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CONNECTING TEACHER BELIEFS RESEARCH AND POLICY: AN OVERVIEW AND POTENTIAL APPROACHES

This chapter illustrates why the examination of teacher beliefs is important in light of forthcoming and accepted educational policies. We discuss the interface between beliefs research and policy, propose a guiding model that links policy and teacher beliefs research, and suggest different research approaches in the context of this model. Throughout the chapter, we also offer examples of research that connects teacher beliefs and policies. We hope to initiate and advance the dialogue among researchers about this area of study, and to make a contribution to policies and beliefs research.

In order to begin a discussion about the connection of teacher beliefs research and policy, it is important to recognize the shifting nature of policies in teacher education. Around the world, heightened interest in the education and performance of teachers has resulted in new policies to guide teacher preparation and teacher professional development. In the United Kingdom (U.K.), for instance, standards have been developed that call for content knowledge, an understanding of student learning, a knowledge of assessment, planning and teaching, and professionalism (U.K. Department of Education, 2012). Each area of concentration contains a list of the specific competencies needed in order to meet the standards. The United States (U.S.) and Australia have adopted similar standards, with expanded descriptions that will be used to monitor teacher development (Australian Institute for Teaching and School Leadership, 2012; Council of Chief State School Officers, 2011). These descriptions offer a professional trajectory of learning, made up of distinct levels within each standard.

The international standards fall into the areas of content knowledge, an understanding of student learning, the knowledge of assessment, planning and teaching, and professionalism. They clearly suggest that teacher practices will impact student learning. In order to ensure that these standards are met, students and teachers may be evaluated on their knowledge and performance. In the U.S., for example, student assessments are prevalent in mathematics, English and science—a result of the No Child Left Behind Act of 2001 (NCLB). Similarly, teachers are required to pass state content and pedagogical knowledge assessments in order to receive their

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teaching certificate. A movement towards assessing teacher performance in the U.S. has inspired a lively debate about the promises and pitfalls of such a system (see Darling-Hammond, Amerin-Beardsley, Haertel, & Rothstein, 2011).

While the research that connects standards and teacher practices is important, it overlooks the condition that guides the practices of teachers – their beliefs. We suggest that looking at the beliefs of teachers is important, as beliefs influence actions (Czerniak & Lumpe, 1996; Nespor, 1987; Pajares, 1992; Richardson, 1996). Even with support from researchers interested in understanding teacher beliefs, few have pursued this line of work to the degree that is needed, and rarely do researchers explicitly examine the beliefs of teachers in relation to current policies. With the global emphasis on teacher standards, in addition to research that examines the content knowledge and practices of science teachers, we will need further investigation into how teachers attain content-based standards in light of their beliefs.

THE INTERFACE OF POLICY AND BELIEFS

The connection of policy to research in science teacher education is relatively new. In 2001, White noted an absence of studies on policy research after reviewing decades of science education research studies. Fensham (2009) reviewed two years of the *Journal of Research in Science Teaching* and found only one article and one guest editorial that addressed policy work. Additionally, he analyzed two science education research handbooks and was surprised by the absence of any work focused on policy (Fensham, 2009). In fact, Fensham noted, "In the Fraser and Tobin handbook, the authors of the three papers on curriculum change and reform remarkably managed to avoid making any reference to the word 'policy' (p. 1077)." In this same article, Fensham (2009) called for connection of research, policy, and practice, as well as consideration of the many factors that influence the relationship between these three entities. Critical factors include the roles of stakeholders who are internal and external to school settings, as well as the impact of the values and authority of all those involved when linking policy and practice.

More recently, Luft and Hewson (in press) highlighted the presence of policy in the field of professional development program research. The connection between educational policies and various teacher factors occurred in studies that stated the standards (considered to be the policy area) as a goal of teacher learning, and then measured the changes experienced by teachers. Standards and national or regional issues were used to frame the problem, while teacher knowledge or teacher practice were common measures that indicated attainment of the standards. Unlike Fensham (2009), Luft and Hewson (in press) found studies that linked policy and teacher knowledge. However, they did not report on any studies from 2003-2012 that explicitly connected policies to teacher beliefs.

There is certainly a need for research that connects policy and teachers' beliefs, as beliefs are mediators of practice (Cimbricz, 2002; Davis, 2003; Mansour, 2008).

While the connection between policies and teachers' beliefs is assumed, it is not well understood. As a consequence, those who work with teachers to promote teacher change (which is often the outcome of such research) are hampered in supporting the design and implementation of teacher education programs that can impact teacher beliefs, and ultimately teacher practice. In order to understand the complicated interface between policy and teacher beliefs research, it is necessary to characterize the orientation of the policy, and the beliefs of teachers that potentially relate to the policy. Existing research in the area of policy and beliefs can clarify this necessary but complex connection. Figure 1 will help guide this discussion.

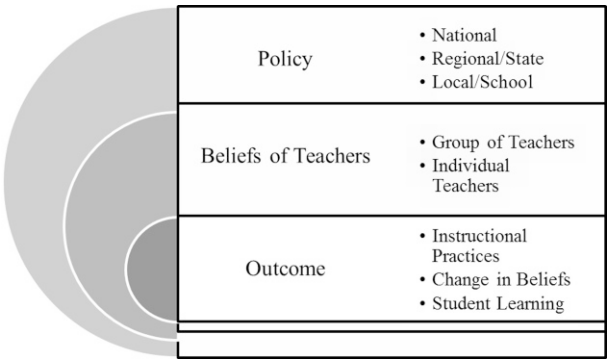

Figure 1. A model illustrating the connection of policy, teacher beliefs, and measured outcomes.

Figure 1 illustrates the nested nature of policy, beliefs, and the anticipated outcome. At the outermost level is policy. The policy can be a national document, a regional or state requirement, or a school or local rule. Specific policies can mandate, for example, the funding of professional development programs for teachers, the structure of an initial certification program for science teachers, or the number of professional development hours that a teacher must complete in a year. These policies can be stated by groups of people who are remotely familiar with education, or groups that are invested in the educational environment that is under study.

The intermediate level consists of science teacher beliefs. Ultimately, the size of the sample pool indicates the relationship of the policy to the beliefs of the teachers. Beliefs can be collected from a large group of teachers and in direct response to a specific policy. The beliefs held by the teachers are guided by their prior experiences in education, their understanding of students, or experiences outside of education. Studies collecting the beliefs of a large group of teachers tend to utilize standardized assessments, and to propose and test a theory about the connection of beliefs and policy. Beliefs discussed in a study may also come from an individual teacher or a small group of teachers. Studies that focus on a small number of teachers often try to

understand the beliefs held by the teacher or teachers as they pertain to overarching policy. These studies suggest connections that can occur between policy and teacher beliefs. Again, the difference in sample sizes indicates a researcher's desire to understand the different direction of the relationship between policies and beliefs.

The interior level of Figure 1 consists of the outcomes of policy research, which takes into account teacher beliefs. These outcomes represent the effect of the stated policies. They can be reported as changes in instruction or beliefs of a teacher or a group of teachers, or changes in student learning. At times, the results of the teachers can be emphasized with student results addressed secondarily, or the results of students can be emphasized with the teacher results addressed secondarily. In either instance, when teacher or student outcomes are reported, they are directly connected to the policy, with some explanation about the nature of the connection.

In research that focuses on policy and teacher beliefs, the relationship between teacher beliefs and policy can take on different orientations. The orientations can be consistent teacher beliefs between teachers and policies, incongruent teacher beliefs and policies, and mixed teacher beliefs and policies. The following examples will clarify these different orientations.

In very few instances, the orientation of the policy is consistent with the beliefs of teachers. This type of research often reports how teacher beliefs changed to align with the stated policy. In a unique study in this area, Pilitsis and Duncan (2012) followed 17 preservice teachers as they engaged in their secondary science methods course. In this study, the authors were interested in understanding how preservice teachers re-oriented their beliefs in response to U.S. policy reform documents. They found that as the preservice teachers experienced different types of instructional approaches aligned with reform-oriented instruction, they developed more reform-oriented beliefs. They concluded that teachers' beliefs could be modified to comply with national reforms, but there was still more to learn about the process of modifying or changing teacher beliefs.

Another orientation in this research area is the incongruence between policy and teacher beliefs. When policy and teacher beliefs are incongruent, the policy is not enacted by teachers as envisioned. Tan (2011) illustrates this in a study of policy change in Malaysia. In 2003, Malaysia changed the national language of instruction to English, with the goal of increasing English proficiency and students' mathematical and science learning. Suddenly, science and mathematics teachers had to function as English, as well as content instructors. Tan (2011) found that when working on language during instruction, the science and mathematics teachers focused on defining concepts instead of building the students' capacity in language. This instruction limited the potential for language work in the science and mathematics courses. Tan (2011) also found that science and mathematics teachers believed they should focus on content of their subject areas, while language teachers believed they should focus on teaching the English language. This study revealed that the teachers' distinct beliefs about their roles in the classroom created challenges for adhering to the new national policy about learning content and language.

Another example of incongruence between policy and teacher beliefs is illustrated in a study by Milner, Sondergeld, Demir, Johnson, and Czerniak (2012). In this U.S. study, there is evidence of the difficult transition between the intended policy and teacher, and the teacher and student experiences. The goal of this study was to determine whether the emphasis on teaching science had changed in the elementary setting since the onset of NCLB. The NCLB policy envisioned a robust education for students in all academic areas, but only assessed students in the area of literacy and mathematics. Milner et al. (2012) collected qualitative data from 44 elementary teachers, and quantitative data from over 140 elementary teachers who were participating in a professional development program on teaching science. The collected data were analyzed and revealed that teachers' beliefs about teaching science remained unchanged despite NCLB, and that the teachers reported enacting less science since NCLB. In this case, the NCLB policy was instituted, but elementary teachers held beliefs that emphasized literacy and mathematics even in the midst of a science-focused professional development program. Ultimately, the teachers' beliefs were not receptive towards the NCLB policy in the non-tested area of science, and despite the policy's intent, students did not get additional science experiences.

Another orientation in this research area is the examination of congruent and incongruent teacher beliefs in the midst of the advocated policy. This is a 'mixed' orientation. Not surprisingly, there is more accumulated research in this area. An example of the varied beliefs that teachers can hold in the midst of a national policy can be found in Czerniak and Lumpe (1996). In this study, they investigated U.S. science teachers' beliefs about the *National Science Education Standards* (NSES) (National Research Council (NRC), 1996), and the implementation of strategies aligned with this reform document. The teachers in the study believed reform was needed, and most implemented strategies aligned with the NSES (NRC, 1996), such as cooperative learning. Even though there was support for the document, 81% of participants did not believe in the reform's central notion of constructivism, nor did they implement the constructivist strategies advocated in the document. In Czerniak and Lumpe's (1996) study, they found teachers' beliefs about reform to be the greatest indicator for implementing reform-based strategies. If a teacher did not believe in the necessity of changing the way science was taught and assessed, changes were not likely to occur in the their classroom instruction.

Davis (2003) also illustrates the mixed nature of teacher beliefs in the midst of an emphasized policy. The study examined how middle school science teacher beliefs influenced whether they implemented reform-based curriculum, which aligned with U.S. documents guiding science education. Davis (2003) found that not all the teachers' belief systems aligned with the reform-based curriculum materials. Teachers with more teacher-directed beliefs were not convinced the new curriculum materials would be an improvement when compared to the already established curriculum. These teachers experienced challenges in incorporating the new curriculum into their instruction. On the other hand, teachers with student-centered beliefs systems possessed greater knowledge of the concepts and strategies in the new curriculum

and were more apt to integrate the material into their existing instruction. Ultimately, the beliefs of the teachers guided their use of the new curriculum, which resulted in their classroom practice aligning with advocated national reforms.

In summary, there is a connection between policy, teacher beliefs, and expected outcomes. Research that bridges these three areas is important, but it reveals that teacher beliefs can be congruent with policy, incongruent with policy, or that teachers can have beliefs that are both congruent and incongruent with policy. Research often reveals that teachers' beliefs are incongruent with advocated policies, or that teachers hold mixed beliefs about the advocated policies. The beliefs held by teachers ultimately have an influence on their instruction.

RESEARCH APPROACHES THAT HAVE POLICY IMPLICATIONS

As additional studies are conducted in the area of teacher beliefs, four research approaches will be especially useful to policy makers or those who guide their work: the synthesis of studies on beliefs, the use of valid instruments or measures, longitudinal studies of populations, and studies that explore the connection of beliefs and practice. Synthesizing the research on teacher beliefs is a common method to determine salient findings pertaining to teacher beliefs and policy. This approach requires the review of articles in order to make general and specific conclusions. Another approach involves the use of a common instrument to measure teacher beliefs. This approach allows for the consolidation of several studies in order to make a compelling case about the impact of, for example, an event or instructional approach. In this book, the chapter about the use of instruments is relevant to the present section. Another important approach pertains to longitudinal studies. These studies highlight trends in beliefs over time, in the midst of specific policies. Finally, studies can explore the connection between teacher beliefs and practices. While this connection is often assumed, more research in this area is certainly needed. The following sections will illustrate these different areas.

Synthesis Studies

When making decisions, policy makers are often interested in the accumulation of results. Results can be derived from a synthesis of several studies, or they can be the collective results of an instrument that has been used over time. This second point will be discussed in the next section. In terms of the first point, when enough data are collected it is possible to make decisions that guide certain policies. Data pertaining to the beliefs of teachers help us to avoid crafting policies that are incompatible with teacher beliefs, or that result in unexpected outcomes (Eisenhart, Cuthbert, Shrum & Harding, 1988).

Synthesis studies are often reviews of a collection of studies, although they can also be a statistical analysis of a collection of studies. Kang, Sandretto and Heath's (2002) synthesis study on beliefs and practices of tertiary instructors is an

example of this approach. In this review, they examined 50 studies on the beliefs and practices of those in higher education. Among other findings, they concluded that there were inconsistencies between the beliefs and practices of tertiary instructors, and that conclusions not grounded in research had been drawn about the beliefs and practices of instructors. Their review of research demonstrated the need for professional development opportunities for academics in higher education in order to build their beliefs and practices in ways that align with high quality learning experiences.

For policy makers, Kang, Sandretto and Heath's (2002) study questions how faculty teach and how they are supported to teach. This study adds to numerous investigations of the questionable instructional conditions in higher education. While policy makers have not mandated professional development or certification for those in higher education, there is a movement in the U. S. to improve the educational experience of undergraduate science students. Several documents have been published in just the last 10 years that emphasize the need to improve the instruction of faculty, and learning of their students. The Vision and Change Report (American Association for the Advancement of Science, 2009), for example, calls for the improvement of biology instruction at all levels in the higher education system. Ultimately, this type of study could be used to support changes in higher education, which would involve both the crafting and funding of policies.

Instrument Use

Another way in which the accumulation of data can guide policy pertains to data collection. In science, self-efficacy is often monitored through the Science Teaching Efficacy Belief Instrument (STEBI) (Enochs & Riggs, 1990). The STEBI is a 23-item instrument that uses a rating scale from strongly agree to strongly disagree, and was developed for elementary teachers. Monitoring the change of science teachers' self-efficacy has been a long-standing area of interest among those who work with science teachers. The assumption associated with this instrument is that without good self-efficacy, important instructional practices will not be adopted by a science teacher.

Countless studies have been conducted using the STEBI, and they reveal the impact of self-efficacy on instruction. The most common type of study examines the effect of a professional development program on a teacher's self-efficacy. Palmer (2011), for example, studied the self-efficacy of 12 Australian elementary teachers who participated in a professional development program. Data were collected through interviews and the STEBI prior to, during, after, and two years after the program. The data were analyzed in order to understand the improvement of teachers in terms of their self-efficacy. The author concluded that the teachers' self-efficacy improved as they engaged in a professional development program that targeted their perceived abilities to teach science. In addition, self-efficacy improved as teachers were provided with feedback about their teaching.

In another study using the STEBI, Lakshmanan, Heath, Perlmutter and Elder (2011) explored how professional learning communities supported teacher self-efficacy. In addition to the STEBI, data were also collected through observations of practice. In this study, the self-efficacy of the elementary and middle school U.S. teachers did not significantly increase by the end of the program. However, teachers with higher self-efficacy tended to use practices advocated by the professional development program providers, while teachers with lower self-efficacy struggled to adopt the practices advocated in professional development program.

For policy makers, these studies could suggest professional development program formats that guide teacher beliefs, which would in turn have an effect on student learning. The studies also confirm the ongoing need to support the professional development of teachers, since without professional development the beliefs of teachers cannot be modified to support various goals of policy documents. In addition, these data provide information about the beliefs of teachers, which policy makers can monitor as they decide on policies or reform directions that are attainable by teachers. As in the previous area, decisions made about supporting teacher professional learning will have fiscal implications for policy makers.

Longitudinal Research

Longitudinal research is important in teacher belief and policy research. This type of research demonstrates how beliefs can change over time in the presence of policy-related initiatives (which may be at different educational levels). An example of longitudinal research that focuses on teacher beliefs can be found in the work of Luft and her colleagues. They followed close to 100 beginning U.S. secondary science teachers over five years in order to understand how the beliefs of teachers changed as they learned about standards-based instruction. During the first two years, however, the new teachers experienced different types of induction programs. Two programs emphasized reform-based science, while two programs did not have this emphasis. The science instruction advocated in the science induction program aligned with the National Science Education Standards (NRC, 1996).

The participating teachers were interviewed using the Teacher Belief Interview (TBI) (Luft & Roehrig, 2007) prior to their first year of teaching, and then each year afterwards for five years. The responses of the teachers were quantified following Miles and Huberman (1994). Traditional and instructive responses represented more traditional or teacher-centered beliefs, and were scored one or two respectively. Responsive and reform-based responses represented beliefs aligned with the goal of the current science education reforms and student-centered learning, and were scored with four or five respectively. Transitional responses, scored with a three, demonstrated an affective response toward students, but did not clearly affirm students' roles in the classroom as co-constructors of knowledge. The responses for each participant to the questions on the TBI were summed and used in the analysis. A total score of 35 indicates student-centered beliefs, while a score of 7 indicates

teacher-centered beliefs. Scores in the middle represent beliefs that are moving between teacher and student-centered orientations.

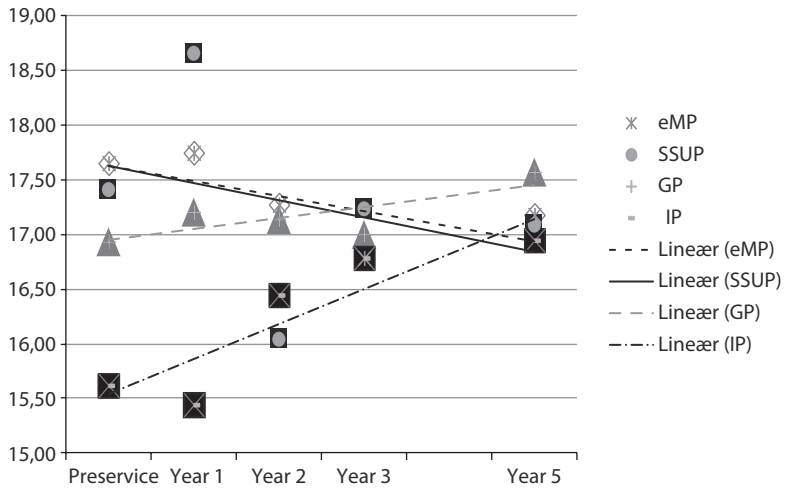

Figure 2. TBI scores and best fit lines (linear) of beginning teachers in the different induction programs over five years. eMP = electronic Mentoring Program, SSUP = Science Specific University Program, GP = General Program, IP = Intern Program.

Figure 2 shows how the beginning teacher beliefs changed over time. It indicates that the beginning secondary science teachers held different beliefs about inquiry instruction prior to starting their careers. Over time, their beliefs became similar and they collectively held transitional beliefs about inquiry.

To better understand the belief changes of the beginning science teachers over this five year period, qualitative data were also collected. The data were analyzed thematically and revealed that induction programs had an impact in the early years on the beliefs of the new teachers. Over time, however, the new teachers were subsumed into the school's belief system about the use of inquiry instruction.

From a beliefs and policy perspective, this study demonstrates the fluctuating nature of teacher beliefs and the need to provide ongoing professional development opportunities to new teachers in order to ensure that they are supported to enact reform-based instruction. Longitudinal research can reinforce the need for professional learning at different career stages, and it can suggest different ways in which teachers develop. For policy makers, this study and other longitudinal studies, suggest that there is a need to consider how to support science teachers throughout their careers. Specifically, adequate guidelines should be established and adequate funds should be allocated in order to provide teachers with various educational opportunities to support and strengthen their instruction and beliefs orientations.

Teacher Beliefs and Practices

Another important research area to consider is the relationship between teachers' beliefs and practices. In 1987, Nespor stated that beliefs "play a major role in defining teaching tasks and organizing the knowledge and information relevant to those tasks" (p. 324). Since then, research has shown that a teacher's beliefs influence classroom practice. For example, Brickhouse's (1990) study of three U.S. science teachers reported that the beliefs of the teachers about the nature of science guided their design and implementation of science lessons. Similarly, Cronin-Jones's (1991) work with two U.S. middle-grade science teachers found that both teachers' beliefs about student learning and their own roles in the classroom influenced the ways they adapted and implemented curriculum.

When studying the connection of beliefs and practice, it is important to observe the practices of teachers. Several researchers in this area do observe teacher practices while monitoring their beliefs. Luft, Roehrig and Patterson (2003) followed 18 beginning secondary science teachers into their first year of teaching. They observed and interviewed the new teachers in order to understand how their beliefs and practices were impacted by their participation in an induction program. One group of teachers participated in an induction program focused on science, and another group participated in an induction program developed by a school district. The last group of teachers did not participate in an induction program. In a multiple methods study, Luft et al. (2003) found that the new teachers in science-focused induction program implemented more inquiry oriented investigations and had more student-centered beliefs than did their counterparts in the other programs. They concluded that science-focused induction programs were important in supporting beginning science teachers.

These studies, and others in this area, are important because they link beliefs and practices. However, studies that rely on the self-report of teacher instruction do not establish a firm link between beliefs and practice. If future studies in this area are going to impact policy, they will have to include researcher observations of teachers. Unfortunately, this type of work falls into a cycle: Funding is needed in order to ensure the research happens, but compelling research needs to be present in order to secure funding. For policy makers, the connection of beliefs and practice is apparent, but more data are needed.

NEXT STEPS: BRINGING IT ALL TOGETHER

Teachers are ultimately responsible for implementing educational policies in the classroom, therefore they should be involved in the policy making process. Some academics advocate for teachers to be included as equal collaborators in decision making (Eisenhart et al., 1988). They reason that including teachers in policy formation and implementation is critical because it may influence their beliefs about the policy, and the teachers may also gain a better understanding of the purpose of the policy. Most academics, however, use research that examines the beliefs or practices

of teachers to speak to policy makers. In doing this, teachers are not presenting their views to policy makers. Instead, academics are presenting the views of teachers, which may or may not be consistent with the actual views of teachers. In the area of beliefs, several parameters need to be considered when bridging policies and teacher beliefs. As discussed in this chapter, they include understanding the connection of a policy to teacher beliefs, and the type of research approaches that will be promising in the area of policy.

No matter how teachers are included in future policy work, research pertaining to teacher beliefs must take a more strategic approach in order to impact policies that pertain to science teachers. While we have suggested ways in which to enhance research in the area of beliefs and policy, we should also point out that simply understanding how a study can relate to policy is crucial. Educational researchers should be able to show how their research directly relates to a policy. Furthermore, this relationship needs to be foregrounded, either at the beginning of the study, or in a special section that links the policy to the problem that is under investigation. In doing so, researchers provide policy makers with one more signpost to guide their decision-making process.

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