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Implications for Math and Science Professional Development within the Theory of Planned Behavior *RESEARCH*

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Abstract

This pilot study used the Theory of Planned Behavior (TpB) as a framework for developing a questionnaire that will help with planning professional development pertaining to the science and engineering practices, with the intention of repeating the same process for the mathematical practices. To ensure that all components of the new standards are implemented with fidelity, teachers should be provided with the appropriate tools, understanding, and administrative/peer support in order to foster their buy-in of the changes. Efforts to implement the new standards in all classrooms require a concerted effort in the planning of Professional Development (PD) for appropriately preparing teachers for the infusion of the science, engineering, and mathematical practices, which were new introductions to the standards' format. The TpB, which has historically been used primarily in health and physical sciences, provides a sound framework and methodological approach for monitoring teachers' attitudes and beliefs, thereby leading to predicting teachers' behaviors in implementing the practices. This article provides an overview of the science, engineering, and mathematics practices; the constructs of the TpB; a description of how the TpB provides a solid framework for planning PD; and a discussion of the implications of applying the TpB in an educational setting, specifically for planning PD within the context of the practices.

Keywords: common core, mathematics, science, professional development, theory of planned development

Introduction

State initiatives such as the Next Generation Science Standards and Common Core Mathematics Standards, particularly with regard to the science, engineering, and mathematical practices, present a natural burden on school districts to introduce new professional development (PD) requirements in order to ensure that all teachers are implementing them appropriately. The success of these PD opportunities, and teachers' behaviors afterward, depends on the teachers' beliefs, attitudes, and responses to the delivery. If the PD is ineffective, teachers' beliefs and assumptions may create barriers that restrict the success levels of the school districts. Therefore, teachers should be allowed to provide input for PD decisions, and a solid theoretical framework is required in order to maximize decision-making potential. The Theory of Planned Behavior (TpB) provides a conceptual framework for connecting and exploring relationships between an individual's attitudes and behaviors within several areas of consideration: (a) to direct the development of instruments to measure the variables that determine behavior; (b) to predict behavior; and (c) to assist in the development of belief-based intervention techniques for influencing behaviors (Ajzen, 1988; Fishbein & Ajzen, 2010).

This pilot study utilized the TpB as a framework for developing a questionnaire that will help with planning professional development pertaining to the science and engineering practices, with the intention of repeating the same process for the mathematical practices. To ensure that all components of the new standards are implemented with fidelity, teachers should be provided with the appropriate tools, understanding, and administrative/peer support in order to foster their buy-in of the changes. Efforts to implement the new standards in all classrooms require a concerted effort in the planning of PD for

appropriately preparing teachers for the infusion of the science, engineering, and mathematical practices, which were new introductions to the standards' format. The TpB, which has historically been used primarily in health and physical sciences, provides a sound framework and methodological approach for monitoring teachers' attitudes and beliefs, thereby leading to predicting teachers' behaviors in implementing the practices. This article provides an overview of the science, engineering, and mathematics practices; the constructs of the TpB; a description of how the TpB provides a solid framework for planning PD; and a discussion of the implications of applying the TpB in an educational setting, specifically for planning PD within the context of the practices.

Changes to Kentucky Mathematics and Science Standards

The need for the United States to remain competitive on a global scale led to the development of new standards in Language Arts, Mathematics, and Science over the past four years. Kentucky was one of the states involved in the process of updating standards to meet students' 21st-century needs. Particularly, the mathematics and science standards have shifted to require more process than content understanding, which can lead to teachers' feelings of inadequacy or fears of failing. Therefore, school districts are left with the burden of determining how best to provide effective professional development that can change the culture in their classrooms. Before the introduction of the theory presented in this paper as a plausible solution, the changes that have occurred within the math and science standards will be discussed, as well as why they are so important to education.

Science and Engineering Practices

As Kentucky has moved from Core Content to the Next Generation Science Standards, a lot has changed with science education across the state. These changes are reflected in both the curriculum and the way teaching occurs. The Core Content in science was focused primarily on content knowledge. Along with content knowledge, the Next Generation Science Standards have included eight science and engineering practices embedded in the framework. These practices include: asking questions (for science) and defining problems (for engineering); developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations (for science) and designing solutions (for engineering); engaging in argument from evidence; and obtaining, evaluating, and communicating information (Achieve, Inc., 2013).

The purpose of embedding the science and engineering practices within the framework of the new science standards is to focus on engaging students in their learning. These practices promote direct student involvement and inquiry learning. As teachers are adjusting to the new curriculum, they will likely make changes to their teaching styles. These science and engineering practices demand a much more collaborative, hands-on approach to learning than the previous state standards required.

Standards for Mathematical Practices

Much like the change Kentucky experienced in moving from Core Content to the Next Generation Science Standards, there are similar experiences in moving to the Common Core State Standards for Mathematics. Mathematics also has practices that are embedded in the standards that are based on processes and proficiencies that math students should demonstrate as

they work toward mastery. These mathematical practices include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively, constructing viable arguments and critiquing the reasoning of others, modeling with mathematics, using appropriate tools strategically, attending to precision, looking for and making use of structure, and looking for and expressing regularity in repeated reasoning (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

Similar to the changes experienced with science, teachers are most likely moving toward a more hands-on, collaborative approach to teaching mathematics and getting away from extended periods of direct teaching. These practices imply that students are active in the learning process and teachers must make time in the classroom for application of the content being taught. In order to help decrease stress, teachers and leaders from across the State of Kentucky deconstructed the standards and identified which mathematical practices could be addressed by each standard. These documents are available to teachers on the Kentucky Department of Education's website.

These changes within the math and science standards make it evident that cultural change must take place in classrooms because teachers have not been acclimated to teaching process over the past few decades. Kotter (2008) states that "…urgent action is not created by feelings of contentment, anxiety, frustration, or anger, but by a gut-level determination to *move, and win, now*. These feelings quite naturally lead to behavior in which people are alert and proactive, in which they constantly scan the environment around them, both inside and outside their organizations, looking for information relevant to success and survival" (p. 8). This sense of creating urgency for the betterment of the work environment, which in education encompasses the school and, therefore, the children within it, illustrates the necessity for high-quality PD. Therefore, a strong theory is required to support the creation of these PD opportunities. The next section describes the theory that is being proposed in this paper, known as the Theory of Planned Behavior.

Theory of Planned Behavior (TpB)

The TpB is used to assess attitudes and, according to Fishbein and Ajzen (2010), can be used to predict individuals' behavior. Assuming that humans make decisions by utilizing rational thought and systematically using available information leads to the conjecture that every action is given thought before the individual decides whether or not to engage in the behavior (Ajzen & Fishbein, 1980). A historical review of attitude research by individuals such as Thomas, Znaniecki, and Bandura was utilized to develop the TpB's methods of measurement, first known as the Reasoned Action Approach, leading to the TpB (King, 2012). Throughout the past three decades, multiple researchers have provided support for the validity of the TpB within short-term behaviors (Amireault, Godin, Vohl, & Pérusse, 2008; Andrykowski, Beacham, Schmidt, & Harper, 2006; Bledsoe, 2006; Blue, Marrero, & Black, 2008; Bonetti & Johnston, 2008; Chtazisarantis & Haggar, 2008).

The purpose of the TpB questionnaire is to assess multiple facets of teachers' attitudes and intended behaviors (Fishbein & Ajzen, 2010). After questionnaires are completed for each component of the science and either

engineering practices and/or mathematical practices, results can be disseminated to plan and develop affective PD that will influence teachers' behaviors (Ajzen, 1988; Ajzen, 2010). The presentation of PD then occurs, followed by classroom observations, which can be used to measure actual behaviors compared to reported intentions and provide assessment of PD effectiveness.

According to Ajzen (1988), the measurement of verbal attitude and personality traits can allow for prediction of behavior, therefore, measuring these through questionnaires can help school districts predict what teachers would do if conditions they requested were provided. Other attitudinal characteristics that contribute to prediction of behaviors include confidence level with which the attitude is held, amount of information on which the attitude is based, involvement with the attitude object, and the way in which the attitude is acquired.

Background Factors

Ajzen and Fishbein (1980) identified two basic types of background factors that influence the way in which an individual's intentions function, i.e., personal factors and social factors. An individual's positive or negative evaluations of performing a behavior or the individual's attitudes toward the behavior comprise the personal factors. These personal factors represent an individual's judgment of the performance of a behavior as good or bad, or the individual's decision in favor of or not in favor of performing the behavior. These components influence the individual's intention to perform a particular behavior and influence the individual's belief that other individuals or groups who are important to the individual (relative to the particular behavior) should also perform the behavior. In addition, the information made available to the individual from internal and external sources (knowledge, media, and intervention processes) influences beliefs, attitudes, and subsequent behavior.

Behavioral Beliefs and Attitudes

As indicated in Figure 1, Ajzen and Fishbein (1980) also support a two-component consideration for measuring an individual's intention: (a) the measurement of intention must correspond to the behavioral criterion in action, target, context, and time; and (b) the intention must not change before the behavior is observed in order to use it to predict behavior. The ability to predict behaviors by intentions depends on the extent to which the intentions lead to the performance of behaviors that control the outcome. The behavioral intention is determined by the attitude toward the behavior and the subjective norm.

Ajzen (1988) added perceived behavioral control as an important component to the TpB as specified in Figure 1 to indicate that the individual must believe that he or she possesses the required resources and opportunities to perform the behavior. Each component of the TpB can be used to determine specifics about an individual's intention to perform a behavior. Considering the individual's beliefs about the likely outcomes and subjective evaluation of the outcomes provides a clear understanding of why an individual holds favorable or unfavorable attitudes toward performing a behavior. Considering the normative expectations of individuals and groups important to the individual with regard to the behavior (perceived social pressure) provides a clear understanding of why the individual elects to perform or not perform a behavior. Considering factors that can prevent or facilitate performing a behavior can be used to determine an

individual's perception of high or low behavioral control. The combination of these factors provides a basis for determining an individual's tendency to perform or not perform the behavior.

The constructs of the TpB depicted in Figure 1 consist of multiple tiers that contain different levels of items contributing to beliefs and behaviors (Fishbein & Ajzen, 2010). Although some modifications have been made to the theory throughout the last three decades, the theory has remained relatively intact with most changes being additions rather than subtractions or substitutions. The first tier consists of behavioral beliefs, normative beliefs, and control beliefs. The second tier consists of attitude toward the behavior, subjective norm, and perceived behavioral control. These constructs contribute to the intention to perform, and subsequently to the behavior.

Tier One. Behavioral beliefs are the outcome expectancies that indicate the positive or negative evaluations an individual has developed about performing a behavior and they contribute to attitude toward the behavior (Fishbein & Ajzen, 2010). Normative beliefs can be injunctive - a perception of what should be done with regard to performing a specific behavior - or subjective - a perception of whether the individual should or should not perform a specific behavior - or subjective - a perception of whether the individual should or should not perform a specific behavior. These normative beliefs lead to a subjective norm - the perceived social pressure to engage in a behavior. Control beliefs are beliefs about personal and environmental factors that can help or impede an individual's attempt to carry out a behavior and they lead to perceived behavioral control, which is a sense of high or low self-efficacy with regard to a behavior.

Tier Two. Attitudes toward the behavior, subjective norms, and perceived behavioral control are components that contribute to the formation of the individual's intention, which indicates a readiness to perform a behavior (Fishbein & Ajzen, 2010). Another component referred to as actual control (see Figure 1) is a potential variable connecting perceived behavioral control and the movement from intention to behavior. Actual control consists of a presence, or lack of, skills, abilities, and environmental factors. If there are no actual control components preventing the behavior, the individual's intention leads to the behavior; however, if there are other existing factors that impede actual control, the individual may intend to perform the behavior but lack the ability to do so.

Summary of TpB

In summary, the TpB posits a framework depicted in Figure 1 for examining the intentions and behaviors of teachers who are faced with the infusion of educational initiatives through the mechanism of professional development efforts. Personal factors and social factors, as well as information received from internal knowledge development and external sources, influence teachers' intentions and subsequent behaviors. Individuals must believe that they possess the required resources and opportunities to perform the behavior. A teacher's behavioral beliefs, normative beliefs, and control beliefs have corresponding interrelationships to a teacher's attitude toward a behavior, perceived social pressure to engage in the behavior, and sense of high or low self-efficacy with regard to the behavior and the teacher's actual control or skills and abilities as depicted in Figure 1. These constructs influence a teacher's intention or readiness to perform a behavior and subsequently the

act of performance of the behavior. The impact of the working constructs of the TpB within a teacher engaged in a professional development experience is also a viable explanation and measure for predicting behavioral output of the teacher upon completing said experience.

Using the Theory of Planned Behavior (TpB) in Examining Professional Development

Ajzen and Fishbein (1980) identified methods for creating a TpB questionnaire to measure teachers' attitudes and predict subsequent behaviors. The responsibility for creating a TpB questionnaire belongs to the researcher because each study is focused on understanding different types of behaviors. Guidelines for creating a TpB questionnaire for use in applications involving the infusion and implementation of professional development in education provided by Ajzen and Fishbein (1980) include the following five steps: (1) "define the behavior of interest in terms of its action, target, context, and time elements...make sure that your criterion measure corresponds exactly to the behavior you have in mind" (p. 261); (2) "define the corresponding behavioral intention" (p. 261); (3) "define the corresponding attitude and subjective norm" (p. 261); (4) "elicit salient outcomes and referents" (p. 262); and (5) "define behavioral beliefs, outcome evaluations, and motivation to comply" (p. 262).

Completing steps one through three will allow the researcher to explain behavior at a general level, but completing steps four and five allows for a substantive amount of information about the cognitive foundation underlying the behavior to be obtained. The National Foundation for the Improvement of Education describes high-quality professional development as a listing of characteristics: (a) champions the goal of improving student learning of every activity within the school; (b) "fosters a deepening of subject matter knowledge, a greater understanding of learning, and a greater appreciation of students' needs" (National Commission on Teaching and America's Future, 1996, p. 83); (c) assists teachers to appropriately meet the needs of diverse student populations; (d) allows ample time for "inquiry, reflection, and mentoring, and is an important part of the normal working day" (p. 83); (e) sustains efforts for long-term change of practice; (f) emphasizes teachers' intellectual development and leadership; (g) "balances individual priorities with school and district needs" (p. 83); (h) utilizes new technologies; (i) "involves shared decisions designed to improve the school" (p. 83); and (j) supports a clearly articulated vision for students. This view of high-quality professional development is highlighted in the literature by multiple researchers who support professional development venues that consist of collaborative learning contexts; teachers engaged in research and inquiry, as well as instruction and assessment; teachers exploring high-quality, relevant subject matter with consistent feedback and follow-up activities; and teachers experiencing teacher networks, study groups, partnerships with universities, peer reviews, online-learning activities, and curriculum-development projects rather than district-mandated workshops or training seminars (Little, 1994; Darling-Hammond & McLaughlin, 1995; Smylie, Allensworth, Greenberg, Harris, & Luppescu, 2001; National Staff Development Council, 2001). Using the TpB as the foundational alignment structure for professional development in education as an applied area of consideration for theory and practice generated the matrix depicted in Table 1, which was created to demonstrate how the TpB accomplishes the

goals set forth by the National Commission on Teaching and America's Future (1996).

Application of the Theory of Planned Behavior (TpB) to Practices Professional Development (PD)

The TpB has historically been used to measure relatively short-term exercise and medical science behaviors. The task of measuring these constructs becomes progressively more difficult when attempting to predict teachers' behaviors relative to educational initiatives such as the introduction of science, engineering, and mathematical practices. Two focus areas of discussion will demonstrate the application of the TpB to PD aimed at addressing these practices: (a) the description, purpose, and concept of the practices in order to understand how TpB constructs apply to PD related to the practices; and (b) the description and alignment of each construct from the TpB relative to its application within a PD scenario for teachers.

The behavioral beliefs construct is the outcome expectancy that contributes to the attitude toward the behavior (Fishbein & Ajzen, 2010). These should be aligned with normative beliefs, control beliefs, and attitude toward the behavior. In essence, this construct in variable form measures teachers' beliefs that the use of these practices will produce negative or positive outcomes.

The normative beliefs construct is injunctive – a perception of what should be done with regard to performing a specific behavior – or subjective – a perception of whether the individual should or should not perform a specific behavior (Fishbein & Ajzen, 2010). They are aligned with behavioral beliefs, control beliefs, and subjective norms. In essence, this construct in variable form measures teachers' beliefs that science, engineering, and mathematical practices should be used.

The control beliefs construct is comprised of beliefs about personal and environmental factors that can help or impede an individual's attempt to carry out a behavior (Fishbein & Ajzen, 2010). These are aligned with behavioral beliefs, normative beliefs, and perceived behavioral control. In essence, this construct in variable form measures teachers' beliefs that their individual personal or environmental issues may prevent or contribute to their use of science, engineering, and mathematical practices. Examples of factors that may contribute to the use of these practices may include self-efficacy, administrative support, time, behavior management, and others.

The attitude toward the behavior construct is the positive or negative evaluation an individual has about performing a behavior (Fishbein & Ajzen, 2010). It is aligned with behavioral beliefs, subjective norms, perceived behavioral controls, and intentions. In essence, this construct in variable form measures the degree to which teachers believe in science, engineering, and mathematical practices, i.e., teachers' degrees of confidence in the practices' ability to promote success in students.

Figure 1. Theoretical Framework for Theory of Planned Behavior. Adapted from "Applying the Theory of Planned Behavior to Measuring Teachers' Reported Belifs with Regard to Response to Intervention," by B. King (2012), *Journal of Research and Advanced Studies, 1*(1), p. 30. Copyright 2012 by the Department of Research and Advanced Studies, The University of West Florida.

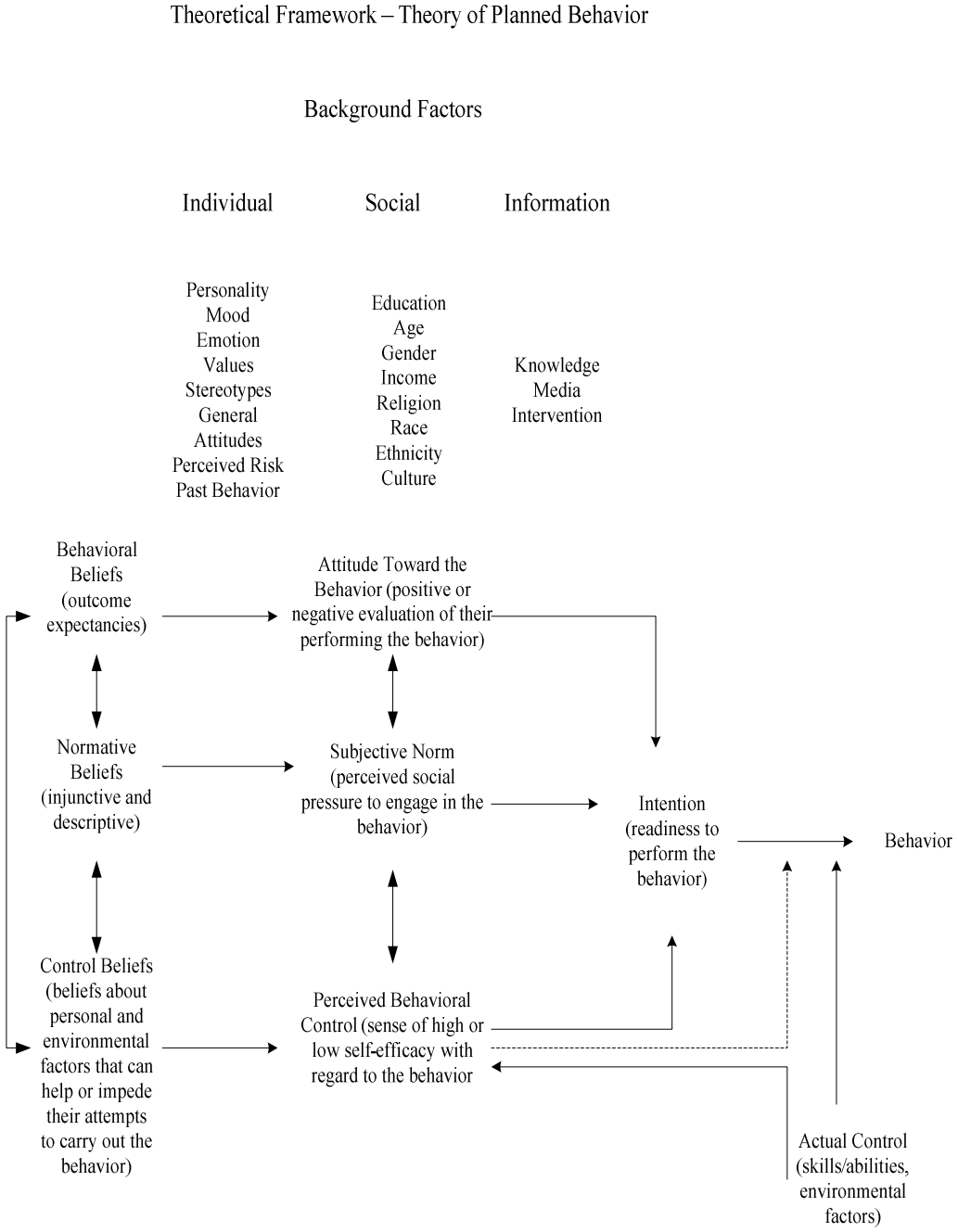

Table 1. Comparison of TpB Process and Characteristics of High Quality Professional Development

Theory of Planned Behavior Five Step Process (Ajzen & Fishbein, 1980, pp. 261-262)	Characteristics of High Quality Professional Development (National Commission on Teaching and America's Future, 1996, p. 83)
(1) define the behavior of interest in terms of its action, target, context, and time elements	(a) champions the goal of improving students learning of every activity within the school; (d) allows ample time for inquiry, reflection, and mentoring, and is an important part of the normal working day;
(2) define the corresponding behavioral intention	(b) fosters a deepening of subject matter knowledge, a greater understanding of learning, and a greater appreciation of students' needs;
(3) define the corresponding attitude and subjective norm	(c) assists teachers to appropriately meet the needs of diverse student populations; (h) utilizes new technologies;
(4) elicit salient outcomes and referents	(e) sustains efforts for long-term change of practice; (i) involves shared decisions designed to improve the school;
(5) define behavioral beliefs, outcome evaluations, and motivation to comply	(f) emphasizes teachers' intellectual development and leadership (g) balances individual priorities with school and district needs; (j) supports a clearly articulated vision for students

The subjective norm construct is the perceived social pressure to engage in a behavior (Fishbein & Ajzen, 2010). It is aligned with normative beliefs, attitude toward the behavior, perceived behavioral control, and intention. In variable form, this construct essentially measures teachers' beliefs about the presence of social pressure to use or not use science, engineering, and mathematical practices.

The perceived behavioral control construct is a sense of high or low self-efficacy with regard to a behavior (Fishbein & Ajzen, 2010). It is aligned with control beliefs, attitude toward the behavior, subjective norms, and intention. In essence, this construct in variable form measures teachers' confidence in their abilities to use science, engineering, and mathematical practices.

The intention construct is the indication of readiness to perform a behavior (Fishbein & Ajzen, 2010). It is aligned with attitude toward the behavior, subjective norm, and perceived behavioral control. In essence, this construct in variable form measures teachers' beliefs that they will use science, engineering, and mathematical practices in their classrooms.

Ultimately, utilizing these constructs allows decision-makers to measure factors

contributing to the behavior, such as the following, before planning PD for teachers:

- Do teachers have any confidence in the changes being made?
- Do teachers believe that these changes will have the expected results?
- Do teachers feel that they have or will be provided with the necessary support?
- What do teachers feel is needed to implement the changes?
- Do teachers believe that there is a level of pressure to comply?
- Do teachers believe that they have the proper knowledge and ability to implement the changes?
- Do teachers believe that their students have the ability to be successful with these changes?

Answering these questions can help in determining the needed focus of the PD, whether it be team building, content training, demonstrating how effective the changes can be, etc. Classroom observations prior to the PD can also provide a wealth of knowledge about current behaviors. These constructs can then be measured after the PD to measure effectiveness in changing intentions. Classroom observations afterward allow measurement of actual changes in behavior.

Methodology

Initial Focus Questionnaire

The first stage of instrument development for this study was the creation of a questionnaire that utilized open-ended focus questions. A total of 54 participants responded to questions via SurveyMonkey®. A link to the survey was sent to teachers who responded that they would be willing to complete the questionnaire. All participants taught science at the elementary, middle, or high school level. Each science and engineering practice, including

- Constructing explanations and designing solutions;
- Asking questions and defining problems;
- Using mathematics and computational thinking;
- Obtaining, evaluating, and communicating information;
- Analyzing and interpreting data;
- Developing and using models;
- Planning and carrying out investigations; and
- Engaging in argument from evidence,

was assessed individually. Within each of these surveys, Science and Engineering Practices as a general term that included the concept of all individual practices was assessed using the same question structure as each individual practice. The purpose of this stage was to determine which indicators should go into questions based on teachers' perceptions of variables. After collecting all responses, it was determined that responses for each category were similar enough that the same indicators could be used for all categories. Coding of all responses provided themes for which the pilot survey questions would include.

Pilot Questionnaire

Following the suggested structure provided by Fishbein and Ajzen (2010), the pilot questionnaire was designed to measure subcategories from the constructs, including

- Outcome evaluations;

- Behavioral belief strength;
- Motivation to comply;
- Injunctive belief strength;
- Identification with referent and descriptive belief strength;
- Power of control factors;
- Control belief strength;
- Direct attitude scale;
- Direct perceived norm scale;
- Direct perceived control scale;
- Behavioral intention scale; and
- Past behavior

A total of 18 participants responded to the 60-item questionnaire either via SurveyMonkey® or in paper format when attending a session discussing the Next Generation Science Standards at a summit. Items were formatted as semantic differentials, which utilize bipolar adjective scales. No demographics were collected for this pilot because the focus of the study was to validate the instrumentation, not measure the actual participants' descriptive responses.

Results

The purpose of this pilot study was to validate the instrumentation in order to utilize it in a larger setting. Data from the questionnaires completed in person were combined in SPSS® with the responses from the SurveyMonkey® participants. The SurveyMonkey® responses were downloaded and manually entered into SPSS®. For the current study, a Cronbach's Alpha, as well as a factor analysis, was conducted utilizing SPSS®.

The Cronbach Alpha was .839 with an N of 60 and no exclusions. This coefficient of reliability demonstrates a relatively high level of internal consistency. Therefore, it is a reasonable assumption that all items measure an underlying construct (Field, 2009).

Next, a factor analysis was conducted to determine how many factors were formed from these items and whether the factors aligned with the proposed constructs in the TpB. The scree plot, which graphs the eigenvalue against the factor, statistically supported the presence of seven factors. The Varimax with Kaiser Normalization rotation method, which clarifies the factors by statistically exaggerating the loadings, was then used while limiting factorization to seven. The item numbers, factor loading values, and TpB constructs are provided in Table 2.

After determining the factor loadings, items for the individual factors were analyzed to determine similarity between items. When possible, factor names were aligned with constructs names from the TpB that matched what was being measured. The findings are as follows:

- Factor 1 – Attitude toward the Behavior (items were primarily measuring whether participants believed the behavior was good or bad)
- Factor 2 – Subjective Norm (items were primarily measuring what participants believed others would think of the behavior)
- Factor 3 – Behavioral Self-Efficacy (items were primarily measuring whether participants believed they can do what is good for students and how their self-efficacy impacts their support for the behavior)
- Factor 4 – Normative Beliefs (items were primarily measuring whether participants want to do what others expect)
- Factor 5 – Control (items were primarily measuring whether teachers believed they would possess

the proper tools to practice the behavior and whether having those would help them perform the behavior)

- Factor 6 – Perceived Control (items were primarily measuring whether participants believed they had control over performing or not performing the behavior)
- Factor 7 – Behavioral Beliefs (items were primarily measuring whether participants believed the increased need for time and resources was worth it)

Table 2. Factor Analysis Results for Pilot Questionnaire

Item Number	TpB Construct	Factor 1 Loading	Factor 2 Loading	Factor 3 Loading	Factor 4 Loading	Factor 5 Loading	Factor 6 Loading	Factor 7 Loading
47	SN	**.925**	-.046	-.023	.199	.043	-.136	.027
45	AtB	**.899**	.115	-.130	-.073	-.294	.061	.016
48	SN	**.865**	.141	.369	-.151	.063	-.166	-.074
51	PbC	**.837**	.293	.009	-.076	-.068	-.176	-.305
46	AtB	**.834**	.374	.312	-.177	.022	-.106	.000
30	NB	**.793**	.258	.168	.214	.020	-.379	-.128
29	NB	**.686**	.462	-.128	.249	.153	-.393	-.097
12	BB	**.665**	-.170	.204	**.611**	-.023	-.026	.218
56	I	**.663**	**.578**	-.054	.059	.030	.032	-.298
55	I	**.663**	**.578**	-.054	.059	.030	.032	-.298
57	I	**.660**	.362	.134	-.094	-.113	.194	-.231
10	BB	**.581**	-.222	.289	.461	.026	-.143	.460
31	NB	**.566**	.100	.221	-.159	.467	-.343	.325
43	AtB	**.561**	.434	-.421	-.016	.065	.104	.173
59	PB	**.544**	.187	-.127	-.459	-.120	-.069	-.451
49	SN	**.534**	-.029	**.532**	-.078	.195	.405	.114
9	BB	**.490**	-.223	.485	.408	-.338	-.134	.322
24	NB	-.088	**.941**	.022	.019	-.221	.119	.140
28	NB	.129	**.905**	-.212	-.006	.186	-.048	.099
27	NB	.263	**.890**	-.054	.004	.254	-.159	.006
25	NB	.136	**.882**	.134	-.102	.039	.041	-.039

23	NB	.114	**.876**	.000	.077	-.213	.185	.165
22	NB	.264	**.867**	-.212	.142	-.150	.016	.027
26	NB	.239	**.844**	-.292	-.049	.033	.037	.048
53	PbC	.291	**.588**	-.056	-.399	-.181	.230	-.121
58	I	**.524**	**.579**	-.044	-.070	-.147	.266	-.225
14	BB	-.153	**.567**	**-.507**	-.209	-.289	.135	.204
39	CB	**-.526**	**.548**	.037	-.056	**.246**	**-.545**	-.039
16	BB	-.026	**-.511**	-.055	-.184	-.085	-.007	.227
44	AtB	.298	**.487**	-.275	-.358	-.035	-.183	.018
3	BB	-.130	-.116	**.885**	.094	.100	-.085	.100
2	BB	.019	-.192	**.861**	.044	.229	.234	.141
5	BB	.318	-.082	**.814**	-.019	-.179	.001	-.159
4	BB	-.238	-.257	**.774**	.197	.193	.286	.248
1	BB	.151	.070	**.728**	.191	.067	-.023	.070
37	CB	-.442	-.041	**-.575**	.100	-.053	-.418	.071
15	BB	-.413	.231	**-.462**	-.346	-.148	.030	.171
17	NB	.004	-.058	.267	**.926**	-.023	.099	.039
19	NB	.235	-.037	.014	**.865**	.265	.224	-.183
32	NB	-.228	.154	-.036	**.837**	.007	-.144	-.102
18	NB	.078	.200	.004	**.788**	-.202	.20	-.229
21	NB	**.535**	.192	-.027	**.636**	.338	.313	.150
40	CB	.064	.141	-.303	**-.572**	.495	-.091	.261
11	BB	.390	-.222	.411	**.484**	-.135	-.245	.344

60	PB	.400	.085	.098	-.475	**-.407**	.203	-.349
50	SN	.285	-.005	-.384	-.467	**-.292**	.063	.032
34	CB	.096	-.052	.327	.153	**.866**	-.080	-.075
35	CB	-.053	-.099	.422	.060	**.836**	.138	.007
36	CB	-.242	.492	.120	.006	**.638**	.247	.190
38	CB	**-.516**	-.122	.062	.033	**.602**	-.294	.015
41	CB	-.046	-.049	-.414	-.114	**.553**	.259	.388
42	CB	-.193	.223	.368	-.030	**-.470**	.393	.371
52	PbC	-.275	.111	.124	.112	-.079	**.852**	-.002
54	PbC	-.133	.377	.063	.204	.051	**.819**	.118
6	BB	.040	-.043	**.610**	.211	.233	**.641**	.024
33	NB	.339	.117	.431	.363	.422	**-.505**	-.042
8	BB	-.241	-.040	-.112	-.296	-.127	-.263	**.850**
7	BB	-.073	.017	.273	-.194	.167	.272	**.773**
13	BB	-.077	.452	-.094	.068	.102	.392	**.707**
20	NB	-.020	.110	.458	**.546**	.115	-.001	**.580**

Note. SN = Subjective Norm, AtB = Attitude toward the Behavior, PbC = Perceived Behavioral Control, NB = Normative Beliefs, BB = Behavioral Beliefs, I = Intention, PB = Past Behavior, CB = Control Beliefs. Items in bold indicate significant factor loadings. Factor 1 = attitude toward the behavior, Factor 2 = normative beliefs, Factor 3 = behavioral self-efficacy, Factor 4 = normative beliefs, Factor 5 = Control Beliefs, Factor 6 = perceived behavioral control, Factor 7 = behavioral beliefs

The loadings in Table 2 show that the number of items for each factor ranged from 7 to 17. Additionally, it is clear from the loading, when adopting the more restrictive .5 loading as the rule for inclusion, that 7 distinct factors were generated where the items within the factors were correlated with one another but were less correlated with other factors.

Regarding the data for the teachers, it is apparent that the 7 factors begin to align with the constructs from the TpB. As stated earlier in this paper, once the focus of the study is the responses provided by participants and descriptives are analyzed,

administrators should be able to determine components such as

- Teachers' beliefs that the use of the these practices will produce negative or positive outcomes;
- Teachers' beliefs that science, engineering, and mathematical practices should be used;
- Factors that may contribute to the use of these practices such as self-efficacy, administrative support, time, behavior management, etc.;
- Degree to which teachers believe in science, engineering, and mathematical practices , i.e., degrees of confidence in the practices' ability to promote success in students;
- Teachers' beliefs about the presence of social pressure to use or not use science engineering, and mathematics practices; and
- Teachers' confidence in their abilities to use science, engineering, and mathematical practices

Conclusion

Major educational reform such as changing state standards in multiple subject areas can be a very stressful and scary situation for teachers and school districts. Therefore, it is pertinent that school districts maximize opportunities for changing the culture of classrooms. This paper has presented a theory that allows for discovery of key components for influencing teacher buy-in because the success of any educational reform depends on the buy-in from the individuals who will most be implementing the changes, which are teachers. The results of this pilot study provide a promising theory for measuring multiple facets of teachers' beliefs and attitudes. Further use of these questionnaires and implementation of classroom observations can aid school districts in the creation of high-quality professional development that fosters cultural change, which will ultimately affect students positively.

Future Research

Although loadings did not completely align with the TpB, no items will be excluded prior to administering the questionnaire again because the suggested number of participants for an instrument with 60 items is between 200 and 300 (Field, 2009). Therefore, it is the belief that 18 participants is not sufficient to exclude some items, and even with the limited number of participants, there were patterns forming within the factors that indicate the potential for alignment with the TpB constructs. Also, since this theory has not been utilized heavily in education, further research involving these semantic differential items may lead to the discovery of other factors that exist within education specifically.

Future research should utilize the theory within school districts that will allow for initial pre-instrument assessment, pre-professional development observations of classroom practices, meetings to disseminate data, professional development planning based on results, post-professional development instrument assessment, and post-professional development observations of classroom practices. Although this is a lengthy process, the benefit to the school districts is believed to be vast.

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