

# Cross-cultural Comparisons of Science Education Reform: Japan and the United States

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(Received October 29, 1999)

## Abstract

The results of this study comparing teacher perceptions and observed teacher behaviors for teachers from Japan and the U.S. are attributed to cultural differences, difficulty in interpretation of the practices, or differing degrees of confidence in implementing constructivist practices, or a combination of factors remains to be seen. But, this investigation is but a beginning in terms of successes and failures with science education reform initiatives around the world. Looking at these problems globally may be important to assure that current reforms are successful for all and will stimulate continuous progress.

## KEY WORDS

Cross-cultural Comparisons

Science Education Reform

Constructivist

STS

As science education reform proceeds in the latter part of the 90's, significant differences in what is thought to be good science teaching have occurred. No longer is it sufficient to stay within the confines of the classroom and work from a textbook. Instead, current reform efforts have called for the broadening of what is meant by content, and at the same time, have recommended that content, concepts, and practices be tied to the real lives of students by placing these in the environment in which students live. Additionally, technology is now seen as necessary to understand science fully. Science and technology are closely connected with similar procedures but very different in terms of goals, starting points, and end products. Finally, collaboration has become an essential part of science education both in schools and in research concerning the reforms. This collaboration includes not only interactions between students in the classroom, and between students and people in the local community, but it also includes collaboration with people from around the world via the internet. One form of collaboration, which has become more common, involves cross-cultural comparisons of reform efforts. If the goals of science education

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practices for the classroom include collaboration with people from around the world, then educational research should also begin to reflect a more multinational effort. This is a report of such a comparison between science teachers in the United States and in Japan.

This report concerns the constructivist teaching practices of 24 teachers, 12 in the United States and 12 in Japan. The paper reflects similarities and differences concerning several behaviors thought to be related to effective constructivist teaching and learning strategies. Data were collected on both teacher perceptions of their classroom behaviors as well as in-class observations of teaching behaviors by trained observers. The assumption driving the study was that any differences noted could be caused by (a) cross-cultural differences in terms of educational practice or (b) differences in interpretation and implementation of reform efforts. Several recent studies report on differences in classroom teaching behaviors across cultures such as different cultural attitudes concerning what is good teaching, cultural beliefs and practices, theories of classroom management, and different views of appropriate teacher-student interactions. The goal of this study is to further the understanding of how teachers from different parts of the world vary while implementing practices thought to be in line with science education reform efforts.

**METHODOLOGY:** Both sets of teachers are unique in the fact that they have worked closely with university faculty for at least five years. The American teachers are all teachers in the state of Iowa where they have worked with faculty at the University of Iowa. The Japanese teachers are residents of the Joetsu area in Japan and have worked closely with faculty at the Joetsu University of Education. All 24 teachers are thought to be experts in the use of constructivist teaching methods; all had completed several in-services on such methodologies through their university partnerships. All teachers completed basic demographic surveys which included age, gender, years of teaching experience, school setting, subject(s) taught, highest degree earned, and awards received. Following this, they were asked to report what they felt their rationale for teaching was. In addition, the teachers were also asked to list their goals for students leaving their classrooms. Teachers then completed self-reports concerning their teaching behaviors in the classroom. The instrument used for this self-report consisted of 19 behaviors thought to be representative of constructivist philosophy based on work completed in Iowa as part of the national Scope, Sequence, and Coordinate Project. The teachers rated themselves relative to these behaviors on a 5 point Likert scale. Observers in each classroom also completed this scale based on their own interpretations of what was happening in the classroom. This permitted a comparison of perceived and observed classroom practices.

- 1) Encourage students to identify and initiate their ideas/problems/issues,
- 2) Accept a variety of student responses,
- 3) Allow adequate time for student expression and analysis,
- 4) Use student ideas to drive lessons,
- 5) Seek elaboration of initial responses offered by students,

- 6) Use various local resources (people, places, situations),
- 7) Focus on current societal issues related to science and technology (i.e., issue-oriented science),
- 8) Encourage students to explore and use technology in the learning process,
- 9) Ask higher-order thinking questions,
- 10) Give students opportunities to experience applying their knowledge in meeting everyday challenges,
- 11) Create situations leading to increase career awareness related to science and technology,
- 12) Motivate students to take actions that illustrate exemplary citizenship roles,
- 13) Work with students in the process of their individual learning,
- 14) Encourage student-student verbal interactions,
- 15) Encourage students to use higher-order thinking skills,
- 16) Use a wide variety of assessment tools as well as those arising from student self-evaluation,
- 17) Design themes that promote questions that illustrate science as fields of inquiry (without discipline boundaries),
- 18) Change the curriculum to utilize student present understandings,
- 19) Use varied methods of teaching,

**RESULTS:** Demographics: The teachers in the United States and in Japan were found to be very comparable in terms of several demographic features, including age, gender, years of teaching experience, and setting of the school in which they teach. There were seven male and five female teachers. Both groups had an average of 19 years of teaching experience. Most of the teachers in both groups taught in suburban or urban settings; however, there were slightly more rural teachers in the United States sample.

Goals for teaching science were also similar. In response to the question "Your students should be able to . . . after leaving my classroom," the teachers in both the United States and in Japan listed similar goals although they listed them in different order of importance. For example, the top three goals for teachers in the U.S. seem to reflect a desire for students to be lifelong learners and to use their science skills actively; the teachers want these students to ask good questions, be good problem solvers, and apply these skills to their daily lives. These goals reflect several things considered important in the U.S., namely (a) for all citizens to be independent, confident members of society who can (b) solve problems that arise in their daily lives using (c) knowledge and skills they learned in school, and to be able to do this with great confidence. Further, these goals reflect current trends across the nation concerning about what makes a good student; to be able to solve problems and apply knowledge. The top three goals for Japanese teachers were (a) for students to be able to appreciate science and be interested in learning more science, (b) to be able to see how science and the natural world connect to their own lives,

and (c) to be able to think both creatively and critically. See Table 1 for the specific list of responses to this question for both sets of teachers.

Rationales for effective teaching were also collected. In response to the question "What is your rationale for effective science teaching," the teachers again provided similar answers, but in a different order. For example, the top three rationales for effective teaching as seen by the American teachers were: (a) the teacher should be a facilitator, listener, and participator in the classroom; (b) the teacher should provide students opportunities to experience concepts, critical thinking, problem solving visually, auditorially, and kinesthetically; and (c) science should be student-centered, not teacher-centered. In Japan, the top three rationales were: (a) the teacher should be a facilitator, listener, and participator in the classroom; (b) the teacher should provide opportunities for students to experience concepts, critical thinking, problem solving visually, auditorially, and kinesthetically; and (c) science should use concerns and issues which students are interested in; this is very effective and has fewer discipline problems. See Table 2 for the specific lists of responses to this question by U.S. and Japanese teachers.

Observer rating of teaching behavior was also recorded. Using the nineteen item scale again, and looking specifically at the six sub-scales of the instrument, no difference was found in terms of two of the sub-scales namely; classroom practices and questioning. On the remaining four scales, i.e., context/citizenship, technology use, student experience base, and student-centeredness, the U.S. teachers were found to be using more of the behaviors in these categories than were the Japanese teachers.

**DISCUSSION:** As teachers around the world struggle to adapt the philosophies concerning current reform movements, they will undoubtedly find they are able to implement some changes easily while others remain very difficult. When looking across cultures, it is highly likely that there will be cultural differences noted in terms of behaviors thought to be associated with good constructivist practices. Reasons to explain these cultural differences will reside at many different levels; (a) personal, inside of the specific teacher him/herself, (b) school, related to the philosophy of the school itself, the beliefs of the administrators, and the reactions of colleagues to changes made in curriculum and teaching practice, (c) economically, related to that specific community conditions where the specific school is located the teacher is employed, (d) community, related to the specific life patterns of the community where the school is located, and (e) societal, related to the beliefs of the society as a whole, which will also include aspects of the cultural history of a particular country. Therefore, for teachers around the world to experience as much satisfaction and success with reform efforts, an understanding of not only similarities, but also differences across cultures in terms of constructivist teaching practices will help all science educators better understand the issues surrounding science education reform. In addition, they listed comparable goals for their students upon completion of their class and their rationale for effective science teaching, although the order of these goals and rationale statements were different

for the two groups. The differences noted could reflect some of the cross-cultural differences listed above. Again, these goals reflect something about current culture in Japan; specifically, they reflect concerns about the status of scientific and technological progress in Japan. There is a long history in Japan for developing an appreciation nature, and this is reflected in these goals. Further, the teachers want their students to appreciate what science can do for them in their own lives. Finally, again reflecting national trends in Japan, teachers want students to be able to think critically and creatively and to extend this into their lives outside of school currently and as adults. These same kinds of cross-cultural differences can also be used to explain differences in teachers' rationales for teaching science. Although there are differences evident, it is important to remember that teachers in both cultures responded to the two questions with similar statements (see Tables 1 and 2).

The most interesting finding in this study was the differences noted between what teachers perceived themselves to be doing and what observers to their classrooms reported. It was seen that only in the case of teacher practices, context/citizenship, and technology were the perceptions and observations similar, but, this was only true in the case of the teachers in the U.S. For the remaining three areas, perceptions and observations were not the same; in some cases teachers felt they were doing worse than how observers rated them. In other cases, teachers felt they were doing better than the observer did. It is important to point out that in most cases, the scores of all 24 teachers were relatively high. The point of this analysis is not to say that either group of teachers is doing a poor job. Rather, it is far more interesting to speculate on reasons why the perceptions and observations are not in accordance with one another, especially in terms of the Japanese teachers. They actually rated themselves as performing higher in terms of questioning and use of student experience as a base than did their American counterparts. Yet when observed, they actually scored the same or lower than U.S. teachers in these two categories. Several possible explanations exist for this finding. It may be that the Japanese teachers may not understand the full implications of the use of higher order questions when asking questions of their students. If so, they may also not fully understand how to help their students use higher order questions in their own investigations. Likewise, the Japanese teachers feel they are using student experiences to drive their lessons, yet the observer did not agree. Perhaps the teachers do not understand completely how to help students generate questions based on their own experiences that then can be used to drive lessons/investigations. With some in-service training, they could make better use of these strategies. On the other hand, cultural differences, such as desire for teacher control, the kinds of student-teacher interactions permitted in the classroom, and the types of questions that are considered important or appropriate may be holding the Japanese teachers back in these areas. The same kinds of things can be said for the U.S. teachers in the areas where they do not perceive the same things as the observer did. For example, U.S. teachers do not feel they are using student-centeredness to the extent that the observer did. Perhaps with further training and

experience with this concept, they may begin to feel that some of the things they do in the classroom really are more student-centered than they think. For both sets of teachers, findings such as these have important implications which can allow them to improve practices further. There is already good progress in terms of science education reforms in both countries.

It is important to note that in no way is one group of teachers better than the other; any interpretation of the data in such a way would be faulty. Both groups scored very high on all six sub-scales (in other words, on all 19 items). The only differences reported are those which were found to be statistically significant; they are in no way meant to reflect quality. More important is the fact that the perceptions of teachers in both classrooms are not completely in line with observations made in their classrooms. The reasons for this need to be explored further. Since it is possible that some areas of reform are not completely understood by teachers in both cultures, efforts should be made to assure that all teachers understand the goals of current reform movements; then, support for those areas where they are weak should be provided by those engaged in current research and in staff development efforts. In this way, the reform movement will likely be more successful for all.

In conclusion, this study looked at 12 teachers in Japan and 12 in the United States in terms of how these teachers perceived themselves in the classroom and how observers rated them on a variety of behaviors. In all cases, the behaviors examined were thought to reflect current views on what makes good science-teacher practices related to current science education reforms. In addition, the goals for students and rationale for science teaching were compared among the 24 teachers in order to get a picture of what aspects of reform were emphasized in the two cultures. It was found that although the goals and rationale statements were similar, they differed in important ways that may reflect cultural differences. Moreover, the actions and behaviors that teachers perceived concerning their own teaching did not always correlate positively with observer ratings. This suggests that the tenets of science education reform may not be completely understood and that there may be cultural differences, that there is differing difficulty in interpretation, or that a combination of factors may explain differences.

#### Reference List

1. Aikenhead, G. S., & Ryan, A. G. (1992). The development of a new instrument: Views on science-technology-society (VOSTS). *Science Education*, 76, 477.
2. Alberta Department of Education. (1992). *International comparisons in education: Curriculum values and lessons*. (Education Report). Alberta: Alberta Chamber Resources.
3. Goh, N-K. (1993). Some misconceptions in chemistry: A cross-cultural comparisons and implications for teaching. *Australian Science Teachers Journal*, 39, 65.
4. Kimble, L. L. (1999). A Comparison of Observed Teaching Practice with Teacher Percep-

- tions of Their Teaching during and Following Major Funding. Unpublished doctoral dissertation, University of Iowa, Iowa City, IA 52242.
5. National Science Teachers Association. (1992). Scope, sequence, and coordination of secondary school science: Volume I. The content core. A guide for curriculum designers. Washington, D.C.: Author.
  6. Sensales, G., & Greenfield, P. M. (1995). Attitudes toward computers, science, and technology: A cross-cultural comparison between students in Rome and Los Angeles. *Journal of Cross-Cultural Psychology*, 26, 229.
  7. Yager, R. E. (1996). Science/Technology/Society As Reform in Science Education, Albany, NY: State University of New York Press.

Table 1

Goals for Teaching Science. Listed in order of frequency.

After leaving school, students should be able to;

United States

Apply their knowledge and skills in daily lives.

Be problem solvers.

Be good questioners.

Learn how to learn, be life-long learners, be self-learners.

Be responsible and productive citizens.

Think creatively and critically.

Work with others.

Communicate effectively.

Know and understand science and the natural world and see its connection with their lives.

Appreciate science and be interested in learning more science.

Japan

Appreciate science and be interested in learning more science.

Know and understand science and the natural world and see its connection with their lives.

Think creatively and critically.

Work with others.

Apply their knowledge and skills in daily lives.

Be problem solvers.

Learn how to learn, be life-long learners, be self-learners.



Table 2

Rationale for Effective Teaching. Listed in order of frequency.

#### United States

Teacher should be a facilitator, listener, and participator in the classroom.

Teacher provides students opportunities to experience concepts, critical thinking, problem solving visually, auditorially, and kinesthetically.

Student-centered, not content-centered.

Using concerns and issues that students are interested in is very effective and has no discipline problems.

Developing student understanding by practicing, using hands-on activities, sharing their ideas, and working with their ideas.

Letting students drive the direction of curriculum; Learning things that are relevant to students; coming from student questions, and based on students' understanding.

Using STS/Constructivist model is the best way to alleviate misconception Integrating science disciplines.

Interdisciplinary approach in science.

Implementing authentic assessment.

Focusing on large ideas before getting into the details.

#### Japan

Teacher should be a facilitator, listener, and participator in the classroom. Teacher provides students opportunities to experience concepts, critical thinking, problem solving visually, auditorially, and kinesthetically.

Using concerns and issues that students are interested in is very effective and has no discipline problems.

Developing student understanding by practicing, using hands-on activities, sharing their ideas, and working with their ideas.

Letting students drive the direction of curriculum; Learning things that are relevant to students; coming from student questions, and based on students' understanding.

Student-centered, not content-centered.

Integrating science disciplines.

Interdisciplinary approach in science.

Implementing authentic assessment.

Using STS/Constructivist model is the best way to alleviate misconception.