Abstract Title Page

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Title: Preschool Teachers' Attitudes and Beliefs toward Science: Development and Validation of a Questionnaire

Author(s): Michelle F. Maier, Daryl B. Greenfield, and Rebecca Bulotsky-Shearer

Abstract Body

Limit 4 pages single spaced.

Background / Context:

Description of prior research and its intellectual context.

In order to address low achievement in science and related disciplines (Casserly, 2003; NCES, 2001; NCMST, 2000), greater emphasis has been placed on science education in the preschool classroom (Eshach & Fried, 2005; National Research Council, 2007). In particular, a number of preschool curricula have been developed that use science as a foundation for developing other skills, such as language, literacy, math, and problem solving skills (e.g., French, 2004; Gelman & Brenneman, 2004; Quinn, Taylor & Taylor, 2004). Despite this new emphasis, science remains one of the school readiness domains in which Head Start preschoolers make the least gains (Greenfield et al., 2009). Considering such low science achievement as early as preschool and the potential value of science in early childhood education, teachers will likely be asked to include more science in their everyday activities. The effectiveness of these initiatives in positively affecting preschoolers' science outcomes, however, may depend greatly on teachers' preexisting attitudes and beliefs toward science.

Studies have shown that both teacher attitudes (their feelings about their teaching) and beliefs (what they consider to be true about teaching) play a role in shaping their classroom instructional practices and interactions with students (Jones & Carter, 2007; Levitt, 2002; McDevitt, Heikkinen, Alcorn, Ambrosio, & Gardner, 1993). Because research has shown that teachers of young children may possess insufficient scientific background, hold "anti-science attitudes" (Koballa & Crawley, 1985; Eshach, 2003), and may not feel comfortable teaching science in comparison to other domains (Pedersen & McCurdy, 1992; Wenner, 2001; Westerback, 1984), it is important consider individual differences among teachers' attitudes and beliefs toward science teaching. Several different aspects of educators' attitudes and beliefs toward science may impact their teaching, including their perception of their ability to teach science, of the importance of science for young children, and of the difficulty of doing science activities. Knowledge of these attitudes and beliefs may help further our understanding of how teachers' science attitudes and beliefs affect science teaching, curricula implementation, and student outcomes.

Currently, there are a small number of instruments designed to measure teachers' attitudes and beliefs toward science (e.g., Thompson & Shrigley, 1986; Riggs & Enochs, 1990), but these instruments are for elementary school teachers. Although there have been some attempts to create measures for early childhood teachers (e.g., Coulson, 1992; Cho, Kim, & Choi, 2003), researchers have not systematically developed and evaluated such scales. Therefore, the goal of the current study was to develop and validate a questionnaire of preschool teachers' attitudes and beliefs toward science.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

The goal of the current study was to develop and validate a self-report questionnaire of preschool teachers' attitudes and beliefs toward science.

Setting:
Description of the research location.

Head Start programs throughout Florida

Population / Participants / Subjects:
Description of the participants in the study: who, how many, key features, or characteristics.

The sample consists of 507 teachers: 98% female, 34% White or Caucasian, 34% Black or African-American, 26% Hispanic or Latino, 5% other, and 1% did not respond. Fifty-two percent of the teachers completed a CDA (Child Development Associate credential) or associate's degree, 39% a bachelor's degree, and 9% a masters or doctoral degree. Ninety one percent of the teachers reported the number of years they have been a preschool teacher, ranging from 4 months to 42 years (M = 11.79, SD = 8.70). Teachers reported whether in the past three years that had participated in any projects that influenced their classroom instruction; 16% mentioned a science-related project.

A subset of 30 teachers simultaneously participated in a quasi-experimental study evaluating a preschool science curriculum in the local Head Start program. In order to further examine the validity of the P-TABS, additional observational data of science-related teacher classroom practices and fidelity to the curriculum were collected on this subsample. In this subsample, 20 were intervention teachers participating in a training of a science curriculum and 10 were comparison teachers. All teachers were female. Nineteen teachers were Hispanic or Latino, 8 were Black or African American, 1 was White or Caucasian, 1 was Asian, and 1 did not respond. All but one teacher reported highest education level obtained: 11 teachers completed a CDA or other associate's degree, 15 a bachelor's degree, and 3 a master's degree. The number of years reported as a preschool teacher ranged from 0 months to 30 years (M = 12.39, SD = 8.54).

Intervention / Program / Practice:
Description of the intervention, program, or practice, including details of administration and duration.
For Track 2, this may include the development and validation of a measurement instrument.

In preparation for the current study, the research team developed the Preschool Teachers' Attitudes and Beliefs toward Science Questionnaire (P-TABS). As recommended by Osterlind (2006), development of the questionnaire proceeded in three steps. First, an in-depth content review was conducted to determine the relevant topic areas with regard to early childhood and elementary school teacher attitudes and beliefs toward science: comfort/discomfort with teaching science; knowledge of science; importance of preschool science; perception of science; preparing and managing science activities; and developmental appropriateness of preschool science (Cho et al., 2003; Coulson, 1992; Thompson & Shrigley, 1986; Riggs & Enochs, 1990). Second, a pool of 44 items was created using the content review as a guide. With the authors' permission, four items from the Early Childhood Teachers' Attitudes toward Science Teaching Scale (Cho et al., 2003) were added to the pool verbatim because they were deemed appropriate for the new measure. Another 12 items from that scale, as well as two items from the Early Childhood Educators' Attitudes towards Science Scale (Coulson, 1992), were added to the item pool after they were re-worded slightly. An additional 26 items were then created based on the content review. Both positively- and negatively-worded items were generated to reduce the likelihood that teachers' answers would be skewed toward the positive response options. In the third step, each item was reviewed by a panel of seven early childhood teachers from a local preschool program. This panel was asked to determine whether each item was clear or confusing and was suitable for the questionnaire. The vast majority of items were considered clear and appropriate. Three items were revised slightly, and nine items were deleted: either the expert panel of teachers considered them unclear or the item content was redundant with another item. The final version of the P-TABS included 35 items rated on a five-point Likert scale ranging from "strongly disagree" to "strongly agree".

Research Design:
Description of the research design.

Correlational study

Data Collection and Analysis:
Description of the methods for collecting and analyzing data.
For Track 2, this may include the use of existing datasets.

Study packets including a consent form, the P-TABS, and a demographic questionnaire were mailed to 851 lead teachers from 18 Head Start programs throughout the state of Florida. Seventy one percent (601) of the packets were returned. Of these, 78 teachers did not consent, 3 teachers were no longer employed by their respective program, and 1 teacher was on medical leave. Of the 519 teachers that did consent, 1 did not send back the questionnaire with the study packet. Eleven questionnaires were excluded because the back of the double-sided questionnaire was incomplete, resulting in a final sample of 507 teachers.

Analyses included several steps. First, means, standard deviations, skewness, and kurtosis were examined for each item. To determine whether the P-TABS had a psychometrically sound latent structure, a series of exploratory and confirmatory factor analyses were conducted. Cross-validation of the factor structure was conducted to ensure structural invariance and generalizability to important demographic subgroups within the sample (i.e., teacher ethnicity, education level, and experience level. Structural invariance was examined by repeating common factor analysis across these subgroups and comparing the solution with that for the full sample using Wrigley-Neuhaus coefficients of congruence based on all obtained loadings (Guadagnoli & Velicer, 1991), which assess the extent to which the solution established for the larger population could adequately represent solutions unique to subgroups. Internal consistency reliabilities (Cronbach's coefficient alpha) were generated across these subgroups to examine whether internal consistencies were maintained adequately across the subgroups.

Concurrent validity was examined in the overall sample (N = 507) by testing whether P-TABS factor scores differed by involvement in teacher-reported preschool science activities using an independent samples t test. Concurrent validity was also examined for the smaller subsample of intervention and comparison teachers who simultaneously participated in the science curriculum training project (n = 30). Correlations among these teachers' factor scores and their observed science-related instructional practices were examined. Additional correlations were examined among intervention teachers' factor scores and their fidelity to the curriculum. Because intervention and comparison teachers completed the P-TABS at two time points (before curriculum training and at the very end of the school year), changes in factor scores were also examined using a paired sample *t* test.

Findings / Results:
Description of the main findings with specific details.

Exploratory and confirmatory factor analyses identified three salient and reliable factors: teacher comfort, child benefit, and challenges (please insert Table 1 here). The factor structure was found to be invariant across teacher ethnicity, education level, and experience level, indicating the P-TABS measured the same constructs across these subgroups. The internal consistency was adequate for the P-TABS overall as well as for the three factors. Internal consistency for each factor was adequate across subgroups, but was a little low for Factor 3 (Challenges) for Black/African-American (.65) and Hispanic/Latino (.69) teachers as well as teachers with bachelor's degrees (.67).

Concurrent validity in the overall sample indicated that teachers who reported involvement in a science-related project had higher mean scores on both the Comfort and Child Benefit factors in comparison to teachers who did not report a science-related project. In the subsample of teachers participating in the science curriculum training project, positive correlations were found between Comfort and Child Benefit factor scores and observed science-related instructional practices as well as fidelity to the science curriculum (*r*'s = .41-.65). In comparison to their scores before curriculum training, intervention teachers had significantly higher Comfort scores and Child Benefit scores at the end of the year. No differences were found in any of the comparison teachers' factor scores between the beginning and end of the year.

Conclusions:
Description of conclusions, recommendations, and limitations based on findings.

This study provides evidence that the P-TABS is a reliable and valid measure of early childhood teachers' attitudes and beliefs toward science for a diverse set of Head Start programs in Florida. However, our findings are limited to this population of early childhood educators. Further work should be conducted with a broader range of early childhood teachers, as well as with early childhood teachers implementing science curricula, to see if the P-TABS is valid for these populations of educators. Further evidence of concurrent and predictive validity of the P-TABS is also needed.

There has been an increased focus on science teaching in the preschool classroom in recent years. However, the current lack of valid and reliable instruments for science in early childhood has challenged our ability to assess the effectiveness of these efforts. To address this need, the present study expands the availability of valid and reliable measures of preschool teacher attitudes and beliefs toward science. Current findings indicate that positive teacher attitudes and beliefs toward science are associated with implementing science-related instructional practices in the classroom. Further, results support the idea that teacher attitudes and beliefs should be addressed in order for professional development training focused on science to be effective. Further knowledge of these teacher-related factors may help researchers and educators to determine how teacher attitudes and beliefs toward science affect teaching practices, curriculum fidelity and, ultimately, student outcomes.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures
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Table 1

Exploratory and Confirmatory Structures of P-TABS Factors (N = 507)

Factor and Items	Exploratory Analyses		Confirmatory Analyses[a]		
	Varimax loading	Variance explained	R^2 with own factor	R^2 with next factor	Structure loading
Teacher Comfort		5.61			
Comfortable with physical/energy science	.54		.39	.12	.62
Discuss ideas, issues with other teachers	.54		.34	.08	.58
Use all kinds of materials for sci activities	.63		.47	.10	.69
Use resource books to get ideas	.57		.35	.08	.59
Comfortable doing science activities	.70		.63	.18	.79
Comfortable plan/demonstrating life science	.57		.44	.12	.67
Use internet to get ideas	.44		.25	.07	.50
Get ideas from what kids do, say, ask	.43		.27	.13	.52
Include science books during story time	.55		.39	.13	.63
Enjoy doing science activities	.60		.54	.29	.73
Demonstrate experimental procedures	.50		.33	.12	.58
Include science throughout the week	.61		.46	.13	.68
Comfortable plan/demonstrating earth sci	.63		.47	.14	.68
Collect materials, objects for sci teaching	.70		.56	.12	.75

(continued)

Factor and Items	Exploratory Analyses		Confirmatory Analyses[a]		
	Varimax loading	Variance explained	R^2 with own factor	R^2 with next factor	Structure loading
Child Benefit		4.09			
Sci activities foster interest in science later	.58		.44	.11	.67
More science should be taught in classroom	.55		.37	.13	.61
Hands-on is how children learn	.48		.29	.07	.54
Science improves approaches to learning	.73		.61	.10	.78
Science improves math skills	.67		.56	.15	.75
Science improves language skills	.65		.53	.12	.73
Young children can't learn sci until can read	.44		.25	.07	.50
Science activities too difficult for children	.50		.33	.15	.58
Science improves social skills	.54		.48	.25	.69
Young children are curious about science	.49		.39	.17	.62
Challenges		2.53			
Not enough time in a day to teach science	.45		.36	.02	.60
Preparation for sci teaching takes more time	.44		.34	.02	.58
Don't have enough knowledge to teach sci	.54		.46	.10	.68
Uncomfortable talking about sci method	.53		.28	.08	.53
Afraid children ask a question can't answer	.52		.41	.09	.64
Plan/demonstrating science is hard	.41		.36	.17	.60
Don't have enough materials to do science	.40		.36	.12	.60

Note. Sci = science

[a]Entries are based on oblique, principal-components cluster analysis (Anderberg, 1973; Harman, 1976), where hypothesized item-factor membership is determined through prior exploratory factoring. R^2 for an item's *own* factor indicates the proportion of an item's variance predicted by other items in the hypothesized correct factor, whereas R^2 for an item's *next* factor indicates variance predicted by items in the alternative factors.