Constructivist Beliefs About the Science Classroom Learning Environment: Perspectives From Teachers, Administrators, Parents, Community Members, and Students

Jodi J. Haney  
Bowling Green State University

Charlene M. Czerniak  
The University of Toledo

Andrew T. Lumpe  
University of Texas at Tyler

This study examines the perceptions of teachers, administrators, parents, community members, and high school students about the science learning environment. The participants were active members of a grant project aimed at creating community action teams. Varrella and Burry-Stock's (1997) Beliefs About Learning Environments (BALE) Instrument was used as a theoretical model for constructivist belief identification and comparison. Two primary questions were explored: (a) What are the beliefs of the teachers and other school community members about the science learning environment? and (b) How do these belief structures compare? Analysis of the BALE responses indicated that, although beliefs varied greatly, the administrators and teachers possessed the most constructivist beliefs. The authors suggest that identifying the beliefs of teachers, as well as those of the entire school community, is crucial. If the school community does not believe in (or understand) the recommendations, the chance for long-lasting reform is improbable.

Constructivism is a philosophy that, put simply, states that students construct understanding for themselves (Lowery, 1997). Constructivist views about learning have gained acceptance among educators as a viable framework for understanding learning and developing models of effective teaching. As such, constructivism has become an intricate aspect of current educational reform and is included in many of the national science education reform recommendations; namely, the National Science Education Standards (National Research Council [NRC], 1996) and Project 2061: Science for All Americans (Rutherford & Ahlgren, 1993). Moreover, in 1994, the Biological Science Curriculum Study (BSCS) organization listed constructivism as one of the primary strands guiding contemporary science reform.

Taylor, Fraser, and White's (1994) and Aldridge, Fraser, Taylor, and Chen’s (2000) definition of constructivist teaching includes five components that help describe an effective classroom learning environment (scientific uncertainty, student negotiation, shared control, critical voice, and personal relevance). Teachers who believe and enact these tenets of constructivism would present scientific knowledge as arising from human experience and values, evolving and insecure, and culturally and socially determined. They would let students plan and justify their ideas, examine the ideas of other students, and reflect upon the viability of their own ideas, as well as invite students to share control of designing and managing activities, assessments, and classroom norms. Students would feel free to question the teacher’s pedagogical plans or methods and express concern about things that may hinder their learning. Finally, the science they taught would make use of students’ everyday experiences, and classroom activities would be meaningfully related to students’ lives.

In contrast, Armstrong (1994) revealed, “For most Americans, the word classroom conjures up an image of students sitting in neat rows of desks facing the front of the room, where a teacher either sits at a large desk correcting papers or stands near a blackboard lecturing students” (p. 86). This view of classrooms permeates many people’s beliefs about teaching and learning. Therefore, teachers and administrators trying to implement constructivist practices may find that parents and community members perceive teaching methods based on constructivist philosophy as incongruent with their own images or beliefs regarding effective classroom
instruction. In this event, a misalignment of educational goals is likely, and community support for the constructivist philosophies is impeded.

Pajares (1992) synthesized findings on beliefs and found that beliefs are formed early, are acquired through cultural transmission, and are self-perpetuated. Therefore, beliefs about classrooms are formed as early as preschool or kindergarten. Some teachers may perpetuate these views, and parents, community members, and students may solicit traditional teaching techniques that fit with their views of classrooms. Pajares also found that beliefs formed early are more difficult to change. Changes in adulthood are rare. It could be assumed that beliefs about classrooms would be included in this category. They would be difficult to change. Finally, Pajares noted that beliefs (personal philosophies and outlooks) strongly influence perception (understanding and awareness) of phenomena. Therefore, teachers implementing constructivist techniques may face resistance from others who perceive effective teaching differently.

Several educators studying school reform support the notion that teacher beliefs are precursors to change and that the teacher is the crucial change agent in paving the way to reform (Bybee, 1993; Cuban, 1990; Fullan & Miles, 1992; Tobin, Tippins, & Gallard, 1994). However, those implementing reform efforts often ignore teacher beliefs. Additionally, Haney, Czerniak, and Lumpe (1996) reported that teachers feel isolated in their efforts to implement science recommendations. They do not believe that the school community supports them in reform implementation. Therefore, investigations examining the belief structures of both teachers and other members of the school community are needed to guide the existent science reform efforts. This study sought to examine the constructivist belief structures of teachers, administrators, parents, community members, and students.

Science educators have described various programs and studies in which teachers using constructivist teaching approaches have improved classroom discourse, increased achievement in science, and altered misconceptions in science (Fensham, Gunstone & White, 1994; Shapiro, 1994; Tobin, 1993). Therefore, constructivism has become relatively well accepted in the science education community. Although constructivism has gained acceptance in many educational circles, many people still view classrooms as settings where teachers transmit information to students while they sit in straight rows reading, working on worksheets, or listening to the teacher (Armstrong, 1994). As a result, teachers, administrators, parents, community members, and students may not believe that classrooms should look like the constructivist ones just described and, therefore, may not readily accept constructivist techniques. Dramatic changes in society have necessitated dramatic changes in schools, and as such, schools can no longer operate alone. It is becoming increasingly important to establish positive school-community relationships. If educational ideas such as constructivism are to permeate schooling, then the beliefs parents and community members hold regarding these ideas are crucial.

The Role of Beliefs in Educational Settings

Beliefs in educational settings can be described as one’s convictions, philosophy, tenants, or opinions about teaching and learning. Individuals’ decisions throughout their lives are strongly influenced by their beliefs (Bandura, 1986, 1997). Pajares (1992) asserted that clusters of beliefs around a particular situation form attitudes, and attitudes become action agendas — people act upon what they believe. Pajares summarized educational literature about beliefs:

1. Beliefs form early and tend to be self-perpetuated. They tend to be preserved throughout time, experience, reason, and schooling.
2. People develop a belief system that houses all the beliefs acquired through the process of cultural transmission.
3. Beliefs are prioritized according to their connections or relationship to other beliefs.
4. The earlier a belief is incorporated into the belief structure, the more difficult it is to change.
5. Beliefs alter relatively rarely during adulthood.
7. The beliefs individuals possess strongly affect their behavior.
8. Beliefs about teaching are well established by the time a student attends college.
9. Beliefs play a key role in defining tasks and selecting the cognitive tools with which to interpret, plan, and make decisions regarding such tasks.

Pajares’s work provides insight into the difficult tasks that teachers, administrators, parents, community members, and students may face as they teach, observe, and work in constructivist classrooms. Since the beliefs that teachers and members of the school community hold may impact the classroom, beliefs become a crucial change agent in systemic school reform. Cuban (1990) avers that reform recommendations cycle repeatedly because policy makers discount the importance of individuals’ beliefs in making change occur.
Identifying Beliefs

Since beliefs are thought to impact classroom practice, it is important to be able to identify beliefs of teachers and members of the school community. Several useful instruments exist to accomplish this task. Taylor et al.'s (1994) definition of constructivist teaching included five components: scientific uncertainty, student negotiation, shared control, critical voice, and personal relevance. Their CLES instrument measures the degree to which individuals value each of the five components. Varrella and Burry-Stock's BALE Instrument (1997) offers an authentic and open-ended approach to share beliefs about the relationship between teachers and their students in an effective learning environment. The BALE includes five categories (teaching for understanding, instructional approach, valuing the learner as an individual, questioning habits, and extensions of students' thinking) and 12 subcategories. Both the CLES and BALE instruments enable researchers to construct intricate profiles of the constructivist beliefs individuals hold toward teaching science.

Design and Procedures

The Participants

Seventy-two participants of a year-long Eisenhower-funded grant project were purposely selected for this study. The participants represented several school community groups: teachers (n = 35), administrators (n = 9), parents/community members (n = 18), and high school students (n = 10). Of the 72 participants, 46 were female and 26 were male. The participants represented seven school building or districts teams. Each team was required to recruit a minimum of one administrator, three teachers, two parents, one community representative, and one high school student. Teams elected to involve more than the minimum number of individuals required. Team members were recruited by curriculum coordinators and/or science resource teachers who were involved in a previously funded Eisenhower project. Business leaders, parents, and high school students who were viewed by their peers as active participants in the school community were solicited for team membership. Several of the students serving on the teams had parents involved in the project (serving as teachers or community representatives). The primary goal of the Eisenhower project was to create community action teams to improve community awareness of, support for, and involvement in the inquiry-based science programs adopted by the districts. The project activities included discussing contemporary issues in science education, conducting local school needs assessments, developing detailed action plans targeting the project goal, creating positive public relations with the media, creating school-community partnerships, and implementing the developed team action plans. Several of the teachers and administrators in this project participated in two previous and related Eisenhower grant funded projects focusing on developing new science courses of study and preparing resource teachers to facilitate the implementation of the newly adopted programs.

The BALE Instrument

Since the project participants possessed diverse educational experiences, this study utilized the BALE instrument (Varrella & Burry-Stock, 1997) at both the onset and conclusion of the project in hopes of offering greater flexibility in the generated open-ended responses. The BALE consists of a single open-ended statement for participants to complete: “My perception of the relationship between students and teachers in the learning environment is...”

In developing this instrument, Varrella and Burry-Stock (1997) revealed five significant factors and identified 12 belief characteristics that accounted for 80.8% of the total variability in the instrument (see Appendix A). In order to use the factors as subscales (categories) reliability coefficients were obtained. Cronbach's alpha reliability coefficients for the five factors range from .67 to .88, and the overall reliability coefficient for the BALE was .92.

The “teaching for understanding” factor consists of five belief characteristics, including the teacher acting as a facilitator or guide, considering student preconceptions (prior knowledge) and student relevance, fostering higher order thinking/critical thinking/problem solving skills, checking for student understanding through assessment and evaluation techniques, and promoting the construction of student conceptual understanding by seeking, identifying, and resolving inconsistencies or misconceptions. The “instructional approach” consists of three belief characteristics: using a rich variety of instructional approaches or teaching strategies; using an activity-based instructional approach (hands-on and inquiry-based); and using diverse materials, equipment, and resources. The third significant factor is “valuing the learner as an individual” and consists of two belief factors: building a positive teacher-student relationship (affective components such as concern, respect, trust, etc.) and fostering student autonomy in the classroom by valuing the importance of students’ opinions and offering shared decision making. The fourth significant
factor involves “questioning habits,” and only one belief factor is associated with this construct: using appropriate questioning strategies such as wait-time. The final significant factor is “extension of students’ thinking,” which includes a belief factor dealing with the elaboration of students’ responses by probing students to extend their thinking.

For this study, the open-ended statement was modified slightly to read, “My perception of the role of a teacher and his/her students in a successful learning environment...” Additionally, the following directions were offered to guide the respondents:

This statement may be addressed using a brief (one page essay), a concept map or web, a series of key points, labeled diagrams, or any other way that is meaningful to you. Please be sure that your end product adequately communicates your ideas and beliefs regarding this issue.

The modification made to the original BALE instrument included replacing the word “relationship” with the word “role” in order to avoid bias, since “teacher-student relationship” was identified as one of the 12 significant belief characteristics. Varrella et al. (1997) verified both the validity and reliability of the BALE instrument.

### Data Analysis

BALE responses were rated (using a blind review process) using the BALE rubric, which consists of a 1 to 5 point system, with 5 representing a response highly constructivist in nature (see scoring rubric in Appendix B). The BALE instrument has five categories composed of a total of 12 belief characteristics. Each belief characteristic is rated on this 1-5 scale, resulting in a maximum score of 60. Prior to evaluation, four raters practiced and discussed scoring until an acceptable level (.75) of interrater reliability was established and maintained. All four of the raters were graduate students in curriculum and instruction with an emphasis on science education, all had several years of teaching experience in the science classroom, and all were well versed in the topic of constructivist philosophy. Concurrently, the raters were enrolled in an independent study graduate course entitled Constructivist Beliefs About Teaching Science. The course requirements included several readings and summaries of papers on constructivist practice and participation in the data analysis phase of this project. The final Pearson interrater reliability coefficient for the scored BALE responses was .77 (see Table 1), which is considered to be “high positive correlation,” according to Hinkle, Wiersma, and Jurs (1988, p. 118). Using both the total and five construct BALE scores, comparisons were made between the following categories: gender, team role (administrator, teacher, student, community representative/parent), and team. Since multiple dependent variables were present, MANOVA tests were performed to determine if the differences were significant, and Tukey’s post hoc analyses were used to determine between which variables the significant differences existed. The criterion for significance was set at alpha = .05

### Results

Significant differences were found between the constructivist beliefs of teachers, administrators, parent/community members, and students for the BALE “teaching for understanding” construct (see Table 2), which includes the following belief characteristics: teacher as facilitator, student preconceptions and relevance, higher order thinking skills, demonstration of understanding, and construction of student conceptual understanding. For this construct, the administrators held the most positive constructivist beliefs (mean = 9.313), followed by the teachers (mean = 8.750), students (mean = 6.500), and parent/community members (mean = 6.308). The administrators’ scores were significantly more positive than those of the parent/community members or students (see Table 3).

For the total BALE scores, significant differences were also found (see Table 4). Both the administrators (mean = 21.938) and teachers (mean = 21.442) held more positive beliefs than did the parent/community members (mean = 16.346), as shown in Table 5. There were no significant differences between the scores of the students (mean = 17.375) and any other group. Figure 1 depicts these findings.

No significant gender differences were found for any of the BALE constructs. However, significant differences did exist between the participating teams.
Table 2
Analysis of Variance Procedure for the Dependent Variable Teaching for Understanding

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
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<td>74.297</td>
<td>24.766</td>
<td>6.41</td>
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<tr>
<td>Error</td>
<td>68</td>
<td>189.441</td>
<td>3.866</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>263.738</td>
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Table 3
Mean and Standard Deviation Values by Group for the Teaching for Understanding

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Post Hoc Grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrators</td>
<td>9</td>
<td>9.313</td>
<td>1.329</td>
<td>A</td>
</tr>
<tr>
<td>Teachers</td>
<td>35</td>
<td>8.750</td>
<td>2.336</td>
<td>AB</td>
</tr>
<tr>
<td>Students</td>
<td>10</td>
<td>6.500</td>
<td>1.214</td>
<td>B</td>
</tr>
<tr>
<td>Parents</td>
<td>18</td>
<td>6.308</td>
<td>1.242</td>
<td>B</td>
</tr>
</tbody>
</table>

Note. Means with the same post hoc grouping letter are not significantly different (alpha = .05)

Table 4
Analysis of Variance Procedure for the Dependent Variable, "Total BALE Score"

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>3</td>
<td>289.438</td>
<td>96.479</td>
<td>6.93</td>
<td>0.0006</td>
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<tr>
<td>Error</td>
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<td>682.418</td>
<td>13.927</td>
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</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>971.856</td>
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<td></td>
</tr>
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</table>

Table 5
Mean and Standard Deviation Values by Group for the Total BALE Score

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Post Hoc Grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrators</td>
<td>9</td>
<td>21.938</td>
<td>2.258</td>
<td>A</td>
</tr>
<tr>
<td>Teachers</td>
<td>35</td>
<td>21.442</td>
<td>4.315</td>
<td>A</td>
</tr>
<tr>
<td>Students</td>
<td>10</td>
<td>17.375</td>
<td>2.488</td>
<td>AB</td>
</tr>
<tr>
<td>Parents</td>
<td>18</td>
<td>16.346</td>
<td>3.129</td>
<td>B</td>
</tr>
</tbody>
</table>

Note. Means with the same post hoc grouping letter are not significantly different (alpha = .05)

The seven school building or district teams for the BALE instructional approach construct, which consists of the following belief characteristics: a rich variety of instructional approaches, using an activity-based instructional approach, and use of materials and resources (see Table 6 and Figure 2). As shown in Table 7, Team A (mean = 7.500) reported a significantly higher score than did Team G (mean = 3.583), indicating that the members from this school building or district held significantly more constructivist beliefs related to instructional approaches (a rich variety of instructional approaches, using an activity-based instructional approach, and using materials and resources).

The total mean score for all participants was 19.275 based on a possible score of 60. No group (teacher, administrator, parent/community member, or student) reported a total mean score greater than 22.
**Figure 1.** Administrator, teacher, student, and parent/community member mean scores for the total BALE instrument.

**Total BALE Includes:**
- Teaching for Understanding Construct
- Instructional Approach
- Valuing the Learner as an Individual
- Using Effective Questioning Habits
- Extending Students Thinking

** Administrator and teachers means were significantly greater (alpha = .05) than students or parents/community members.

**Table 6**
Analysis of Variance Procedure for the Dependent Variable, “Instructional Approach”

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>MeanSquare</th>
<th>F Value</th>
<th>Pr &gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>6</td>
<td>76.745</td>
<td>12.791</td>
<td>2.48</td>
<td>0.037</td>
</tr>
<tr>
<td>Error</td>
<td>65</td>
<td>237.710</td>
<td>5.168</td>
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<tr>
<td>Total</td>
<td>71</td>
<td>314.455</td>
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</table>

**Table 7**
Mean and Standard Deviation Values by Team for the Instructional Approach Factor

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Post Hoc Grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team A</td>
<td>11</td>
<td>7.500</td>
<td>3.249</td>
<td>A</td>
</tr>
<tr>
<td>Team B</td>
<td>13</td>
<td>6.075</td>
<td>3.103</td>
<td>AB</td>
</tr>
<tr>
<td>Team C</td>
<td>9</td>
<td>5.417</td>
<td>2.488</td>
<td>AB</td>
</tr>
<tr>
<td>Team D</td>
<td>9</td>
<td>5.292</td>
<td>1.198</td>
<td>A B</td>
</tr>
<tr>
<td>Team E</td>
<td>13</td>
<td>4.525</td>
<td>1.315</td>
<td>AB</td>
</tr>
<tr>
<td>Team F</td>
<td>9</td>
<td>4.214</td>
<td>1.489</td>
<td>AB</td>
</tr>
<tr>
<td>Team G</td>
<td>10</td>
<td>3.583</td>
<td>1.429</td>
<td>B</td>
</tr>
</tbody>
</table>

*Note. Means with the same post hoc grouping letter are not significantly different (alpha = .05)*
When identifying the most frequent beliefs depicted in the BALE responses, several patterns emerged. Generally, the participants believed that a successful learning environment is one in which the teacher has a genuine “love” or “enthusiasm” for his/her profession, possesses adequate content knowledge, has the ability to motivate students to learn, is caring, is a good classroom manager, acts as facilitator or guide, is able to communicate (explain) knowledge, respects his/her students, provides students with multiple ways of learning, and provides a supportive environment for learning. Most of these beliefs reflect affective characteristics of teachers. Few of the responses elaborated on ideas regarding the science curriculum, instructional strategies, and issues of student assessment; however, the more constructivist responses at least identified these factors as prominent to successful learning. The following quotes were taken from participants who scored relatively high on the BALE instrument:

The role of the teacher is to stimulate and guide research and then create and or present opportunities for students to apply what they research in a laboratory situation. The teacher must also use critical questioning to elicit reflective responses from students. Science learning is successful when students are actually doing “real” science. Real science is the process of research beginning with observations that lead to inferences that can be tested and resolved. The role of the student is active, reflective and cooperative. Students must work together at times to collect and analyze data. Students must also learn convergent thinking -- that is to come to a common understanding as well as insight to how others think. (teacher)

The teacher creates the environment for learning, sets the stage, guides, helps learners learn how to learn, provides materials/where to obtain them, assesses, evaluates, helps learners to self-evaluate, encourages, appreciates, exhibits joy in learning and leading others (students) to learn, respects students, must love learning or learn to love to learn. The student is at the center. (teacher)

Likewise, responses that were scored on the lower end of the BALE continuum are illustrated with the following:

This is very difficult for me to answer since I’m a parent and the last learning environment I was involved in was 25 years ago. One thing I think is of utmost importance is respect. That’s respect on both parties — the teachers and the students. For a successful learning environment, the teachers need to have the knowledge, equipment, and willingness to want to teach the students. In turn, the students need to respect the teachers, be willing to absorb the information, and use it to the best of their knowledge. (parent)

The role of the teacher in a successful learning environment is to introduce information and ideas in an interesting and exciting manner. The teacher should encourage and cajole his/her students to...
Beliefs About the Science Classroom

obtain maximum participation, i.e., learning. The role of a student in a successful learning environment is to have an open mind, a hunger for knowledge (even if they’re not aware of it), and a respectful manner. (parent)

The following student response was scored well below the mean, yet it conveys a message worth noting. I think the main focus in a teacher’s curriculum should be to make a student enjoy the subject. Too many teachers try to rush through a chapter or reach their personal goals and they don’t think to stop and ask — have these students learned anything? They don’t take the time to get the students’ interests. If you don’t have their attention then it’s safe to say most of them won’t learn very much. (10th grade student)

Discussion

Constructivism is a philosophy that anchors many contemporary reform ideas. National, state, and local science recommendations all have included constructivist teaching strategies in their recommendations guiding their plans for educational change. Since teachers are typically thought of as educational change agents (Fullan & Miles, 1993), and since beliefs often become action agendas (Pajares, 1992), the notion of educational change has been repeatedly rooted in the beliefs of teachers (Haney et al., 1996; Tobin et al., 1994).

As a result of increasingly prevalent state, national, and international educational assessment reports, a new era of public education has arisen. Schools are being influenced heavily by, and held accountable to, entire school communities, consisting of business and industry representatives, parents, students, and other local constituents. The No Child Left Behind legislation has increased attention toward high-stakes testing. As a result, most parents and business leaders want students to do well on high-stakes (often paper-and-pencil tests), and constructivist practices often appear to them to be incompatible with doing well on tests. However, research supports the notion that constructivist practices increase student achievement (Bowen, 2000; Haberman, 1991; Wenglinsky, 2000). If the school community has expanded its membership, then identifying the beliefs about science reform recommendations must reach beyond the school building barriers. Eliciting the beliefs of parents, community members, and students is now integral to school improvement.

This study identified and compared the constructivist beliefs of the school community: administrators, teachers, parents/community representatives, and students. Constructivist teaching ideas did not dominate their beliefs regarding successful teaching. The constructivist beliefs of all the participants were relatively low (mean = 19.275, based on a possible score of 60). Traditional views regarding the teacher as “knower” and student as “recipient” were noted, yet even more pervasive were affective beliefs pertaining to teacher enthusiasm, respect, care/concern for students, and the ability to motivate students. These factors appeared to be highly associated with perceptions of successful teaching. In contrast, constructivist beliefs related to the curriculum, use of instructional strategies, and assessment techniques seem to be lacking. This finding is consistent with previous studies by these authors (Haney et al., 1996), in which constructivism was found not to be a pervasive belief of teachers. However, it is somewhat different from the findings of Varella and Burry-Stock (1997), who noted relatively strong constructivist beliefs for teachers enrolled in a National Science Foundation teacher enhancement project.

It appears that both teachers’ and administrators’ experiences and/or participation in professional development may contribute to the construction of positive constructivist beliefs about teaching science. Administrators and teachers reported significantly higher total constructivist belief scores than did the parents/community members or students. It is evident that these school community groups lack the awareness, understanding, and/or experiences associated with constructivist philosophy.

Since administrators and teachers in this study participated in one or more Eisenhower Professional Development funded programs, it appears that direct involvement in professional development opportunities may be associated with greater fidelity to the identified constructivist practices. In other words, professional development has the potential to influence positively the beliefs of those involved in the experience. This notion is supported by Vygotsky’s (1986) ideas that knowledge (and associated beliefs) are socially constructed and that collaborative interactions with peers yield the collective construction of knowledge and beliefs. The social constructivist philosophy is also supported by Varella and Burry-Stock’s work (1997), as these researchers found that teachers who were involved in a systemic professional development project over greater lengths of time developed more positive constructivist beliefs about teaching science.

Administrators reported significantly higher constructivist beliefs than did the parents/community members or students regarding the “teaching for
understanding” construct. This construct includes the following belief characteristics: teacher as facilitator, student preconceptions and relevance, higher order thinking skills, demonstration of understanding, and construction of student conceptual understanding. The finding that administrators possess relatively positive beliefs about constructivist teaching is somewhat perplexing. Previous studies have reported that teachers do not believe administrators support them in implementing many of these belief characteristics (Haney et al., 1996; Haney, Czerniak, Lumpe, & McArthur, 1997). It could be that these administrators scored higher than most, given their previous involvement in science professional development opportunities. Or perhaps teachers are unaware of the beliefs administrators hold toward contemporary reform ideas. It remains unclear why this disparity exists. The critical need to include activities devoted to the identification, discussion, and reflection of teacher beliefs regarding teaching practices was made clear by Haney and Lumpe’s (1995) professional development framework. However, this study lends evidence that the beliefs of all professional development participants (including administrators, parents, community members, students, and others) should be considered of primary importance in any professional development experience.

Differences existed in the beliefs regarding the need for diverse instructional approaches. A suburban school closely tied to professional development between two universities over several years scored significantly higher than that of a rural school, which was moderately tied to one university, on the belief factor associated with the need to utilize diverse instructional approaches. The association with the university cannot be linked directly to the higher constructivist belief scores, since school community culture, team make-up, and other confounding variables were present. However, it is promising to know that this team collectively reported relatively positive beliefs regarding successful learning. Both Rutherford and Ahlgren (1996) and the National Science Education Standards (NRC, 1996) advocated a “Science for ALL students” philosophy. To ensure that science opportunities are afforded to all students, the inclusion of diverse instructional approaches is necessary to provide these students with abundant opportunities to learn based on the multitude of existing student learning styles.

Implication 1: Professional development opportunities should be extended to all school community partners.

School improvement projects should focus on improving community awareness of, support for, and involvement in constructivist-based school science programs. If it is true that both teachers and administrators adopt more positive constructivist beliefs through their involvement in effective professional development opportunities, then parents, community members and students will likely benefit from these experiences, as well. Funding structures need to be altered to include the participation of non-school employees. As it stands, it is extremely difficult, if not impossible, to provide grant funded incentives (graduate credit, stipends, materials, etc.) for these individuals. Moreover, the program evaluation reporting templates frequently lack a means for describing the activities and impact on these groups. Community involvement is not a new concept, yet it is difficult to bring community representatives into the current professional development programs.

Implication 2: Fostering positive public relations with the school community needs to become a priority.

Recently, there was public debate in California (and subsequently in several other states) regarding the implementation of the National Council of Teachers of Mathematics guidelines for constructivist teaching approaches (L. Williams, personal communication, December 11, 1997). Most of the clamor was based on misguided vocal opponents who were attempting to debunk the recommendations. It is imperative that decision-making citizens are not only presented with accurate information based on classroom research regarding teaching and learning, but they are invited into the schools to see these ideas in operation and that they become actively involved with these constructivist practices. Teachers and administrators can no longer afford to “close the door and do as we please.” The time has come to take on yet another role — that of the public relations agent. Fostering positive public relations with the school community is a priority. Educators are typically ill prepared for this role and, therefore, there is a need to provide educators background in public relations, marketing, and media relations—topics that would be excellent additions to graduate programs in teacher education, teacher leadership, and school administration.

Implications of This Study

Two fundamental implications of this particular study are offered to the science education community.

Future Research

In a constructivist classroom, the inquiry-based approaches used to teach of science closely relate to

School Science and Mathematics
those used to teach mathematics. Moreover, national and state reform recommendations guiding these two disciplines have similar history and have faced similar implementation challenges. Therefore, the BALE instrument, or other constructivist belief instruments, could be used to assess and monitor the beliefs of mathematics teachers and other school community members to identify the strength of the constructivist beliefs and to monitor changes to constructivist belief structures as mathematics reform efforts are tried. In doing so, the beliefs of those involved in the change process can be targeted and addressed so the reform has a better chance for lasting success.

It is hoped that new research (such as the studies described in the previous paragraph) will be generated in light of the findings offered in this study. Gaining an understanding of the beliefs of school community partners is an area of research that is seriously underrepresented. Yet, this area of research appears to be critical as we as a society enter a new paradigm of educational expectations. Possible ideas for research of this nature are endless; however, a few are offered in this article that are closely tied to this particular study.

Other professional development projects specifically addressing constructivist teaching practices might utilize the BALE instrument as an indicator of project success. Moreover, qualitative methods using the BALE constructs as a framework would be helpful in probing further into the identification of the beliefs of teachers, administrators, community representatives, and students regarding constructivist teaching practices. Combining quantitative and qualitative techniques to establish constructivist belief profiles for all of the school community partners would be valuable. Finally, the BALE instrument should be given to larger groups of community representatives and students to enhance its strength as a belief identification instrument.

References


Appendix A

Five Categories and Twelve Belief Characteristics of the Science Teacher Beliefs About the Learning Environment Rubric (BALE)

Category I: Teaching for Understanding.
   A. Teacher as facilitator (guide)
   B. Student preconceptions and relevance (prior knowledge)
   C. Higher order thinking skills (critical thinking/problem solving)
   D. Demonstration of understanding (assessment/evaluation)
   E. Construction of student conceptual understanding (seek, identify, and resolve inconsistencies, misconceptions)

Category II: Instructional Approach
   F. A rich variety of instructional approaches (teaching strategies)
   G. Using an activity-based instructional approach (hands-on, inquiry-based)
   H. Use of materials and resources (equipment, resources)

Category III: Valuing the Learner as an Individual
   I. Teacher-student relationship (affective components)
   J. Student autonomy - the importance (valuing) of students' opinions (critical voice, shared decision making)

Category IV: Questioning Habits
   K. Questioning habits and wait-time (questioning strategies)

Category V: Extension of Students' Thinking
   L. Elaboration of students' responses (probing students to extend their thinking)
Appendix B
Modified Rubric and Scoring Worksheet for the Science Teacher Beliefs About the Learning Environment (BALE)

<table>
<thead>
<tr>
<th>Score</th>
<th>Descriptor</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Elaboration</td>
<td>The concept is discussed with clarity and linked to other related elements.</td>
</tr>
<tr>
<td>4</td>
<td>Inclusion</td>
<td>The concept is discussed with clarity OR linked to other related elements.</td>
</tr>
<tr>
<td>3</td>
<td>Identification</td>
<td>The concept is identified as a term and/or in a list.</td>
</tr>
<tr>
<td>2</td>
<td>Allusion</td>
<td>The concept is alluded to or loosely included, but not clearly identified.</td>
</tr>
<tr>
<td>1</td>
<td>Absent</td>
<td>The concept is not identified or alluded to as a feature of an successful learning environment.</td>
</tr>
</tbody>
</table>

Scoring Worksheet:

I.D. # ______  
Total BALE Score = _____/60  

Category I: Teaching for understanding [Subtotal TU= _____/25]  
A. Teacher as facilitator = _____/5   
B. Student preconceptions and relevance = _____/5   
C. Higher order thinking skills = _____/5   
D. Demonstration of understanding (assessment/evaluation) = _____/5   
E. Construction of student conceptual understanding (seek, identify, and resolve inconsistencies) = _____/5

Category II: Instructional approach [Subtotal IA = _____/15]  
F. A rich variety of instructional approaches = _____/5  
G. Using an activity-based instructional approach = _____/5  
H. Use of materials and resources = _____/5

Category III. Valuing the learner as an individual [Subtotal VI = _____/10]  
I. Teacher-student relationship = _____/5  
J. Student autonomy - the importance (valuing) of students’ opinions = _____/5

Category IV: Questioning habits [Subtotal QH = _____/5]  
K. Questioning habits and wait-time = _____/5

Category V: Extension of students’ thinking [Subtotal ET = _____/5]  
L. Elaboration of students’ responses = _____/5