Developing a STEM Transfer-Self Efficacy Survey: Methods of item generation and validation

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Research suggests that self-efficacy is a productive lens that can provide potential for better understanding the complicated experience [1] of transferring from two-year colleges (associate-granting institutions) to bachelor's degree granting institutions. We have begun the development of a survey to measure community college student's STEM Transfer Self-Efficacy (S-TSE). In this poster we discuss the critical step of developing a new survey; generating items from multiple sources. Our first step of developing items for the S-TSE survey was to adapt existing items from the Laanan-Transfer Students' Questionnaire developed by Lanaan [2] and refined by Moser [3, 4]. We then generated additional items through reflecting on the first author's personal transfer experience. We will present a system of lenses used to generate quantitative survey items from previously published qualitative research papers [1, 5]. We will also present analysis of the items generated and discuss the merits of this methodology for generating items.

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I. INTRODUCTION

Associate-Degree Granting Institutions (ADGIs), (also known as community colleges, two-year colleges, or technical colleges) serve 44% of all undergraduate students and provide a valuable pathway into higher education for underserved populations (including low-income students, first-generation college students, and students of color) [6]. Within the population of undergraduate students who start their post-secondary education at an ADGI, 80% report that they intend to earn a bachelor's degree; however, only 14% graduate with a bachelor's degree within six years [7, 8]. Despite this, students who successfully transfer are equally as likely to earn a bachelor's degree as those who start their post-secondary education at a Bachelor's Degree Granting Institution (BDGI) [9–11]. If these students are just as likely to graduate post-transfer then this discrepancy between student intent and eventual degree attainment cannot be explained by a change in the students' goals alone [12].

There are many programs in the United States that are designed to support undergraduate students on their transfer journey from an ADGI to a BDGI. In order to support these programs with their efforts, it is critical that there are accessible evaluation tools designed to assess participant outcomes. Our research team is engaged in a larger project to build a survey to measure STEM transfer self-efficacy (S-TSE) as a resource for evaluation for programs that are supporting transfer students in STEM.

In this work, we will present the first piece of our survey design process which includes a new systematic approach for the construction of a pool of items centered on S-TSE. Our new approach adds to the traditional item generation approach (e.g. adapting items from previously validated survey tools [2, 3, 13]) by creating items grounded in qualitative interviews within the transfer self-efficacy (TSE) and transfer student capital (TSC) literature [1, 5]. This study seeks to answer the following research questions: (1) *What is the added benefit of creating items grounded in previously published qualitative interview data?*

II. BACKGROUND

A. Traditional Approaches to Item Generation

Traditionally, motivational constructs like self-efficacy are explored through multi-item surveys developed through a variety of methods. These methods include adapting existing closed-ended survey items for new contexts, using open-ended surveys to gain insight about the construct of interest or designing construct relevant items based on the survey designers' own experience [14, 15]. Discussions of the content and construct validity of surveys and their items are typically extensive, with detailed examinations of the alignment with the constructs of interest and multiple paths for statistical validation using Exploratory Factor Analysis and Confirmatory Factor Analysis [15–18].

In survey development, interview data is sometimes used as a validity check - to confirm (or disconfirm) various interpretations of survey items. It is rarely the case that the item development *begins* with qualitative data. Even more rare is beginning with previously published qualitative findings, specifically student quotes and themes. In this paper we describe our process of developing a set "lenses" for the consistent generation of survey items from two published qualitative research articles [1, 5]. We hope that these lenses may be adapted to other contexts and serve as a basis for a systematic approach of quantitative survey item generation from qualitative sources. First, to understand why we chose these two papers we will summarize the connection between TSC and TSE.

B. Connection between Transfer Student Capital (TSC) and Transfer Student Self-Efficacy (TSE)

The problems students may encounter throughout the transfer process are diverse, multifaceted, and overlapping [1, 2, 4, 8, 9, 12, 19–23]. Transfer pathways are challenging to study because they differ by institution, state, and degree, and are largely shaped by individual factors such as the need to work or support a family. [1, 5, 12, 13, 21, 22, 24].

In contrast to studying the barriers transfer students face, TSC aims to characterize the opportunities transfer students have to accumulate "capital" [2, 9, 13, 20]. This capital represents the knowledge and skills students acquire at an ADGI that they then use to successfully navigate the transfer process [3, 4, 9]. The study of TSC allows for an asset-based approach to understanding the transfer process, through the focus on how students engage with opportunities to gain that capital.

Self-efficacy is an alternative construct that is used to understand the experiences of transferring from ADGIs to BDGIs [1, 5]. Self-efficacy, often defined as one's belief in their ability to successfully complete a task, is an affective construct that has been studied due to its connection and often correlation with persistence and success [25–27]. Limited work exists on the self-efficacy to *transfer* [1, 4]; however Lukszo and Hayes [5] proposed that developing TSC in turn positively impacts a student's self-efficacy to transfer - building a student's confidence that they *can* transfer. Building from Lukszo and Hayes [5] Buenaflor has proposed a framework for TSE that aligns with the construct of TSC [1].

The creation of Buenaflor's TSE framework [1] that builds from the extensive literature on TSC paves the way for the development of a quantitative survey instrument to measure TSE as an outcome of a program's support in developing TSC. In our work we are taking up this opportunity to develop a TSE instrument that builds on the work from TSC to study the full impact of a program on a students' experience in transferring.

TABLE I. Methods and Descriptions for Item Generation

Method	Description	Number of Items
Existing Closed-Ended Survey Items	Items are adapted from the L-TSQ [2, 3] into self-efficacy statements	88 (42%)
First Author's Transfer Experience	Items are generated from the first author's transfer experience (FATE)	21 (11%)
Existing Qualitative Studies	Items are adapted from existing published qualitative interview studies [1, 5] using one of four lenses:	
	Lens 1: Exact language from student quotes is used to write task and item	17 (8%)
	Lens 2: Exact language from researchers themes is used to write task and item	26 (12%)
	Lens 3: Theme and quote are interpreted and written into task and item with language that aligns with the L-TSQ	13 (6%)
	Lens 4: Theme and quote are interpreted and written into task and item with language from the FATE	43 (21%)

III. METHODS

Our goal for this work is to present a new method for item development that could be adapted for use across other contexts. The context that we present this new method is *STEM transfer self-efficacy* (S-TSE) defined as

> Students' belief in their ability to access resources and build knowledge to successfully transfer to a BDGI to pursue a STEM degree.

Developing a new tool that is operationalized for this definition requires generating a pool of items. In this section we describe the three methods we used for this study: (1) existing closed-ended survey items, (2) first author's transfer experience, and (3) existing qualitative studies. The first two methods are in line with the traditional approaches to item generation and we will contextualize them for our purposes. We will present the third (and new) method with four different lenses as a means of communicating the ways in which we leveraged previously published qualitative interview data. Table I presents the three methods of item generation with a description of how each method was applied for our context of STEM transfer self-efficacy.

A. Existing Closed-Ended Survey Items (L-TSQ)

Using the more traditional approach for item generation, we leveraged existing closed-ended survey items from the related construct of TSC, specifically the Laanan-Transfer Students' Questionnaire (L-TSQ) [2] and the iterated upon version [3]. From this previously validated TSC survey, we used the categories of items that were in line with our operationalized definition of S-TSE to discern a relevant task. For example, as a part of the "transfer process" category in [2], we extracted the task of "visit the campus of my intended four-year college or university to learn where offices and departments are located" directly from the original L-TSQ item "*I visited the [University] campus to learn where offices and departments were located.*" We then added explicit self-efficacy language such as "I am confident in my ability to" to the extracted tasks.

B. First Author's Transfer Experience (FATE)

The first author is a transfer student who himself enrolled in ADGI fives years after dropping out of high school and earning a GED. He earned an Associate's Degree before transferring to a BDGI to pursue a degree in physics. Byrd earned his Bachelor's Degree having received a full-tuition scholarship for two-years at the BDGI, without which the pursuit of a further education would been financially impossible. Reflections on Byrd's experience, the supports and resources provided by transfer advocates at the ADGI and BDGI, and the experiences of his friends and peers guided the generation of additional items for the S-TSE survey.

These items were generated independently from other methods with the goal of capturing key tasks accomplished throughout the first author's transfer experience. Many of these items focus on experiences outside of the classroom such as planning coursework, career paths, and degree timelines. Additionally, this method generated items explicitly focused on STEM courses and programs.

C. Existing Qualitative Studies (EQS)

As a means of generating S-TSE items from previously published qualitative interview studies, we focused on the work done by Buenaflor [1] and Lusko and Hayes [5] which motivates the need to explore TSE. These studies draw from student interview data. Our process for generating items from these studies included collecting relevant passages from these articles and coding them for language specifically related to tasks appropriate for the transfer process. Below we describe how we applied four different lenses to the quotes from student interviews and the corresponding analysis and discussion by the authors. Table II shows an example of generated transfer-related task(s) from each lens. Survey items were then created by adding "I am confident in my ability to" in front of the identified task.

1. *Lens 1: Exact language from student quotes*

The first lens utilized the exact student voice from quotes found in [1] and [5]. In generating items from the qualitative studies, we started with this lens, attempting to create items that directly matched the language of students in the inter-

TABLE II. Example of the task generation process for each lens. The quote/passage is taken direction from Lukszo & Hayes, 2020 [5].

Quote/Passage	Lens	Task
Peers and family. Students often cited a variety of peers as critical sources of transfer information, including classmates, significant others, friends, and coworkers. Sarah explained that she learned about the transfer process mainly through classmates. She explained: "***Mostly it was my classmates and other ex-students*** I knew that went [to State University]. My cousin goes here. And a couple of my friends from high school go here. ***So they were kind of a big resource.***"	1	Use classmates and other ex-students as a resource
	2	Learn about the transfer process from classmates
	3	Speak with former community college transfer students about their transfer experience
	4	Use fellow students as a resource to learn about transferring
	4	Use successful transfer students as a resource to learn about transferring

views. In doing so we coded (shown in the bold-faced text in Table II) for students describing tasks they completed, or were confident in their ability to complete. As an example, the quote from [5] shown in Table II, where a student says, *"Mostly it was my classmates and other ex-students..."* led to the task *Use classmates and other ex-students as a resource*. We can see the distinction of drawing from student direct language in this example with the use of the term "ex-students", where it would be unlikely that this type of language would show up in existing published surveys.

2. *Lens 2: Exact language from researchers themes*

The second of the lenses that we would apply to the passages from [1] and [5] focused on the exact language used by the researchers in their discussion and analysis of the student data. The passage in Table II from [5] that reads *"Students often cited a variety of peers as sources of transfer information, including classmates..."* led to the task *Learn about the transfer process from classmates*. Comparing the item generated from this passage using Lens 1, we see a step formalizing language from "ex-students" to "classmates", distinguishing the approach between these two lenses.

3. *Lens 3: Interpreted Quotes & Themes with L-TSQ Language*

The third lens aimed to interpret the theme from the passage in the published studies, and then to write an item using the language common to surveys like the ones found in the L-TSQ [2, 3]. Examining the passage from [5] displayed in Table II, this passage was located in the paper under the heading "Peers and family." We see that the authors pulled the quote from "Sarah" that discussed peers as a resource. Recognizing this theme from the published work allowed us to generate the task, *Use fellow students as a resource to learn about transferring*. At the same time, we generated a second task that interpreted the theme to focus on fellow students as successful transfer students, *Use successful transfer students as a resource to learn about transferring.*

4. *Lens 4: Interpreted Quotes & Themes with FATE Language*

The fourth and final lens was also a thematic interpretation of the qualitative work, but with the first author's own language based on his transfer experience as described in Sec III B. As an example, using the same passage from [5], we extend the language about peers to specifically include former community college transfer students. Additionally we specify the discussion to be about the transfer experience. The task generated with this lens from the passage in Table II is *Speak with former community college transfer students about their transfer experience.*

IV. RESULTS

The three approaches described in the Methods, Sec III generated a total of 208 survey items intended to measure S-TSE. The more traditional approaches of adapting existing closed-ended survey items and generating items from the first author's transfer experience generated 109 items (52%), 88 (42%) and 21 (11%) items, respectively. Our new approach of generating items from existing published qualitative interviews generated an additional 99 items (48%) which were distributed across four different lenses.

A. Application of Lenses to Published Qualitative Studies

Lens 1, using exact language from student quotes, generated 17 of the items. Lens 2, using exact language from researchers themes, produced 26 items. Lens 3, interpreting quotes and themes with L-TSQ language, and Lens 4, interpreting quotes and themes with FATE language, generated 13 and 43 items, respectively.

Almost all of the items generated with these lenses were unique in comparison to the two more traditional approaches of generating survey items. Only 4 items were near duplicates - 2 duplicating items from the L-TSQ, and another 2 items generated by the first author's transfer experience. This new approach of leveraging existing qualitative interview studies resulted in a total of 95 unique items.

TABLE III. Category names and descriptions for the items generated across the three methods (L-TSQ, FATE, EQS). The number of items for each category is presented along with the number of items generated from the method of leveraging existing qualitative studies in parentheses. 17 items were placed in a miscellaneous category pending content and construct validation for a total of 208 items including the 191 represented in this table.

Category	Description	Source	Items
Experience with Faculty (Coursework)	Items related to interactions and experiences with faculty related to coursework either inside or outside of the classroom.	L-TSQ	30 (10)
Experience with Faculty/Staff (Not Coursework)	Items related to interactions and experiences with faculty/staff not related to coursework including research opportunities and career/transfer exploration	L-TSQ	22 (11)
Transfer Process	Items related to the logistical process of transferring to a four year college or university including navigating transfer and degree credit	L-TSQ	37 (15)
General Courses, Course Learning, and Study Skills	Items related to course experiences and skills	L-TSQ	34 (15)
Academic Advising/Counseling Services	Items related to navigating the financial process of transferring to a four-year college or university	L-TSQ	27 (15)
Financial Mediators	Items related to navigating the financial process of transferring to a four-year college or university including exploring financial aid options	L-TSQ	5 (0)
Social Engagement	Items related to becoming involved in non-academic activities either pre or post transfer	FATE	7 (3)
Learning from Peers/Family	Items related to utilizing peers and family as a resource.	EQS	29 (28)

B. Categorizing Items

The next step in the survey design process sorts items into categories that align with the theoretical framework. For our work, we began with sorting our generated items within the previously published categories from the L-TSQ [2, 3] and the first author's transfer experience. The category names and descriptions are presented in Table III.

The range of items across the original categories spread between 5 items for the "Financial Mediators" category and 37 items for the "Transfer Process" category. Specifically, the items generated across the two traditional methods (L-TSQ and FATE) had a similar range; the range included a total of 5 ("Financial Mediators") to 22 items ("Transfer Process"). However, the number of items that were generated from the four lenses approach had a larger spread across categories. Specifically, no items were generated using this method for the "Financial Mediators" category and one new category arose from the additional unique items that were generated from this method: "Learning from Peers/Family". A total of 29 items were categorized under learning from peers/family, 97% of which were generated by the four lenses method.

V. DISCUSSION & CONCLUSIONS

Our initial item generation suggests that using the system of four lenses to create items from previous qualitative work led to unique items and the almost unique preliminary category of "Learning from Peers/Family" (97% of items from EQS). These lenses also provide consistency in the types of items generated across different qualitative sources, which helps to reduce bias.

While we find this new method of item generation promising, there are also limitations to the work. The development of the items and lenses was built on the previous work: the L-TSQ [2–4, 13] and two research articles that present qualitative findings centered around transfer self-efficacy [1, 5]. There exists other research studying transfer student experience to which these lenses have not yet been applied. Additionally, these items have not yet been validated by students and transfer experts. However, as part of developing a survey tool to measure S-TSE, additional validation will be conducted to ensure robust coverage and clarity of the construct.

When designing an instrument to measure an affective construct such as S-TSE, it is impossible to cover every possible dimension of experience that may contribute to the construct of interest. However, it is critical for survey designers to attempt to cover as much of the core experiences that relate to the theoretical framework that is guiding the research. To that end, we should strive to be as holistic as possible in the breadth and types of existing work we incorporate into our survey instruments.The structure presented in this paper should be expanded to any instrument development process. It is our hope that others looking to create quantitative survey tools to measure affective constructs will test the four lenses process as a foundation for their own holistic process.

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