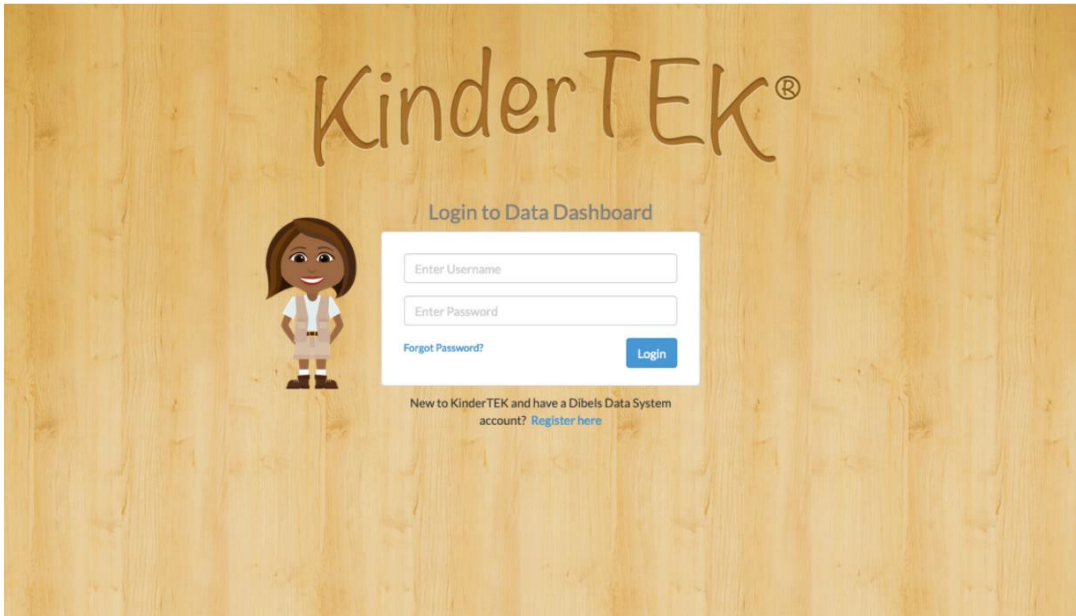
In addition to being an area for future study, the application of teacher choice versus mandated participation has clear implication for schools. As mentioned previously, there was a clear difference between participants who were required and those who were encouraged to engage in the OPD modules. This gives evidence that participants show more progress with accountability. Yet there must be balance. This contrasts with professional learning where a person intrinsically seeks out professional opportunities to grow in their skills. For true authentic learning to take place, mandates aren't enough. Participants must show willingness and initiative in learning new content (Teras & Kartoglu, 2017). In school and work settings which are becoming increasingly digital, participants may find added success with balanced accountability and voice.

Conclusion

Online professional development (OPD) is a promising mode of delivering quality instruction to classroom teachers with the hope of improving classroom practice. My study examined the effect of OPD modules on adult behavior as measured by web and app logins in the KinderTEK[®] teacher dashboard. I addressed a gap in the literature on the study of online professional development by focusing on adult behaviors. I analyzed the relationship between participation in OPD and use of program features. Results from my study found participation in OPD modules significantly impacted teacher use of program features. In addition, results indicated most participant characteristics I analyzed did not have a significant impact on program use, although interesting trends were evident. Results also revealed that the type of study participants took part in impacted their full participation in OPD modules and use of the teacher features. As highlighted in this study, OPD has the potential to be a useful tool in teachers' implementation of new practice.

APPENDIX A

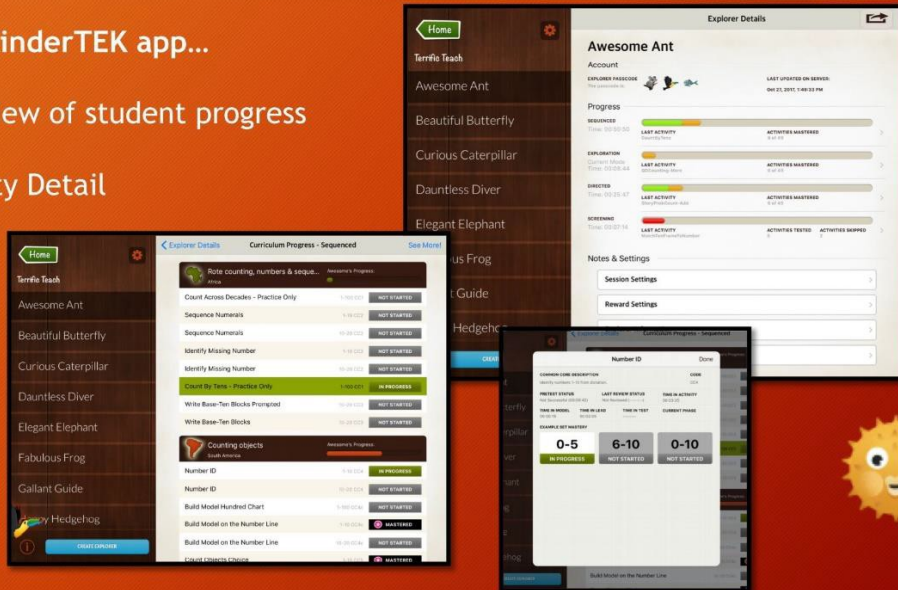
SAMPLES OF APP AND WEB REPORTS



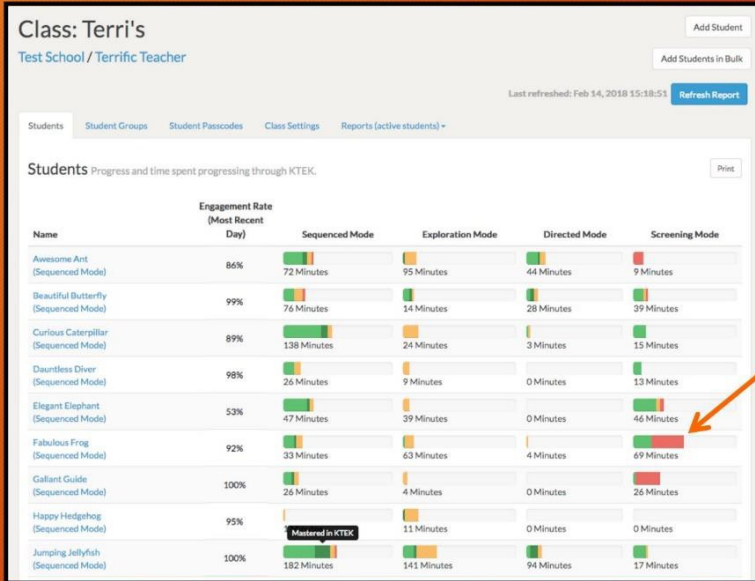
What kinds of reports can I see on the KinderTEK app?

On the KinderTEK app...

- Overview of student progress
- Activity Detail



Data Dashboard Classroom Level Summary



Light Green = Activities Mastered in PreTest
Dark Green = Activities Mastered in Learning Phase of KinderTEK
Yellow = Activities in Progress
Red = Skipped Activities



Activity Status Report

Activity status - All Students in Class

Status Totals	BulkMode/TenFrame 1 CC4c_3aZ1	NumberID 1 CC4_1Z1	BulkMode/NumLine 1 CC4c_3aZ1	CountObjects/Choice 1 CC3_1aZ1	Match/TenFrame/Number 1 CC4b_2aZ1	CountObjects CC3_1aZ1
Mastered in Pretest	5 (of 19)	7 (of 19)	8 (of 19)	6 (of 19)	3 (of 19)	5 (of 19)
Mastered in KTEK	6 (of 19)	4 (of 19)	4 (of 19)	5 (of 19)	1 (of 19)	3 (of 19)
In Progress	1 (of 19)	0 (of 19)	1 (of 19)	2 (of 19)	4 (of 19)	4 (of 19)
Skipped	2 (of 19)	1 (of 19)	0 (of 19)	1 (of 19)	1 (of 19)	1 (of 19)
Not Encountered	3 (of 19)	4 (of 19)	5 (of 19)	4 (of 19)	9 (of 19)	6 (of 19)

Students	BulkMode/TenFrame 1 CC4c_3aZ1	NumberID 1 CC4_1Z1	BulkMode/NumLine 1 CC4c_3aZ1	CountObjects/Choice 1 CC3_1aZ1	Match/TenFrame/Number 1 CC4b_2aZ1	CountObjects CC3_1aZ1
Amazing Curfs	Mastered in KTEK	Mastered in Pretest	Mastered in Pretest	Mastered in KTEK	In Progress	Mastered in Pretest
Amelia Cutiepie	Mastered in KTEK	Mastered in Pretest	In Progress	Mastered in Pretest	Not Encountered	Mastered in KTEK
Amelia Adams	Not Encountered	Not Encountered	Not Encountered	Not Encountered	Not Encountered	Not Encountered
Amy Cutie	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	Mastered in KTEK
Anby Claus	Skipped	Mastered in KTEK	Mastered in KTEK	Mastered in KTEK	Not Encountered	In Progress
Captain Crunch	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	In Progress	Not Encountered	Not Encountered
Charlie Brown	Mastered in KTEK	Mastered in KTEK	Mastered in KTEK	Mastered in KTEK	Not Encountered	Mastered in KTEK
Christopher Robin	Skipped	Skipped	Mastered in KTEK	Mastered in KTEK	In Progress	In Progress
Coco Puffs	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	In Progress	In Progress
Eli E	In Progress	Mastered in Pretest	Not Encountered	Mastered in Pretest	Not Encountered	Mastered in Pretest
Emma Explorer	Not Encountered	Not Encountered	Not Encountered	Not Encountered	Not Encountered	Not Encountered
Haley A.	Mastered in Pretest	Endorsing	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest	Mastered in Pretest
Kanga Roo	Endorsing	Endorsing	Endorsing	In Progress	Endorsing	Not Encountered
Macy M.	Endorsing	Mastered in KTEK	Mastered in Pretest	Endorsing	Mastered in KTEK	Mastered in Pretest

Data Dashboard
-- Classroom level -
- Activity Status-



Student

Notes

Settings

Reports

Activity Details

CCSS Details

Certificates

Certificate of Mastery
(sequenced)

Exploration Adventurer
(exploration)

KinderTEK Explorer
(work)

Test School District / Test School Kinder // 2019-20

Jumping Jellyfish

Student App Passcode is... (click to edit)



Student Settings

Session Settings

- Enable Intro Activity: No
- Learning Mode: Sequenced
- Directed Mode Skill 1: Story Problems (1-10)
- Directed Mode Skill 2: Number Models (1-10)
- Session Duration: 15 minutes
- Additional Think Time: None
- Use On Screen Timer Instead of Progress Bar: Yes
- Audio Indicator to Prompt Action: On
- Visual interaction indicator: On
- Allow Exit: No
- Progress Path Access: Yes

Reward Settings

- Activity Center Access: End of session only
- Extended Reward Time: Yes
- Sticker Frequency: Balanced

Save Student Settings

APPENDIX B

SURVEY QUESTIONS AND SCALES

Comfort with using iPad

Efficacy: I am comfortable with using iPads (5 pt scale of *agree* to *disagree*)

Dissemination: How comfortable/experienced are you using iPads? (6 pt scale; *very* to *not at all*)

Previous Experience Using Digital Individual Based Learning Programs

Efficacy: I have implemented technology-based, individualized learning programs in the past (5 pt scale of *daily* to *not at all*)

Dissemination: I have implemented technology-based, individualized learning programs in the past (5 pt scale; *daily* to *no*)

Interest in In-app Teacher Reports and Management

Efficacy and Dissemination: Interest in in-app teacher reports and management (5 pt scale of *high* to *low*)

Wi-fi Strength and Stability

Efficacy and Dissemination: Wi-Fi Strength (3 pt scale of *performance is not affected by multiple users* to *WiFi crashes with multiple users*)

Highest Level of Education

Efficacy and Dissemination: Education: (Please check your most advanced degree earned) (5 pt scale *EdD/PdD* to *HS*)

Number of Years in the Profession

Efficacy and Dissemination: Teaching experience: (including this year) - How many years have you taught? (*number*)

REFERENCES CITED

- America Counts Staff. (2017). One in five americans live in rural areas. Retrieved from <https://www.census.gov/library/stories/2017/08/rural-america.html>.
- Babbie, E. R. (2013). *The practice of social research (Thirteenth Ed.)*. Belmont, CA: Wadsworth Publishing.
- Barron, S., Tracy, K. N., Howell, E., & Kaminski, R. (2015). Obstacles to enhancing professional development with digital tools in rural landscapes. *Journal of Research in Rural Education*, 30, 1-14.
- Barton, E.A., Whittaker, J.V., Kinzie, M.B., DeCoster, J., & Furnari, E., (2017). Understanding the relationship between teachers' use of online demonstration videos and fidelity of implementation in MyTeachingPartner-Math/Science. *Teaching and Teacher Education*, 67,189-201.
- Carter, C., & Hursh, A. W. (2014). Peer modeling and innovation adoption among teachers in online professional development. *Computers & Education*, 73, 72-82.
- Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S., (2007). A conceptual framework for implementation fidelity. *Implementation Science*, IS, 2,40. doi:10.1186/1748-5908-2-40
- Ching-Huei, C. (2011). Transforming online professional development: The design and implementation of the project-based learning management system (PBLMs) for in-service teachers. *British Journal of Educational Technology*, 42, 5-8. doi:10.1111/j.1467-8535.2010.01143
- Creswell, J., & Creswell, J., D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (Fifth ed.). Thousand Oaks, California: SAGE Publications.
- Dash, S., Magidin de Kramer, R., O'Dwyer, L.M., Masters, J., & Russell, M. (2012). Impact of online professional development on teacher quality and student achievement in fifth grade mathematics. *Journal of Research on Technology in Education*, 45,1-26.
- Dede, C., Ketelhut D. J., Whitehouse, P., Breit L., & McCloskey E.M. (2009). A research agenda for online teacher professional development. *Journal of Teacher Education*, 60, 8-19. doi:10.1177/0022487108327554
- Durlak, J.A., & DuPre, E.P. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American Journal of Community Psychology*, 41, 327-350.

- Erickson, A. S., Noonan, P. M., & McCall, Z. (2012). Effectiveness of online professional development for rural special educators. *Rural Special Education Quarterly*, 31, 22-32.
- Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, 272-299. doi: 10.1037/1082-989X.4.3.272.
- Guskey, T.R. (2002). Professional development and teacher change. *Teachers and Teaching: Theory and Practice*, 8, 381-391.
- Hunt-Barron, S., Tracy, K.N., Howell, E., & Kaminski, R. (2007). Obstacles to enhancing professional development with digital tools in rural landscapes. *Journal of Research in Rural Education*, 30,1-14.
- Masters, J., Madgidin de Kramer, R. M., O'Dwyer, L. M., Dash, S., & Russell, M. (2010). The effects of online professional development on fourth grade english language arts teachers' knowledge and instructional practices. *J. Educational Computing Research*, 43, 355-375.
- Polly, D., Martin, C. S., Wang, C., Lambert, R. G., & Pugalee, D.K. (2015). Primary grades teachers' instructional decisions during online mathematics professional development activities. *Early Childhood Education Journal*, 44, 275-287. doi:10.1007/s10643-015-0711-8
- Ravitch, S.M., & Riggan, M. (2017). Reason & rigor: How conceptual frameworks guide research 2nd edition. Thousand Oaks, CA: SAGE.
- Renninger, K. A., Cai, M., Lewis, M. C., Adams, M. M., & Ernst, K. L. (2011). Motivation and learning in an online, unmoderated, mathematics workshop for teachers. *Educational Technology Research Development*, 59, 229-247. doi:10.1007/s11423-011-9195-4
- Sedlack, R. G. & Stanley, J. (1992). *Social Research: Theory and Methods*. Boston, MA: Allyn and Bacon.
- Strand Cary, M. & Clarke, B., (2014). *Stepping Up KinderTEK: Expanding Early Math Instruction for Students with Disabilities*. (Office of Special Education and Rehabilitative Services, Stepping Up Technology, CFDA: 84.327S, 2014-2019, H327S140019, awarded \$2,498,503).
- Strand Cary, M., Clarke, B. & Shanley, L. (2017). *Evaluation of the KinderTEK iPad Program*. (U.S. Department of Education; Institute of Education Sciences; Science, Technology, Engineering, and Mathematics (STEM); (CFDA 84.305a; 7/2017-6/2021; R305A170044, awarded \$3,299,986).

- Teras, H., & Kartoglu, U. (2017). A grounded theory of professional learning in an authentic online professional development program. *International Review of Research in Open and Distributed Learning*, 18, 191-212.
- Uptis, R., & Brook, J. (2017). How much professional development is enough? Meeting the needs of independent music teachers learning to use a digital tool. *International Journal of Music Education*, 35, 93-107. doi: 10.1177/0255761415619426
- Vu, P., Vien, C., Vu, L., & Cepero, J. (2014). Factors driving learner success in online professional development. *The International Review of Research in Open and Distance Learning*, 15, 121-139.
- Wiersma, W., & Jurs, S. G. (2005). *Research methods in education*. USA: Pearson.