Crowdsourcing Educators Perspectives on First- and Second- Order Variables Impacting EdTech Implementation

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Abstract

Current edtech implementation falls far below expectations, and there is a critical need to identify the contexts in which technologies do thrive. Following the 2017 EdTech Efficacy Symposium, 2018 summer summits crowdsourced educator perspectives on the contextual variables impacting edtech implementation, and we captured attendees' perspectives on the variables that matter most. To analyze responses, we categorized variables as first-order, structural variables or second-order, human-centered variables and identified themes in attendees' final takeaways. Results suggest second-order, human-centered variables intrinsic to teachers and school leaders are most salient in educators' perceptions of variables that impact technology implementation. These findings provide direction in efforts to define contexts in which technologies thrive or fail by capturing the most critical first- and second-order variables.

Purpose

Education technology (edtech) holds clear potential for improving student achievement (e.g., Cheung & Slavin, 2014; Kulick & Fletcher, 2016). Further, today's students must be exposed to technology to build skills necessary for professional success (Adams Becker, Pasquini, & Zentner, 2017) and to navigate the complex, unfiltered world of modern digital communication (Breakstone, McGrew, Smith, Ortega, & Wineburg, 2018). However, there is considerable variation in return on the 13 billion dollars spent annually on education technology in the United States (Future Source Consulting, 2017), as evidence suggests 65% of purchased licenses for technologies proven to be successful in some contexts are never used and 35% are vastly underused (Stanhope & Rectanus, 2016). Why does seemingly promising technology fail in some environments yet thrive in others? What are the contextual variables that matter for successfully integrating new technology? Answering these questions will allow education technology decision-makers to select contextually appropriate technologies and efficiently reallocate their currently wasted resources. In this study, we take a crowdsourced, educator perspective to investigate why technologies are or are not successful in certain contexts. Specifically, we examine the variables educators identify as impacting technology integration in terms of first- or second-order categorization.

Theoretical Frame

In considering barriers to edtech implementation, Ertmer identified first-order, structural and second-order, human-centered barriers to technology integration (1999). First-order barriers are typically limited resources (e.g., devices, time, training) that can, theoretically, be alleviated with funding. These first-order, quantitatively measurable barriers are extrinsic to students, teachers, and leaders. Second-order barriers are intrinsic and require fundamental changes in beliefs or perspectives, rendering them more difficult to measure and alleviate. More recent research repeatedly documents the impact of second-order barriers on technology integration practices (Hur, Shannon, & Wolf, 2016; Inan & Lowther, 2010; Vongkulluksna, Xie, & Bowman, 2018),

but we have yet to carry that research forward sufficiently to positively impact teacher practice at scale. In addition to teachers' underuse of technology (Stanhope & Rectanus, 2015), the technology they do use often does not provide students with rich learning experiences (van Broekhuizen, 2016). Here, we use Ertmer's framework of first- and second-order barriers to consider what attendees at an edtech implementation summit believe to be the conditions necessary for successful technology implementation, primarily considering the dominance of first- or second-order conditions.

Methods

Context

Building on previous work at the 2017 EdTech Efficacy Symposium calling for crowdsourced edtech implementation research (Epstein, Rush, & Slykhuis, 2017), the Jefferson Education Exchange (JEX) hosted three EdTech Implementation Research summits in summer 2018 to crowdsource variables that impact edtech implementation. Working with higher education and K12 regional partners, JEX invited educators and administrators from both K12 and higher education regional institutions to each summit. Methodologically, crowdsourcing is an efficient data collection strategy in education, providing "diversity (each person adds private information or bias), independence (people form their opinions), decentralization (people draw on their own specialized knowledge) and aggregation (a mechanism exists to turn private judgments into a collective decision)" (Surowiecki, 2005, p. 5). Here, we report on preliminary crowdsourced data from a summit located in a small city northwest of a western state's capital city.

Sample

There were a total of 33 summit attendees – 7 from higher education and 26 from K12 institutions. Of higher education attendees, 3 identified as administrators and 4 as instructional faculty. Of K12 attendees, 6 identified as administrators and 20 as instructional staff. Attendees had an average of 17.68 years of education experience (SD = 8.82) and 9.11 years of experience in their current roles (SD = 6.55). Notably, attendees have generally positive attitudes about technology (M = 2.93, SD = 0.20, possible range = 1-4), with no significant differences between sectors or roles.

Summit Sessions

The summit schedule included sessions on establishing essential conditions, variables beyond the essentials, measuring edtech effectiveness, and educator-driven edtech implementation research. Here, we focus on results from the first two sessions.

The guiding question for **establishing essential conditions** was "*What are the essential conditions for edtech implementation success?*" In this session, attendees sat at tables by sector (higher education vs. K12) and worked together to identify essential conditions (1) within the classroom, (2) within the school/district, and (3) without bounds. To introduce the activity, facilitators defined essential conditions as structural and measurable and provided an example (Wi-Fi access) and non-example (teachers' technology beliefs). Facilitators also drew an analogy to farming, describing three essential conditions as annual rainfall, monthly temperatures, and soil pH. Facilitators aimed for attendees to discuss the first-order structural conditions extrinsic

to individuals but necessary for technology implementation in order to move beyond those in the second session.

The guiding question for **beyond essential conditions** was "*Beyond the essential conditions, what else might impact why edtech is successful?"* In this session, attendees moved into breakout rooms by higher education, K12 administrators, and K12 instructional staff, each led by a trained workshop facilitator. In small groups of three to six, attendees considered human-centered variables that might impact edtech implementation, focusing separately on (1) teachers, (2) formal leaders/administrators, (3) schools/districts, and (4) students/parents. To introduce the session, attendees spent time reflecting on successful and unsuccessful technology integration and received guidance from facilitators to consider human-centered variables.

Measures

We collected information at three timepoints: before attending the summit (pre-survey), during summit conversations (session artifacts), and after summit conversations (takeaways survey).

Pre-Survey. One week before the summit, attendees received a welcome email with a presurvey link and three background articles describing the need for contextualized edtech research. The pre-survey captured individual attendee thinking before engaging in conversations with others about the conditions that impact technology implementation. First, we asked background questions, including K12 or higher education affiliation, role (e.g., teacher, associate professor), number of years in education and current role, and beliefs about classroom technology (Brush, Glazewki, & Hew, 2011). Second, we asked attendees to identify (1) three variables that influence technology implementation success in terms of *technology usage* and (2) three variables that influence success in terms of *student achievement*. Thirty-four attendees responded to the pre-survey, one of whom did not attend the summit. Of those, twenty-nine attendees provided initial thinking on the variables that impact technology integration (87.88%).

Session Artifacts. Within each session, small groups recorded their responses on Google documents (digital, collaborative documents) prepared in advance and distributed via links on a digital agenda such that response format was consistent across groups. Facilitators could follow attendee participation, and we could access group responses after the session. Data collected during the summit from session artifacts reflects small group thinking, analogous to focus group data.

Exit survey. Facilitators asked attendees to provide their final takeaways from the summit in an exit survey during the closing session. Attendees described one essential condition (structural variable) and one human-centered variable they felt was most critical to technology implementation success, again reflecting individual thinking. Twenty-four attendees (72.74%) responded to the exit survey.

Analysis

We conducted two types of analysis coding on participant responses. First, we used Ertmer's categories of first- and second-order barriers as a priori codes (Crabtree and Miller,

1999), considering attendee responses before, during, and after conversations about edtech implementation. While Ertmer describes these as barriers (1999), we broaden the consideration to variables that impact technology implementation and may be phrased either positively (e.g., teacher belief that technology can enhance instruction) or negatively (e.g., lack time for integration planning). During this coding, we did not classify five responses (1.77%) that were too general or lacked specificity (e.g., "quality" or "Lead Learner"). We also did not code *Beyond Essential Conditions* categories of school/district and students/parents due to a lack of alignment with the coding scheme (See Results). Second, we identified dominant themes in attendees' final takeaways from the summit.

Results

See Table 1 for a categorization and examples of attendee responses as first- or second-order variables by time point and session.

Before Summit Responses

When asked about the variables that impact technology implementation, attendees identified more second-order, human-centered variables overall (87/152 responses, 57.24%). However, when considering variables that impact implementation in terms of *technology usage*, attendees identified almost the same number of first-order (43/82, 52.44%) and second-order variables (39/82, 47.56%). When considering variables that impact implementation in terms of *student achievement*, the majority of responses (48/70, 68.57%) were second-order.

During Summit Responses

During the first session, *Establishing Essential Conditions,* facilitators aimed for attendees to identify first-order, structural variables that impact technology implementation in the classroom, the school/district, and without bounds. However, despite examples and direction to consider structural elements, when focused on the classroom, almost half of attendees' responses were second-order, human-centered variables (32/67, 47.76%). Approximately one-third of responses were second-order when focused on the school/district (13/44, 29.55%) and without bounds (7/19, 36.84%).

During the second session, *Beyond Essential Conditions*, facilitators aimed for attendees to identify second-order variables impacting technology implementation by focusing on specific stakeholder groups. Both when considering teachers and formal leaders/administrators, approximately 70% of attendees responses were, in fact, second-order variables, intrinsic to the individuals (30/41 about teachers; 19/27 about administrators). When facilitators asked participants about human-centered characteristics at the school/district level, attendees focused primarily on district processes dependent on variables intrinsic to the administrators. Similarly, the majority of responses about students /families described school and teacher processes involved with engaging students and families in technology implementation.

After Summit Responses

After participating in summit discussions, attendees identified the most important *essential condition* and *human-centered variable* for successful edtech implementation. After a full day of considering these issues, two-thirds of attendees described first-order, structural

variables when asked for essential conditions, while one-third still described human-centered variables. The three dominant structural variables identified included teacher support/training (5 attendees), equity in device access (5 attendees), and technology infrastructure (3 attendees). Almost all attendees (91.67%) did identify second-order, intrinsic variables when describing the most critical human-centered variables. At the school level, the most frequently identified human-centered variable was culture (5 attendees). This included trusting teachers, allowing for failure such that it is a learning opportunity, having a growth mindset, and allowing for teacher flexibility. The second most frequently identified variable was teacher buy-in (4 attendees), followed by collaborative practices (3 attendees).

Discussion

These preliminary results suggest second-order, human-centered variables intrinsic to teachers and school leaders are more salient in educators' perceptions of the variables that impact technology implementation. This is particularly true when educators' consider technology implementation in terms of student achievement, as opposed to usage. While there are clear, necessary structural variables (e.g., Wi-Fi), attendees continued to trend towards human-centered variables (e.g., comfort with technology), even when explicitly directed to consider the structural variables. JEX designed the summit to remove confounding first-order variables from consideration such that attendees could focus on human-centered variables. However, attendees were drawn to intrinsically oriented conditions. This aligns with findings on the importance of administrative support for technology, teacher readiness for technology use, and perceived benefits of (or beliefs about) technology (Hur, Shannon, & Wolf, 2016; Inan & Lowther, 2010). Attendee responses emphasize school-level cultural variables, which likely operate through teachers' readiness and beliefs (Inan & Lowther, 2010).

While the field of edtech seems to be coming to consensus around the importance of intrinsic variables, there is much work to be done to deepen understanding and refine measures such that they serve both researchers and educators. In future analyses, we will categorize the variables reported at the summit, and in future data collection, we will seek to associate those variables with implementation. We aim to characterize teachers, classrooms, and schools such that they can identify technologies that have proven to work for contextually similar colleagues. To do so, we need to not only define contexts by capturing the most critical first- and second-order variables but also identify technologies that work in varied classrooms and schools. For example, are there technologies available that will be successful in an environment without a strong culture of trust or high level teacher technical knowledge? Finally, we need to prioritize communication and collaboration with educators such that they have access to the most critical information when making edtech procurement decisions.

Tables

Table 1

Categorization of Attendee Responses as First- or Second-Order Variables by Timepoint and Session

	1st Order Variables			2nd Order Variables		
	Freq.	%	Example	Freq.	%	Example
Pre-survey	(Before Summit)					
Implementation Success as *Usage*	43/82	52.44%	*Internet connection*	39/82	47.56%	*fear of the unknown*
Implementation Success as *Student Achievement*	22/70	31.43%	*training*	48/70	68.57%	*outwardly learning from mistakes*
Total	65/152	42.76%		87/152	57.24%	
Session 1: Essential Conditions	(During Summit)					
Classroom	35/67	53.24%	*enough devices for students*	32/67	47.76%	*teachers willing to implement*
School/District	31/44	70.45%	*bandwidth*	13/44	29.55%	*continuous reflection with permission to fail*
Without Bounds	12/19	63.16%	*accessibility*	7/19	36.84%	*parent buy in*
Total	78/130	60.00%		52/130	40.00%	
Session 2: Beyond Essential Conditions	(During Summit)					
Focused on Teachers	11/41	26.83%	*lack of compensation for time*	30/41	73.17%	*fear of failure*
Focused on Formal Leaders/Administrators	8/27	29.63%	*time and money for support*	19/27	70.37%	*learning stance--lack of ego*
Total	19/68	27.94%		49/68	72.06%	
Exit Survey Takeaways	(After Summit)					
Essential Condition	16/24	66.67%	*device access*	8/24	33.33%	*collective efficacy*
Human-Centered Variable	2/24	8.33%	*time*	22/24	91.67%	*shared vision*
Total	18/48	37.50%		30/48	62.50%	

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