Inclusion

Conceptualizing Fidelity of Implementation of a Technology-Delivered Self-Determination Intervention

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Abstract:	As technology becomes a more central support for students with disabilities in inclusive schools, understanding fidelity of implementation of technology-delivered interventions is becoming an important area to inform effective teaching practices that support the adoption of evidence-based practices and advance student outcomes. In this study, we propose a framework for conceptualizing fidelity of the Goal Setting Challenge (GSC) App, a technology-delivered, school-based intervention based on the Self-Determined Learning Model of Instruction (SDLMI) to advance student-directed goal setting for postschool outcomes in inclusive communities. To develop the fidelity framework, we adopted elements of the standard setting process. Specifically, we created performance level descriptors that describe 'good enough' fidelity for three fidelity dimensions: adherence, quality of delivery, and participant responsiveness. Using data from a pilot trial, we present information on our conceptualization of the dimensions of fidelity specifically related to participant responsiveness with a technology-delivered self-determination intervention. We discuss how this could direct future research to support effective adoption of technology-delivered interventions by teachers and schools and examine impacts on student outcomes with a particular focus on supporting students with intellectual and developmental disabilities to access self-determination instruction to advance inclusive outcomes.

Conceptualizing Fidelity of Implementation of a Technology-Delivered Self-Determination Intervention

Abstract

As technology becomes a more central support for students with disabilities in inclusive schools, understanding fidelity of implementation of technology-delivered interventions is becoming an important area to inform effective teaching practices that support the adoption of evidence-based practices and advance student outcomes. In this study, we propose a framework for conceptualizing fidelity of the Goal Setting Challenge (GSC) App, a technology-delivered, school-based intervention based on the Self-Determined Learning Model of Instruction (SDLMI) to advance student-directed goal setting for postschool outcomes in inclusive communities. To develop the fidelity framework, we adopted elements of the standard setting process. Specifically, we created performance level descriptors that describe 'good enough' fidelity for three fidelity dimensions: adherence, quality of delivery, and participant responsiveness. Using data from a pilot trial, we present information on our conceptualization of the dimensions of fidelity specifically related to participant responsiveness with a technology-delivered self-determination intervention. We discuss how this could direct future research to support effective adoption of technology-delivered interventions by teachers and schools and examine impacts on student outcomes with a particular focus on supporting students with intellectual and developmental disabilities to access self-determination instruction to advance inclusive outcomes.

Keywords. Self-determination, implementation fidelity, secondary education and transition, instructional technology, students with disabilities

Measuring fidelity of implementation is essential not only to document that an intervention was implemented as intended but also to identify reasons why expected outcomes of research-based interventions are not obtained when scaling-up in practice (Fixsen et al., 2010). Despite a growing emphasis on reporting fidelity of implementation data in intervention research as well as calls to use these data to inform the enhancement of needed implementation supports (Bellg et al., 2004; Gersten et al., 2005; Toste et al., 2023; What Works Clearinghouse [WWC], 2017), there is limited agreement on best practices to capture data on fidelity, report it in research studies, and analyze it to inform research and the implementation of evidence-based interventions to advance student outcomes in inclusive schools. This is particularly true of fidelity for complex interventions, which require flexibility and problem solving on the part of teacher implementers to integrate core components into their curriculum and local context while addressing the needs of individual students, particularly students with intellectual and developmental disabilities planning for their transition from school to adult life (Shogren et al., 2021). This is also true for technology-delivered interventions, which introduce new considerations in defining fidelity and its indicators as delivery shifts from teachers to technology, but teachers still play a role in supporting student access and engagement in inclusive schools (Gersten & Edyburn, 2007; Helsabeck et al., 2022).

In self-determination research, the Self-Determined Learning Model of Instruction (SDLMI; Shogren et al., 2018) has been identified as an evidence-based practice to enhance in-school and postschool outcomes for students with disabilities (Hagiwara et al., 2017; Mazzotti et al., 2021). The SDLMI is a complex intervention that requires trained implementers (e.g., general and special education teachers in school contexts) to problem solve how to implement its three core components (Student Questions, Teacher Objectives, and Educational Supports) in

ways aligned with their curriculum and individualized student needs and supports. Reporting on fidelity of implementation of the SDLMI in the research literature has varied significantly over time, with different definitions of fidelity and measures adopted across studies (Kiblen et al., 2023); however, research has suggested that teachers of students with a range of disabilities, including intellectual and developmental disabilities, can implement the SDLMI with fidelity with effective supports in inclusive general education classrooms as well as during transition planning (Shogren et al., 2020). Recently, based on a review of the literature, Shogren et al. (2021) introduced a framework for conceptualizing fidelity of implementation of complex interventions like the SDLMI. The authors highlighted how the framework could guide planning for factors that could influence fidelity in inclusive schools and classrooms, advancing supports for teachers and schools to adopt evidence-based interventions to advance student outcomes. They also described how such a framework could enhance greater personalization of supports based on student needs and inform targeted training and professional development for teachers based on fidelity data if, for example, a greater need to focus on how to support students with intellectual and developmental disabilities during self-determination instruction was identified. Shogren et al. (2021) recommended that three fidelity dimensions (i.e., adherence, quality of delivery, participant responsiveness) be assessed using diverse data sources to evaluate implementation of the SDLMI by teachers to inform their practice and support their sustained use of evidence-based interventions. General definitions of each of these dimensions from the fidelity literature, as well as definitions for the SDLMI specifically, are provided in the first three columns of Table 1.

As can be inferred from the definitions of fidelity dimensions for the SDLMI, teacher-delivered SDLMI instruction requires significant training and support for teacher implementers

to ensure adherence and quality of delivery to the core components of the intervention and individualize to the support needs of students learning in inclusive schools. For example, students with intellectual and developmental disabilities may have specific needs related to self-determination instruction, but unless this is infused into broader supports for fidelity of implementation, these needs may be missed or students denied access to instruction. Given that teachers consistently acknowledge the importance of self-determination instruction, but also state that they have limited time, training, and support for personalizing such instruction, there is an identified need to explore ways to promote access to evidence-based interventions like the SDLMI in innovative ways (Mazzotti et al., 2022). Technology-delivered SDLMI instruction has the potential to change demands placed on teachers to learn and implement a complex intervention, and provide standardization of delivery of the core components aligned with student's needs (Office of Education Technology, 2017).

The Goal Setting Challenge (GSC) App was developed to address this need; its development is more fully described by Mazzotti et al. (2022). The GSC App was specifically developed for the purpose of providing schools and teachers with a method for delivering goal setting and attainment instruction to students with disabilities in an innovative and time efficient way that could occur across settings in schools to advance transition planning. Initial research has shown the impacts of the App during transition instruction with students with a range of disability labels and support needs, including primarily students with learning disabilities but also students with intellectual and developmental disabilities who are receiving transition instruction (Shogren, Mazzotti, et al., 2024). To develop the GSC App, the process model of engagement, principles of instructional design, and culturally responsive practices (e.g., engaging end-users with disabilities from varying racial/ethnic backgrounds in development,

including a range of "characters" in the App reflecting diverse identities, using examples of goals and action steps that reflected a range of family and student values) were used to "translate" the SDLMI and its core components into a web-based application that leverages cutting-edge instructional technologies and supports to deliver the SDLMI core components via technology. The GSC App includes 14 web-based lessons, including two introductory lessons and 12 lessons aligned with the 12 Student Questions organized into the three SDLMI phases (Phase 1 – Set a Goal; Phase 2 – Take Action; Phase 3 – Adjust Goal or Plan; Shogren et al., 2018). Accessibility and engagement features are embedded in the GSC App (e.g., multiple student response options, varying activity formats, predictability in structure) to address student needs in accessing the SDLMI core components (Student Questions, Teacher Objectives, Educational Supports). Development was guided not only by best practices in technology development (Gersten & Edyburn, 2007) but also by sustained input from end-users (i.e., students with disabilities) and their teachers (see Mazzotti et al., 2022 for further information).

Each GSC App lesson was designed to take students approximately 20 min to complete. To complete one GSC App challenge (i.e., setting and going after one goal by completing all 14 lessons) during one semester, students complete approximately two lessons a week. The GSC App was designed to be used repeatedly, across semesters. After the first semester of use, students can work to set new goals as well as modify goals or plans from previous semesters within the GSC App. Teachers can track students' progress in the GSC App using a Teacher Dashboard. The Teacher Dashboard uses metadata to provide information on where each student is in the GSC App. Teachers can also review students' responses to activities in each lesson to provide feedback. Preliminary research suggests that the GSC App shows promise for impacting student goal attainment outcomes, and teachers report finding the GSC App is time efficient and

engaging for their students (Mazzotti et al., 2023; Shogren, Mazzotti, et al., 2024). However, there are additional questions that need to be addressed, particularly about measuring the fidelity of a complex intervention delivered via technology. Such work is needed to support teachers to embed this technology in their curriculum to support transition planning and to examine the association between implementation and student outcomes in-school and post-school (Bonar et al., 2022).

While on the surface, it may seem as though it could be easier to measure fidelity of implementation for web-based technology interventions given metadata collected, this may not always be the case (Gersten & Edyburn, 2007). Factors related to teacher behaviors and their support for the App, as well as student engagement with the App, also need to be considered. In the fidelity of implementation literature for teacher-delivered interventions, adherence and quality of delivery are typically thought of as fidelity components that describe teacher behaviors, as it is teacher delivery that is evaluated. With the GSC App, these factors are built into the App and standardized through the web-based delivery format, but teachers still play a role in supporting students to access the App and complete lessons aligned with the class curriculum and implementation schedule, when used in school context. Teachers also support generalization of learning to other contexts (e.g., transition planning, academic learning; Shogren et al., 2022) and need to be able to individualize supports, based on student support needs and instructional goals in inclusive settings. For example, teachers may need to support students with a range of disability labels and support needs during transition instruction. Planning for inclusive supports that can be personalized for student's specific needs is critical. Too often, the needs of students with intellectual and developmental disabilities are not systematically considered in creating supports for technology-based or self-determination instruction. For these

reasons, the roles teachers play in supporting students to engage with the App are relevant to fidelity (Helsabeck et al., 2022).

As technology becomes a more common way to deliver educational interventions, it also becomes critical to identify robust ways in which fidelity can be measured through indicators of user engagement collected by technology (Breitenstein et al., 2017; Helsabeck et al., 2022). Participant responsiveness as a fidelity dimension describes a student's engagement and involvement in the intervention (i.e., student engagement with the App). It goes beyond just the amount of content received by students, but how they engaged with the content. While participant responsiveness within a teacher-delivered intervention is typically reflected in observations of student engagement and response to instruction, a technology-delivered intervention, such as the GSC App, collects metadata that allow teachers and researchers to access different indicators of student responsiveness (Breitenstein et al., 2017; Donkin et al., 2013). This allows for exploration of students' engagement and enactment of skills (e.g., student response time and written or verbal responses to activities within the App). The GSC App collects significant amounts of metadata that feed into the Teacher Dashboard as well as researcher "backend" data that can be downloaded to analyze information on use for research purposes (Breitenstein et al., 2017; Donkin et al., 2013). For example, information can be accessed on student engagement in the App, such as, time spent on each lesson, completion of activities used to deliver core components, and responses provided to activities (e.g., Student Questions). Teachers can then infuse this into the supports they provide students as they engage with the App and as they support generalization of learning to other areas of transition planning.

However, limited literature exists on how to leverage these metadata to define fidelity indicators and support teachers. This is particularly nuanced for the GSC App, given the

decisions made in designing the App to support students with a wide range of disabilities (e.g., learning disabilities, intellectual and developmental disabilities) to use the App across contexts with a variety of goals. For example, to finish each lesson, students must answer questions confirming they have met the Lesson Objectives (one of the core SDLMI components), as well as provide a response to each Student Question (another core SDLMI component; lessons 3-14). This does not vary because if students do not confirm they met the Lesson Objectives or do not provide a response to the Student Question, they are required to review the lesson again. However, the quality of this engagement can vary as the system cannot yet screen the quality of the responses provided (e.g., whether a student provides a meaningful response to the Student Question). Evaluating quality of these responses goes beyond simply aggregating the metadata and requires additional analysis and coding (Raley et al., 2023) as well as consideration of how teachers support individual and groups of students in their classes to engage and progress in the GSC App using the Dashboard.

Given these complexities, we developed a framework for conceptualizing fidelity of implementation of a technology-delivered self-determination intervention, the GSC App, that we believe can also inform efforts to advance high fidelity implementation in inclusive settings of other technology-delivered interventions. To develop this framework, we began by exploring general definitions of fidelity for complex interventions and performance level descriptors (PLDs) of the SDLMI that had already been developed (see Table 1). In general, performance levels are categories into which implementers, who are being assessed, are classified based on their scores (Zieky et al., 2008). These categories can be used to inform ongoing needs for supporting teachers or students to engage with the App and its content. Then, we developed preliminary PLDs for fidelity of the GSC App. Next, we used these PLDs to develop preliminary

indicators of each fidelity component; we also identified potential data sources for the indicators (e.g., metadata, teacher surveys, observations; Bonar et al., 2022; Breitenstein et al., 2017). We provide descriptive data on identified indicators collected from GSC App implementation in a small, pilot trial (Shogren, Mazzotti, et al., 2024). Implications for assessing and using fidelity data are described throughout, including ways this could drive the supports provided to teachers and students using the GSC App during transition planning.

Developing a Fidelity Framework for the GSC App

To develop a fidelity framework for the GSC App, we reviewed the available literature on fidelity and technology-delivered interventions, particularly how the use of metadata has been conceptualized for other interventions (e.g., Helsabeck et al., 2022) as well as the literature that informed the development of the SDLMI Fidelity Framework (Shogren et al., 2021). We found that (a) there were differences in how dimensions of fidelity are conceptualized and defined across teacher-delivered and technology-delivered interventions and (b) the literature on fidelity of web-based applications to inform fidelity focused on metadata did not robustly consider other factors related to teacher behaviors that support implementation and student responses to the instruction delivered through technology (Bonar et al., 2022; Breitenstein et al., 2017).

To develop the fidelity framework for the GSC App, we adopted elements of the standard setting process (SSP). Standard setting refers to the process of developing cut scores on tests (Cizek & Earnest, 2015). The function of cut scores is to split the distribution of test scores into categories, which may provide a basis for score interpretations and uses (American Educational Research Association et al., 2014). The SSP has been extensively applied to educational and occupational tests (Zieky et al., 2008) but recently has been gaining traction in establishing fidelity standards for educational interventions, including the SDLMI (Shogren, Pace, et al.,

2024). Broadly, the SSP includes: (1) identifying the purpose of the fidelity indicators and measure being established; (2) choosing an appropriate method; (3) selecting a facilitator and a panel, and familiarizing the panel with the measure and the process; (4) developing PLDs (or, if already developed, training the panel on PLDs); (5) conducting rounds of the panel's work on determining cut scores; (6) collecting the panel's feedback as well as their level on confidence in the result; (7) creating technical documentation that allows one to evaluate the validity of the cut scores; and (8) making a recommendation to a policy-maker, whose responsibility it is to make a final decision (adapted from Pitoniak & Morgan, 2017).

In this paper, we focus on the first four steps, particularly Step 4 (development of PLDs). A unique feature of our work is the absence of an already developed measure of fidelity. In contrast to typical standard setting studies where measures are available prior to the beginning of the SSP, we intend to use the PLDs to guide the development of indicators, given the newness of delivering self-determination instruction through technology via the GSC App and the critical need to identify ways to identify teacher and student support needs to advance adoption in inclusive schools during transition planning. It should also be noted that neither the PLDs nor indicators described in this paper should be considered final and must be further refined as ongoing work and implementation of the GSC App occurs.

Applying the Standard Setting Process to the GSC App

In this section, we describe the implementation of the first four steps of the SSP to the development of the GSC App fidelity measure. We focus specifically on Step 4 (i.e., development of PLDs).

Step 1: Purpose of the Fidelity Indicators and Measure

In applying the SSP to developing the GSC App fidelity measure, we aimed to (1)

develop preliminary PLDs for the future GSC App fidelity measure, (2) develop preliminary indicators or identify directions for indicator development, (3) identify potential data sources for the indicators, and (4) develop cut scores later. Aligned with the standards setting work on the SDLMI fidelity measure (Shogren, Pace, et al., 2024), we used two performance levels: sufficient (i.e., 'good enough') and non-sufficient (i.e., not 'good enough') levels of implementation of the GSC App. Again, the goal of these performance levels is to be able to inform the targeting of supports to advance implementation and inclusive supports. We conceptualized fidelity at the teacher level, as we assumed that teachers would be the primary driver of access to and feedback on quality of responses in the App during transition planning.

Step 2: Choice of Method

In general, SSP can be classified into two broad categories: content-based methods and methods based on external evidence (e.g., data about completion of preformance based tasks that do not require judgment; Cizek & Earnest, 2015). Content-based methods rely mainly on judgments about test items or test-takers; external evidence (if used) is used at the end of the SSP to evaluate reasonableness of cut scores. In the context of fidelity measurement, it is important for PLDs to describe what 'good enough' fidelity looks like; thus, we used content-based methods. However, in future research, we will also aim to explore relations to external evidence (e.g., student outcomes, teacher performance of specific tasks related to App delivery).

Step 3: Facilitator and Panel

The third author served as a facilitator of the panel meetings given methodological expertise. Our expert panel included six experts with extensive knowledge of the SDLMI, the GSC App and its development, and fidelity and implementation science. The meetings occurred over an 8-month period and finished when there was consensus on the PLDs.

Step 4: Development of PLDs

In defining PLDs for the GSC App, we began with the framework developed for the SDLMI, as it was informed by a review of the fidelity literature and has informed teacher implementation supports in inclusive general education settings and during transition planning. However, we recognized that changes would be needed to the framework based on how the GSC App delivers instruction. The PLDs developed by the expert panel for the GSC App are provided in the last column of Table 1. Table 1 includes notable distinctions in the PLDs for the fidelity dimensions for the GSC App compared to the SDLMI. These distinctions relate to the different features that are available in technology-delivered interventions that can enable standardization in the delivery of the core components alongside individualized supports based on students' responses in the GSC App. The GSC App includes elements of Universal Design for Learning and best practices in instructional technology that were integrated into delivery of the lessons to ensure adherence and quality of delivery. Specifically, students are required to go through every page of the GSC App as well as provide a response to each activity (including Student Questions) embedded in a lesson before they can move forward or complete the lesson. If students do not complete an activity, they are consistently returned to that page and not allowed to move forward until the activity is completed. This approach standardizes the delivery and ensures students receive the same instruction on the core components built into each lesson, although student responsiveness to activities in the App could vary the same way they can during teacher-delivered SDLMI instruction (described subsequently). It is important to note that there was flexibility built into the GSC App to support how students could engage in lessons and activities to make it accessible to students with a range of support needs; however, each flexible option was designed to ensure the same core components were delivered (e.g., lessons could be

read aloud or read by students, students could write or verbally record responses).

Thus, the panel determined that adherence and quality of GSC App content delivery were standardized and not applicable for fidelity measurement. However, the panel also determined that teachers' contributions to the delivery of the GSC App were considerable as they plan curriculum and provide access to the App in school contexts (e.g., setting up accounts, allocating instruction time, sharing the purpose of the App, providing feedback by reviewing data in the Teacher Dashboard, supporting generalization). Thus, specific GSC App teacher behaviors were determined to be part of the PLDs for adherence and quality of delivery. As highlighted in Table 1, teacher behaviors were divided into what teachers do (a) before students begin engaging with the GSC App (e.g., setting up schedule, introducing purpose of the GSC App to students); and (b) during GSC App implementation (e.g., monitoring students' progress and responses using the Teacher Dashboard, supporting high quality delivery and engagement).

The third fidelity dimension, participant responsiveness (i.e., student responses and engagement with the App), was determined to be a central dimension by the panel. Student behaviors as they engage and respond to activities (including Student Questions) are critical to understanding their responsiveness. Unlike teacher-delivered interventions, like the SDLMI where student responsiveness was observed and rated during classroom instruction, the panel determined metadata could replace traditional observational data collection (Bonar et al., 2022; Breitenstein et al., 2017; Helsabeck et al., 2022).

Development of Indicators of Fidelity and Identification of Data Sources

After agreeing on the initial PLDs, the expert panel began to define indicators for each of the fidelity dimensions and identified data sources for each indicator (see Table 2). These indicators, data sources, and PLDs were iteratively developed and refined by the same panel. To

inform this process, we reviewed implementation information and data from the development (Mazzotti et al., 2022), feasibility testing (Mazzotti et al., 2023), and pilot trial (Shogren, Mazzotti, et al., 2024) of the GSC App, including (a) training materials, (b) metadata collected in the App, (c) rubrics developed to analyze the quality of student responses to activities (including Student Questions), (d) surveys completed by teachers on how they supported implementation of the App in their classes, and (e) student perceptions of their engagement with the App. We also explored new and additional indicators or data sources that might be needed beyond existing data sources. Table 2 provides an overview of key indicators identified by the expert panel for each of the fidelity dimensions, as well as proposed sources for data collection to measure each indicator.

Adherence

For the dimension of adherence, the indicators focused on GSC App teacher behaviors. First, part of the standardized GSC App training involves supporting teachers to develop an implementation schedule that details when students will engage in GSC App lessons and how time will be allocated throughout the semester for them to complete at least one GSC App challenge (i.e., all 14 lessons). The existence of these schedules and their implementation serves as indicators that reflect adherence to GSC App instruction.

Further, teachers are provided, during training, a sample lesson plan to deliver “pre-instruction” (i.e., GSC App Overview Lesson) focused on defining the purpose of the GSC App, why self-determination and goal setting are relevant to their lives, and how the GSC App connects to other areas of their education (e.g., setting goals in inclusive content classes, individualized education program [IEP] and transition planning). The Overview Lesson also (a) highlights how students set up accounts; (b) communicates the expected dosage of participation (i.e., how often the student will log into the GSC App each week, how long the student will

engage with the GSC App each session); and (c) introduces the implementation schedule (i.e., anticipated timeline for completing one GSC App challenge during the semester). We also developed preliminary versions of standardized survey questions that can be used to gather teacher self-reported data on delivery of the GSC App Overview Lesson, as well as an observation protocol that external fidelity observers can use to document whether the lesson was delivered as intended.

After pre-instruction, there are also key indicators of fidelity as teachers support students to engage with the GSC App. Specifically, teachers are expected to login and use the Teacher Dashboard to track students' progress, aligned with the implementation schedule. Metadata from the GSC App provides information on teachers' behaviors in the App and can be aggregated for fidelity reporting and analyses, although this was not collected during the initial pilot trial and will need to be evaluated in future work. During training, teachers received information on how to talk with students during other instructional times about their goals set in the GSC App, as well as how to provide additional Educational Supports if teachers observe that students are not meaningfully engaging in the GSC App based on their review of student responses in the Teacher Dashboard. Also, the GSC App User's Guide (Shogren et al., 2022) presents examples and guidance on how to provide additional Educational Supports and linkages to other learning.

Quality of Delivery

Indicators and data sources for quality of delivery by teachers using the GSC App align with and build on the adherence indicators, shifting the focus from *whether* the elements were delivered to *how well* they were delivered. This is similar to the distinction between adherence and quality of delivery for the SDLMI. For this reason, indicators for this dimension more robustly explore the degree to which teachers individualize instruction and supports to student's

support needs, consistent with training protocols. As shown in Table 2, quality of delivery indicators assesses the degree to which (a) pre-instruction was individualized to students' needs; and (b) individualized Educational Supports, supports for engagement, and supports for generalization were provided and aligned with student needs. Metadata from the App can be used to document if teachers routinely review student goals in the App; teachers can be surveyed and observed to examine the degree to which these goals are referenced in other instructional activities to promote generalization and engagement in other educational areas.

Participant Responsiveness

Participant responsiveness was defined by student behaviors as they engaged in the GSC App. Metadata provide a rich source of data to document student engagement in the App. First, GSC App metadata provide log-in information that can be used to determine if students ever accessed the GSC App and, if yes, if they completed at least one challenge (all lessons) in the App. Metadata also provides information on time spent in the App and students written or verbal responses to the Student Questions, as well as to other activities embedded in the lessons. We developed a standardized coding framework (Raley et al., 2023) that teachers or research team members can use to evaluate the alignment of responses with lesson objectives. This can be used for fidelity reporting as well as by teachers to inform ongoing instructional supports needed.

Descriptive Data from the Pilot Trial of the GSC App

Using student data from the pilot trial of the GSC App (Shogren, Mazzotti, et al., 2024), we engaged in an initial evaluation of our proposed participant responsiveness PLDs and associated indicators. Unfortunately, the teacher and observational fidelity protocols aligned with the adherence and quality of delivery indicators were developed using information gathered during feasibility testing and the pilot trial, and the Teacher Dashboard was created in response

to a need identified during feasibility testing and not yet functional in the pilot trial. Thus, these data sources for our fidelity framework were not yet available, could not be evaluated, and should be considered for future research. However, by evaluating the participant responsiveness indicators, we hope to inform ongoing refinement of these indicators and the framework as a whole to further inform the supports provided to teachers seeking to advance inclusive supports for self-determination as students plan for the transition from school to adult life.

School and Participant Context

The data were collected in a small, cluster (schools) randomized control trial of the GSC App (GSC App vs. business-as-usual [BAU] transition instruction) in the 2020-2021 school year in one Midwest and two Southeast states in the United States. Eight schools were randomly assigned to the intervention (GSC App) condition (see Shogren, Mazzotti, et al., 2024 for more information about the sample); 111 students accessed the GSC App during the first semester of implementation. This sample was used to explore data on participant responsiveness Indicator 1b (i.e., completion of the first GSC App challenge within one academic semester; see below). These 111 students were taught by 16 teachers; these teachers had, on average, 6.9 students (SD = 6.0), ranging from 1 to 26. Teachers were supporting students during transition planning activities, either during small group support time or transition class instructional time. Applications in other, inclusive settings need to be further researched. Out of the 111 students who logged in at any point during the semester, 59 (53.2%) students completed the first GSC App challenge (all 14 lessons) during the first semester of implementation. There was school, teacher, and student attrition during the pilot trial, largely because of the ongoing impacts of the COVID-19 pandemic on schools (e.g., teaching shortages, restructuring classes); teachers (e.g., moving classrooms, schools, leaving teaching); and students (e.g., low attendance, exiting

school, needing additional supports for academic instruction during time when they accessed the GSC App). The 59 students were taught by 14 teachers; these teachers had, on average, 4.2 students (SD = 2.6), ranging from 1 to 8 students.

Of the 59 students, 57.6% identified as male and 28.8% as female. The sample also identified as White/European American (40.7%), Black/African American (30.5%), American Indian or Alaskan Native (3.4%), Asian (1.7%), or two or more races (6.8%; the remaining data were missing or outside of these categories). Further, 17.0% of students were of Hispanic or Latino/Latina/Latinx origin, whereas 72.9% were not. Additionally, 40.7% of students self-reported not having a disability, 42.4% reported having a disability, and 17.0% did not provide this information. Students with disabilities had a range of disability labels, with the most common being learning disabilities (11.9%), autism (8.5%), and multiple disabilities (5.1%). However, all students were receiving the GSC App during targeted instruction for transition planning, consistent with receiving special education services. As this was how the GSC App was designed to be delivered, our focus was on exploring the impacts of the App for students receiving transition instruction which would include a range of students, inclusive of students with intellectual and developmental disabilities, who are in need of high quality self-determination instruction.

Data Sources and Operationalization of Participant Responsiveness Fidelity Indicators

As shown in Table 2, we created five indicators of participant responsiveness which are grouped into two categories aligned with data sources.

Metadata

As described, metadata are available in the GSC App and can be used to track student engagement and progress. Our first Indicator (1a) is designed to measure the percent of assigned

students who accessed the GSC App (out of all assigned students taught by the teacher throughout a given semester). Given COVID-19 impacts, we had an original class roster in the pilot study, but we did not have reliable information about the reason for why a given student never accessed the GSC App (e.g., did teacher determine it was not appropriate for the student, did student(s) move to another class). We encouraged ongoing data collection, and we focused on Indicators 1b (i.e., complete the first GSC App challenge [all 14 GSC App lessons] within one academic semester) and 1c (i.e., amount of time that students spent on the first GSC App challenge within one academic semester) for the purposes of this paper. Indicator 1b was operationalized as the percent of students (of a given teacher) who completed all activities in one GSC App challenge within one semester (out of all students who accessed the GSC App). Indicator 1c was operationalized as the average amount of time that students (of a given teacher), who completed the first challenge, spent in the GSC App on the first challenge. Both indicators were aggregated at the teacher level by averaging student-level data for each teacher.

Quality of Student Responses to GSC App Activities

Our second category of Indicators (2a and 2b) evaluated the quality of student responses to activities in the GSC App. The App has a range of activities where students provide written responses to open-ended questions. These activities also included the Student Questions, one of which was presented at the end of Lessons 3 through 14. Therefore, we developed a standardized coding process (Raley et al., 2023) to evaluate the quality of (a) student responses to activities other than the Student Questions that are embedded in GSC App lessons to meet lesson objectives (Indicator 2a); and (b) student responses to the Student Questions presented at the end of each lesson (Indicator 2b). Quality coding for Indicator 2a focused on whether responses to activities were not, partially, or fully aligned with the objective of each activity (e.g., identify

two strengths, identify action steps toward a goal). For Indicator 2b, Student Questions, responses were rated based on if (yes/no) student's response related to their goal area and demonstrated a step toward solving the problem posed in the question. A total of 54 rating questions were developed for 38 activities (including Student Questions). However, four questions for the corresponding four activities (non-Student Questions) were excluded from the indicator calculations because the questions did not allow for variability in their ratings given their design in the GSC App. The procedure for calculating these indicators included multiple steps: (1) putting all ratings on the same scale (0-1) by dividing each rating by its maximum possible value; (2) calculating activity-level ratings by averaging the ratings for the questions developed for each activity (all activities were conceptualized as having the same weight); (3) separating activities into two groups: activities that are not Student Questions vs. Student Questions; (4) for each group of activities, calculating student-level ratings by averaging activity-level ratings for each student; and (5) also for each group of activities, calculating teacher-level ratings by averaging student-level ratings for each teacher.

Results

For Indicator 1b (i.e., complete the first GSC App challenge within one academic semester), we found that, on average, 65.3% of students (of a given teacher), who accessed the GSC App, completed the first GSC App challenge during an academic semester (SD = 40.3). Two teachers (12.5%) did not have any students who completed the first challenge, and for seven teachers (43.8%), all students completed the first challenge. Next, for Indicator 1c (i.e., amount of time that students spent on the first GSC App challenge within one academic semester), we found that students (of a given teacher), who completed the first challenge during the academic semester, spent on average 187.2 min (SD = 66.1), ranging from 98.3 to 359.8 min.

For Indicator 2a, we found that the quality of responses to activities across lessons, other than Student Questions, students (of a given teacher), who completed the first challenge during the academic semester, was rated on average as 0.9 (SD = 0.1), ranging from 0.6 to 1.0. For Indicator 2b, the quality of responses to Student Questions, students (of a given teacher), who completed the first challenge during the academic semester, was rated on average as 0.8 (SD = 0.1), ranging from 0.6 to 1.0.

Discussion

The GSC App is unique as it is a technology-delivered self-determination intervention. Few technology-based interventions have been developed to support self-determination and transition planning that can benefit all students with disabilities but can also be personalized to the unique support needs of each student, including students with intellectual and developmental disabilities. Technological supports have the potential to advance the personalized supports available to students to set and go after goals for inclusive, postschool lives. They also have the potential to promote access for all students, including students that may not always be included in technology development, like students with intellectual and developmental disabilities. However, ways to support the integration of technology-based supports into the curriculum, including ways to document and address problems with fidelity of implementation, are critically needed. We hope this work can have relevance to work that promotes equitable access to high quality technology, self-determination, and transition instruction for students with intellectual and developmental disabilities. In this paper, we described the development and preliminary data on a framework for measuring fidelity implementation of the GSC App that could be used to guide ongoing supports to teachers to enhance student responsiveness and outcomes while engaging with the GSC App during transition planning. But there is a need for ongoing work to

fully evaluate this framework as well as for large scale investigations of the relationship between GSC App fidelity and student outcomes, including exploration of ways to overcome barriers to access for students with intellectual and developmental disabilities and exploration of factors that predict fidelity of implementation for this group.

Limitations and Implications for Future Research

In creating our PLDs and indicators, we did not rely solely on App-provided student data (i.e., metadata) but also attempted to capture the role that teachers play in promoting student responsiveness as there is an increasing need for effective supports for teachers, particularly teachers that are supporting students with intellectual and developmental disabilities to advance transition planning in inclusive schools. Specifically, we developed fidelity indicators to measure teacher roles in adherence (e.g., creating an implementation schedule, communicating the schedule to students, monitoring student progress in the app, checking in with students about their progress) as well as in quality of delivery (e.g., providing a clear justification for the schedule, having conversations with students about their goals, facilitating generalization to other content areas). For the purposes of this paper, we solely focused our fidelity data collection on student responsiveness given the limitations of the GSC App Teacher Dashboard at the time of this work. However, given the amount of time and cost demands of collecting fidelity data, there is often an appeal to simply focus on student responsiveness and conceptualizing fidelity at the student level. However, assessing only student responsiveness cannot provide information on what supports are effectively advancing student engagement and learning, even in a technology-delivered intervention in schools. Conceptualizing fidelity at the student level does not provide information about a teacher and their needed supports, as teachers are the ones who are supporting the implementation of the intervention and may also need supports to advance their

practice. Future work is needed to determine if all adherence and quality of delivery indicators are equally relevant for technology-delivered interventions and fully aligned with student responsiveness indicators, student support needs, and ultimately student outcomes.

Measuring student responsiveness for technology-delivered interventions may seem straightforward as there are rich metadata provided by the GSC App. However, we found that indicators directly from metadata are not sufficient to fully represent the construct of student responsiveness. First, we found that metadata as a data source is not sufficient because it does not provide all data necessary to measure student access to the App (Participant Responsiveness Indicator 1a). Specifically, in addition to the information about who accessed the App (available in metadata), we also need information about who was enrolled in the intervention and whether they were continuously attending the class during the semester. Second, raw metadata is also insufficient as the App itself cannot code and evaluate the quality of student responses to activities (including Student Questions) – although emerging artificial intelligence technologies may change this. For now, the coding of metadata will likely be needed by researchers or teachers to measure quality indicators of student responsiveness. Future work is needed to further explore whether all relevant indicators of responsiveness have been identified and whether the procedures for calculating them are appropriate and time effective. Work should also explore if indicators vary across student groups, including students with intellectual and developmental disabilities.

The available data for the participant responsiveness indicators does provide information on how students engaged in the App and suggests directions for future research, even if there are limitations in these data. For example, for most teachers (62.5%), approximately half of their students completed the first GSC App challenge during the semester – suggesting attrition may

be influenced by teacher-level factors warranting future research. This is promising, particularly given the COVID-19 impacts on this study. However, we also found variability between teachers in terms of the average time their students spent on the first GSC App challenge and between teachers in terms of the quality of their students' responses, although, notably, the quality rates were above the scale midpoint for all teachers. Overall, when students logged in and completed the GSC App, they seemed to show meaningful levels of engagement and high quality of responses, although there was variability. This suggests there may be more ways to engage teachers in supporting students as they engage in the GSC App as well as determining if there are features of the App that should be further considered to promote responsiveness, given the numbers of students that did not complete their first challenge. We also need to further evaluate the impact of student level factors on engagement and responsiveness, particularly how to align supports with student's disability-related support needs and the demands of inclusive contexts as the sample size was too small to present these comparisons.

Once the indicators are finalized, we aim to move to the next steps of the SSP and focus on developing cut scores to enable us to tailor supports to teachers using the GSC App. Specifically, using content-based methods, we aim to determine what level of implementation is "good enough". Once the cut scores are set, several research questions of interest could be explored. Of particular importance is an exploration of the relations to student outcomes. Specifically, we aim to investigate if there is a difference in student outcomes between teachers who implemented the GSC App intervention with fidelity compared to those who did not implement the intervention with fidelity as well as factors that might influence this such as student support needs or disability labels. This information will help us understand which dimensions of fidelity might be the most important for student outcomes and, hence, what factors

should receive more attention during teacher training. We can also further explore various teacher and student factors that influence responsiveness. Another important question is related to how fidelity can best be supported. Specifically, there is a need to explore on to support effective teacher training, what additional teacher supports are needed, and whether the intervention complexity needs to be adjusted based on student characteristics or support needs. Overall, there are a number of research questions that need to be further explored, and this study provides a starting point for doing so and continues to move research forward in the most efficacious ways to support teachers and students to engage in self-determination interventions, specifically technology-delivered self-determination interventions.

Implications for Practice

More work is needed to understand, even for technology-delivered interventions, the role of teachers or other school staff in supporting young people with disabilities, particularly those with intellectual and developmental disabilities, to engage with a technology-based intervention to ensure quality of responses and generalize what is being learned to other areas of their lives to support transition to adulthood. Ongoing exploration of the most time and cost-effective means to support students to meaningfully engage with the GSC App and document fidelity is essential to inform teacher training and supports. Exploring the linkages between adherence, quality of delivery, and participant responsiveness with student outcomes will be an important part of these explorations, to inform both research and practice and can advance equitable outcomes. Understanding what dimensions best predict outcomes will be important and will allow us to begin to ask questions and involve teachers in the process of learning what supports students and teachers need to integrate technology-driven instruction into learning and what supports have the most positive impacts for students. For example, do teachers need coaching and additional

classroom supports for generalizing learning from the GSC App and does this lead to more positive student outcomes, and do these needs vary based on student support needs or other contextual factors? Do teachers still need to implement other interventions, such as the SDLMI, in other contexts, to support students to generalize their learning and do some students benefit more from more intensive instruction? Also, if students are not demonstrating high levels of responsiveness, what supports can teachers provide or what supports need to be built into the GSC App to advance student success? What student characteristics shape responsiveness? Understanding the intricacies and nuances of teacher- and technology-delivered interventions and the importance of fidelity of implementation can and will impact implementation moving forward with the ultimate goal of advancing the use of evidence-based interventions to support students to set and go after goals for their inclusive, self-determined futures.

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Table 1

Definitions of Fidelity Dimensions for Complex Interventions and PLDs for Fidelity of the SDLMI and the GSC App

Fidelity Dimension	General Definition for Complex Interventions	SDLMI Performance Level Descriptor	GSC App Performance Level Descriptor
Adherence [GSC App Facilitator]*	Identification of critical elements of an effective program as well as the amount of program content received by participants. The active ingredients of the intervention include the intervention skills or knowledge the program seeks to deliver.	(1) Teachers delivered SDLMI instruction consistent with their individualized SDLMI Implementation Schedule (2) Teachers, during instructional sessions, address the three SDLMI core components, namely presenting the SDLMI Student Question that is the focus of the lesson, meeting a majority of the aligned Teacher Objectives, and using aligned Educational Supports during instruction.	[GSC App Teacher] * 1. Before students engage with the GSC App, teachers establish and communicate the expected dosage and Implementation Schedule with students (i.e., how often the student will log into the GSC App each week, how long the student will engage with the GSC App each session, and the anticipated timeline for completing one GSC App challenge during the semester). 2. As students engage with the GSC App during one semester, GSC App teachers use the Teacher Dashboard to monitor student progress in completing each lesson and answering each Student Question weekly; if progress is not being made or incomplete responses to Student Questions are entered by the student, teachers check in with students to support App completion.
Quality of program delivery [GSC App Teacher]*	Ratings of provider effectiveness which assess the extent to which a provider approaches a theoretical ideal in terms of delivering program content. This could mean	Teachers individualize SDLMI instruction to the needs and learning goals of the class, reflected by the teacher breaking down instruction into manageable units, linking instruction to the content goals of the class, providing support for students	[GSC App Teacher] * (1) Before students engage with the GSC App, GSC App teachers provide a clear justification for the expected dosage and Implementation Schedule with the

	modifications of elements of the intervention to suit the needs of the individuals within the sample.	based on identified needs, and providing multiple means and opportunities for response	students, and create clear guidelines for when and how students will engage with the App. (2) As students engage with the GSC App during one semester, GSC App teachers use information from the Teacher Dashboard to provide individualized supports when they see issues with students progressing in the GSC App; teachers provide additional in class supports to allow for access and engagement in the App, including supplemental instruction and supports aligned with student needs.
Participant responsiveness [Students/GSC App Users]	Ratings of the extent to which participants are engaged by and involved in the activities and content of the program.	Students engaging in SDLMI instruction, providing responses to Student Questions when presented by the teacher, completing instructional materials and activities, showing self-direction and engagement in the learning process, and taking advantage of opportunities to respond during instruction.	[Students/GSC App Users] (1) Students engaging in the GSC App read or listen to the material in accordance with the expected GSC App Implementation Schedule. (2) Students engaging in the GSC App provide responses to activities (including the Student Questions) that align with the objective of the GSC App lesson.

Note. * The fidelity dimensions of adherence and quality are not applicable to GSC App delivery as the App delivers the core components in a standardized way, aligned with students' responses, and needs as they engage in the App. Fidelity is rated for teacher (i.e., teacher) behaviors as they support students to engage with the App prior to and during the semester of implementation.

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Table 2

GSC App Fidelity Dimension Indicators and Data Sources

Fidelity Dimension	GSC App Fidelity Dimension Indicators	Data Sources
Adherence [GSC App Teacher]	(1) **Before students engage** with the GSC App teachers establish and communicate the expected dosage and Implementation Schedule with students by: (a) Creating an Implementation Schedule reflecting one complete cycle of the GSC App during a semester; (b) Delivering pre-instruction before students engage with the App (i.e., GSC App Overview Lesson provided during instruction about the purpose and plan of GSC App activities). (2) **As students engage** with the GSC App during one semester, GSC App teachers monitor student progress in completing each lesson and answering each Student Question weekly, and check in with students if progress is not being made or incomplete responses to Student Questions are entered by the student by: (a) Logging into the Teacher Dashboard in the GSC App at least weekly to check students' progress aligned with the GSC App Implementation Schedule; (b) Asking students if they are making progress, if they are answering Student Questions, and if they have questions about the App at least weekly; and (c) Providing additional Educational Supports during class time if the Teacher Dashboard or conversations with students suggest that the student in not making desired progress in the App and answering the Student Questions.	(1) (a) – Implementation Schedule created and saved at GSC App training (b) – Teacher Survey and/or Class Observation depending on research/implementation purposes (2) (a) Metadata from GSC App on Teacher logins (b) Teacher Survey and/or Class Observation depending on research/implementation purposes (c) Teacher Survey and/or Class Observation depending on research/implementation purposes
Quality of Delivery [GSC App Teacher]	(1) **Before students engage** with the GSC App teachers provide a clear justification for the expected dosage and Implementation Schedule with students by: (a) Creating the individualized Implementation Schedule developed to address class and student needs; and (b) Providing the pre-instruction (GSC App Overview lesson) aligned with students needs in order to make connections between the App, goal setting, and student's life.	(1) (a) Implementation Schedule is rated as being individualized from example shared at training and reflects school and class schedule and needs (b) Teacher Survey and/or Class Observation depending on research/implementation

	purposes	
	(2) **As students engage** with the GSC App during one semester, GSC App teachers provide individualized supports when they see issues with students progressing in the App, and provide additional supports to allow for access and engagement by: (a) Providing supports to students for engagement with the App (headphones, extended time); (b) Providing additional Educational Supports aligned with student's needs for students experiencing challenges in the App; (c) Having weekly (at a minimum) conversations with students about their GSC App goals; (d) Providing GSC App key terms (e.g., goal, action plan, evaluate) that are in the GSC App Teacher Guide during other instructional activities; (e) Retrieving students GSC App goals from the Teacher Dashboard and referencing those in other instructional activities; and (f) Retrieving students GSC App goal buckets from the Teacher Dashboard and referencing those in other instructional activities.	(2) (a-d) Teacher Survey and/or Class Observation depending on research/implementation purposes (e-f) Metadata on teacher logins and Teacher Survey and/or Class Observation depending on research/implementation purposes
Participant Responsiveness [Students/GSC App Users]	(1) Students read and/or listen to lessons in the GSC App in accordance with the expected GSC App Implementation Schedule: (a) Access the GSC App within one academic semester. (b) Complete the first GSC App challenge within one academic semester; and (c) Amount of time that students spent on the first GSC App challenge within one academic semester. (2) Students provide responses to activities in the GSC App (including the Student Questions) presented at the end of each lesson in ways that are aligned with the Objectives of the lesson: (a) Quality of student responses to activities other than Student Questions that are embedded in GSC App lessons to meet lesson objectives; and (b) Quality of student responses to the Student Questions presented at the end of each lesson	(1) (a-b) Metadata from the GSC App on student login and time (2) (a-b) Metadata and quality coding of written responses to activities