

## Implications and impact of research on teacher belief, inquiry based practice and characteristics of professional development that effect change in secondary mathematics teachers' classroom practices.

Dr. Manoj Kumar Singh  
< [ksingh.drmanoj@gmail.com](mailto:ksingh.drmanoj@gmail.com) >

### Abstract:

*This research paper explores the implication of an inquiry-based classroom teaching practice which had impact on the beliefs of secondary mathematics teachers where Open-ended interviews have been used to have a look at differences in secondary mathematics instructors' beliefs about perfect classroom practices formed by experience to prospective professional development program based on one-of-a-kind of theoretical frameworks. Teachers who had participated in an in depth, inquiry-based, prospective professional development program that focused on favored teaching methodologies from a constructivist, inquiry-based attitude defined were in comparison with instructors who had been via traditional prospective professional development workshops. Analysis of interviews based on the academics' responses to each conceptual and mathematics questions that worried the idea of compactness discovered perception into the teachers' preferred teaching methodologies, their ideals*

*approximately how students study, their attitudes toward their own learning, and their intensity of information of the idea of compactness. This research also show that, for a few teachers, extensive prospective professional program can create a important changes in teachers' beliefs about best possible teaching practice. On the basis of the findings of this research, implications and impact of inquiry-based practice for professional development programmes are discussed.*

**Keywords:** Inquiry based practice, Prospective, professional development program, secondary mathematics instructor, secondary school, beliefs of teachers.

### Introduction:

Teachers' beliefs, practices and attitudes are important for understanding and improving educational processes. They are closely linked to teachers' strategies for coping with challenges in their daily professional life and to their general well-being, and they shape



students' learning environment and influence student motivation and achievement. In this view, Current attempts to reform mathematics education may be traced back. There is abundant evidence, however, that the "satisfactory practices" described in the vast collection of documents calling for reform are no longer being translated into real existence exercise in our faculties (Porter, 2002; Schmidt, McKnight, & Raizen, 1997; Shulman, 1987; Suter, 1995). In spite of big efforts to shift classroom exercise in the direction of a constructivist, inquiry-based totally classroom environment, many teachers still follow a traditional.

In classify to gather long-term modifications in the teaching/learning of method it's far crucial to listen to and reflect upon the implications of teachers' voices because teachers' beliefs have a strong influence on their lecture room exercise. Teachers' ideals about teaching and learning had been proven to have an effect on the implementation of each pedagogical and content -precise reform (Luft, 2001; Lotter, Harwood & Bonner, 2007. Teachers' beliefs are specially essential inside the context of professional improvement programs due to the fact instructors who query whether the content material or practices being advocated will be

useful are no longer likely to contain this content or practices in their classrooms (Richardson, 1996).

This look at used in-depth interviews primarily based on both conceptual and mathematics questions that involved the idea of compactness to examine the outcomes of an inquiry-based totally, prospective expert improvement software on instructors' perceptions of what constitutes an effective coaching/studying environment with equally intensive expert development activities that lacked the identical coherent hyperlink. This take a look at constructed on the muse provided by Marton (1981), who differentiated between first-order research that attempt to describe the fact of the sector wherein the research are accomplished and 2nd-order research that concentrate on people's ideas or experiences of the arena. This look at became not a try to describe the fact of the lecture room practices hired by the intermediate technological know-how instructors involved in the studies that became done. It focused on the teachers' beliefs approximately "exceptional practices" for teaching intermediate mathematics that resulted from experience to professional development behavior.

The reform concerned each the introduction of inquiry-based curriculum materials based on the constructivist idea of understanding (Bodner, 1986; Bodner, Klobuchar, & Geelan, 2001; von Glasersfeld, 1984) and the improvement and implementation of full-size teacher expert development activities that centered on suitable teaching methodologies based on a constructivist, inquiry-based method to teaching and learning.

The professional improvement program consisted of three additives:

- An intensive two -week summer season workshop,
- Monthly daylong workshops in the course of the subsequent educational year, and
- Visits to the classrooms by means of the college professors who taught the summer season workshops.

The teachers who worked together during those workshops had been recommended to retain their interactions inside the school surroundings as a network of learners (Brown, Collins, & Duguid, 1989; Macklin, 2007; Wenger, 1998, 2000). The constructivist -based mathematics teaching reform commenced with secondary school level teaching, and, consequently, it is at this stage

that we predicted to locate instructors who had been maximum in all likelihood to have advanced “constructivist” ideals. The shape of the professional development program contained many of the capabilities advocated for a victorious Professional Development efforts that are:

- Broad and continuous training with opportunities for energetic learning during which the teachers had been capable of exercise the capabilities and expertise developed;
- Vigorous modeling of the techniques the lecturers have been predicted to use;

The creation of a supportive network for implementation of the reform; and a Professional Development environment in which instructors ideals had been active. The professional improvement program therefore centered on teaching strategies based totally on the “excellent practice” literature, rather than on the improvement of content know-how within the area of mathematics.

### **Assessment on Methods of teaching**

Many attempts have been made to differentiate between “conventional” and “constructivist” instructors argued that:



“conventional, instructors have conceived their roles to be concerned with revealing or transmitting the logical structures of their know-how and directing secondary level school students via rational inquiry in the direction of coming across predetermined standard truths expressed in the form of legal guidelines, ideas, policies, and algorithms.” Driver (1989) has argued that teachers who adopt the constructivist idea question secondary level school students’ solutions, whether they may be proper or wrong, to ensure that they and their secondary level school students are using the same phrases to describe the identical phenomena; insist that students provide an explanation for the answers they deliver; do not allow secondary level school students to use phrases or equations without explaining them; and inspire secondary level school students to mirror on their answers, which is an vital a part of the getting to know procedure. Constructivist processes to practice require a diffused shift in angle for the individual who stands inside the front of the study room. A shift from someone who “teaches” to a person who “enables getting to know”; from teaching by means of imposition to teaching by using negotiation (Herron, 1984). While traditional instructors generally tend to create

instructor-targeted or content-centered school rooms, constructivist instructors are extra possibly to produce pupil centered school rooms (Simmons, et al., 1999).The literature on the constructivist theory of expertise affords a basis for categorizing teachers as “constructivist” or “conventional” by means of watching their lecture room practice. But we believe that it additionally offers us with the idea for predicting into which of these classes a instructor belongs with the aid of asking them to explain how they would layout practice to confront students’ misconceptions, which changed into the approach used in this take a look at.

There is motive to anticipate that the ideals the traditional teachers delivered to their lecture room practices have been the end result of a combination of the tradition of teaching that permeated their faculty years, their reviews going via a teacher training software, and subsequent prospective expert improvement. This assumption is based totally at the results of the Salish Project (Simmons, et al., 1999), which concluded that students graduate from teacher guidance programs with a properly - hooked up series of ideals approximately the character of technological know-how, about how students analyze, and how nice to train

technology. This observes become primarily based on following research questions.

1. How do the teaching methodologies of secondary level school teachers who participated in a systemic reform mission vary from the ones of traditional instructors?
2. Are beliefs about the studying manner distinct for reform-motion and traditional intermediate school instructors and attitudes towards studying distinctive for reform-movement and conventional intermediate faculty instructors?
3. How does the depth of each conceptual and mathematics know-how of reform-movement and traditional secondary level mathematics instructors examine?

Data have been gathered using a qualitative research methodology primarily based on a sequence of semi-structured interviews conducted and selected teacher by following criteria.

- They had been teaching in one of the curriculum reform faculties for as a minimum 3 years.
- They had gone thru the in depth initial two-week summer workshop .
- They expressed the perception that their coaching became based totally on a constructivist methodology because of

the curriculum reform movement and also “conventional” teachers had been decided on from among faculties that had now not participated within the reform venture.

For selection of teacher some extra clause as follow

- Teachers had greater than 3 years of experience teaching mathematic at the secondary level,
- Teacher have been teaching mathematics know-how at that stage when the observe become being finished, and they’d participated in few professional development program experiences inside the previous years.

The centerpiece for this look at become a set of seven questions related to the idea of compactness tailored from questions .The questions differed in stage of problem, starting from those that simplest required a simple knowledge of the concept of extent, to people who required a qualitative knowledge of compactness, and, finally, those that required a quantitative expertise of this concept. Three of the questions have been used as a warm-up experience to introduce the lecturers to the interview procedure. The other questions had been used to acquire the statistics analyzed in this examine. The interview protocol becomes

dependent around the set of questions. For each query, the teachers have been requested to:

(1) Predict the most not unusual answer their students could supply,

(2) Answer the question for themselves,

(3) Describe what they would do if their answer becomes not similar to the solution they predicted their secondary level school students could give if these questions become asked in elegance.

The instructors have been interviewed at their own faculties at some point of their ordinary hour for training, with the exception of one teacher who became interviewed after school hours. The interviews had been accomplished in English, audio -taped, and then transcribed via the first creator. The analysis of the interview transcripts centered on typical styles that would offer insight into observable differences between the corporations of instructors. Coding of interview transcripts focused on recognizing patterns in the instructors' responses that had been associated to the four studies questions. A constant comparative approach (Strauss & Corbin, 1990) became used within the evaluation of the facts that produced four widespread classes into which results may be organized:

- Implementation of methodologies in teaching practice
- Observation with this beliefs - approximately how people learn,
- Teachers' Attitude towards learning, and strength of intangible information of compactness.

### Finding of the Research

#### ▪ Implementation of methodologies in teaching practice

One a part of the interview protocol for every question in this take a look at requested the teachers to explain what they might do if their students gave what the lecturers believed have been "wrong" solutions to the query. The purpose of this a part of the interview become to advantage insight into how the teachers might shape their school room behavior to confront secondary level school students' misconceptions of the concept of compactness .A clean sample emerged among the reform-movement teachers, who mentioned that they might use arms-on substances in an inquiry-based totally manner in order to help their students recognize the principles. The reform-movement teachers constantly referred to that they could try to replicate the questions with real materials in the lecture room. They explained how they might reap the



vital substances, how they could set up the experiments, what questions they might ask, and the way they would guide the scholars through the technique.

The traditional teachers focused on the reasons they could gift if the scholars gave what they believed to be the incorrect answer to one of the questions what asked. Although a number of the traditional teachers cited that experiments can be carried out to clarify the ideas, they did no longer supply information about how they could layout or perform these experiments. Interviews with the conventional instructors have been usually shorter than those with the reform-movement teachers, and the conventional teachers spent less time explicitly reflecting on mistakes in their secondary level school students' thinking. Consider the way the traditional teachers replied to the primary question. Many out of traditional instructors thought their students could provide the incorrect answer of the question. However, handiest one trainer from this group certainly knew the right solution. When requested what she could do if the secondary level school students gave the incorrect answer, she spoke back that she might inform them the subsequent:

- **Observation with these beliefs - approximately how people learn**

The literature on teachers' ideals is extensive, despite the fact that the time period "ideals" has been defined as ambiguous (Kagan, 1992; Pajares, 1992). It has been argued that teachers' beliefs approximately learning g are based totally on a "folk pedagogy" received through their lifelong stories (Bruner, 1996) and honed through the various years they spent as secondary level school students or instructors in various school .Because their beliefs about learning have an effect at the way instructors shape the classroom environment the volume to which these beliefs can be changed is of interest to teacher educators.

The groups of teachers who participated in this works had been similar in phrases of historical past, ethnicity, instructional education, years of teaching enjoy, and amount of expert development activities. They differed, but, within the kind of in-carrier sports to which they were uncovered. The reform-motion instructors repeatedly cited that they believed their students examine higher whilst they find out something by way of themselves. Throughout the interviews, they commented on their thoughts approximately how their students think, and repeatedly referred to that their students brought t to their technological know-how lessons many questions from regular

existence. Their description of their school room practices and the way their secondary level students behave counseled that they believed that students study best in a student -focused surroundings, where the instructor gives reports that permit the scholars to: Assemble their own ideas about technological know-how, bring context to the ideas being discussed in class, and learn via doing, gazing, and studying. They expressed the notion that that is a ordinary teaching-mastering environment that they not best can, however must, promote.

The traditional teachers, however, verified their perception that studying happens whilst the trainer gives accurate, clear causes. Their own solutions to the interview questions targeted on recalling the precise answer. The use of experiments became stated inside the context of remarks approximately their remembering something they were told, no longer something that might be an effective manner of teaching and learning.

▪ **Teachers’ “mind-set” towards learning, and strength of intangible information of compactness**

The time period “mind-set” has been defined as a wonderful or negative evaluation of people, gadgets, occasion, sports, or thoughts in an individual’s surroundings that impacts the

manner that person responds to an external stimulus (Zimbardo and Gerrig, 1999). In this examine, the lecturers’ mind-set closer to learning changed into assessed by examining how relaxed they have been whilst positioned in a state of affairs in which they did now not understand the answer to a question.

Again as previously majority of reform-movement teachers confirmed the same method to confronting what changed into, to them, a difficult problem. Although it changed into clean that they were now not sure approximately their answers, they expressed confidence in their potential to find the solution for themselves via calmly describing how they would cross about setting up an experiment to find out the best solution. They regarded to recognize what to do and the way to use their knowledge to address the hassle. Furthermore, they were express in expressing their personal curiosity approximately the problem and their interest in learning an appropriate solution.

➤ **Strength of Intangible Considerate of Compactness**

Both their comments and their nonverbal communiqué advised that the reform-movement instructors were now not certain of the perfect answer to some of the conceptual questions but



they have been comfortable of their belief that the solution changed into smooth to find out through doing the correct experiments. With only one exception, they definitely defined how they might put together the substances to do the experiments, what questions they could ask the students, and the way they would guide the scholars in their production of information.

The conventional teachers all gave the wrong solution to the first query, they went on to give an explanation for why the students might be incorrect. With one exception, the traditional teachers regarded at ease with their answer to the question, even though it turned into wrong.

#### ➤ **Strength of Mathematics understanding**

Three of the questions in this look at have been conceptual; the fourth is frequently defined as “mathematics.” A better label, however, could be “mathematics” (Bodner & Herron, 2002) because the answer is seldom received by the software of a rehearsed set of rules. Some hassle fixing conduct related to the manipulation of mathematical symbols is important. The reform-movement instructors described compactness experiments their students had achieved.

#### **Discussion and Conclusion**

Research has publicized teacher support to be a significant engine of transform and quality development in schools. In this research each groups of instructors had been out in the open to professional development program experiences, they confirmed clean variations in the manner they translated these experiences into their beliefs about appropriate ways to present himself with their study and learning materials in their classroom. The reform-motion teachers said that they desired the usage of hands-on materials to promote discussions amongst their students. Two of the phrases used most usually through those teachers had been prediction and observation. A ordinary word changed into: “... Have the scholars do and see by themselves and reach their very own conclusions primarily based on those observations.” The reform-movement teachers expressed the perception that they have to actively involve their secondary level school in the learning manner by way of beginning with a query and maintain questioning in the course of the studying technique to guide the scholars in their personal questioning. They expressed the belief that “quality practices” for school room teaching might involve hands-on sports via students operating in groups, leaving questions unanswered with the

goal that students could be sufficiently influenced to maintain experimenting and reach their very own conclusions.

The classroom environment depicted through the reform-movement instructors in this observe would possibly fine be described as student centered inside the sense of this term turned into used within the Salish task (Simmons, et al., 1999). The instructors in this have a look at who have been uncovered to standard expert development sports, however, expressed ideals about teaching exercise one would expect of conventional instructors. They seemed to value relying on reasons and direct solutions to secondary level school students' questions. They expressed the opinion that the choicest lecture room surroundings would encompass presenting sufficient opportunities for students to ask questions, however that much less time have to be committed to probing their students' information. They mentioned that they might be less in all likelihood to use hands-on substances and extra possibly to depend on the blackboard, drawings, and oral explanations. The lecture room surroundings depicted by the conventional instructors in this examine can exceptional be described as trainer focused, (Simmons, et al., 1999).

Both groups on this observe expressed beliefs approximately appropriate classroom practices that were steady with their ideals approximately how secondary level school students examine. The reform-movement teachers time and again referred to that their students study excellent when they find out knowledge through themselves inside the context of their regular lives. Although the conventional instructors did now not explicitly point out that explaining and giving direct set off solutions to questions changed into the "accurate" technique to get students to analyze, it turned into implicit in their interviews that that is the excellent manner to teach. The conventional instructors did not provide any proof to endorse that they reflected on the getting to know system of their students, or on the coaching/studying system taking place of their school rooms.

There was a vast distinction between the reform-motion and traditional teachers' mind-set closer to their very own learning. The reform-movement teachers tested an interest in mastering more after they perceived they did now not realize. They exhibited curiosity about the solutions to the conceptual questions and cautiously described how they might go approximately locating out the proper solution to a tough trouble. They tended to talk

about hard troubles with different instructors which will help every different discover the proper solution. The conventional teachers had been less probable to be aware of errors of their approach to strange issues. They tended to present what they felt became the “correct” answer and infrequently contemplated out -loud whether or not they had been proper.

The traditional instructors had been truly more probably to supply the “accurate” solution to a query, however they validated confusion whilst asked to describe how they knew that solution was correct. As a rule, they did not recognize how to acquire the right answer and, in popular, “knew” however did now not “understand” the solutions. When confronted with a numerical calculation, they had been in a position to answer the question with slight trouble. None of the reform-motion teachers, then again, should remedy the quantitative part of the final trouble and most of them expressed the need to do a test with the intention to be capable of solution the query.

This research indicates that the reform-based professional development experiences may have had unexpected implications that might be of hobby to mathematics teachers involved in each pre -service and prospective teacher preparation programs. In looking to emphasize a

constructivist, inquiry-based totally method to teaching that promotes conceptual understanding, the unintentional lesson the lecturers seemed to receive is that conventional, quantitative problems that require a numerical, mathematics approach to the answer are now not critical. These programs will recognition no longer only on “new” or “unique” strategies of teaching mathematics, but, however additionally talk traditional methods the teachers want to hold doing. The next era of professional development program will try to be “actual” in phrases of modeling the teaching methodologies that effectively expand all type of knowledge.

## References

- [1] ACHESON, K. and GALL, M. D. 1992. Techniques in the clinical supervision of teachers, White Plains, NY: Longman Press.
- [2] Anderson, G. L. (1989). Critical ethnography in education: Origins, current status, and new directions. Review of Educational Research, 59, 249-270.
- [3] BERG, B. L. 1998. *Qualitative research methods for the social sciences*, Needham Heights, MA: Allyn and Bacon. [[Google Scholar](#)]
- [4] Barnes, R. (2005). Moving towards technology education: Factors that facilitated

teachers' implementation of a technology curriculum. *Journal of Technology Education*, 17(1).

[5] Bhattacharya, G. (2007). Ethnography and ethnomethodology. In G. M. Bodner, & M. K. Orgill (Eds.) *Theoretical frameworks for research in chemistry/science education* (pp. 172-186). Upper Saddle River, NJ: Prentice Hall.

[6] Bodner, G. M. (1986). Constructivism: A theory of knowledge. *Journal of Chemical Education*, 63, 873-878.

[7] Bodner, G. M., Klobuchar, M. & Geelan, D. (2001). The many forms of constructivism. *Journal of Chemical Education*, 78, 1107.

[8] Bodner, G. M. & Herron, J. D. (2002). Problem solving in chemistry. In J. K. Gilbert (Ed.) *Chemical Education: Towards Research-Based Practice*. Dordrecht: Kluwer Academic Publishers.

[9] Brandt, D. (1992). The cognitive as the social: An ethno methodological approach to writing process research. *Written Communication*, 9, 315-355.

[10] BRISCOE, C. 1991. The dynamic interactions among beliefs, role metaphors, and teaching practices: a case study of teacher change. *Science Education*, 72(2): 185-199.

[11] Brickhouse, N. & Bodner, G. M. (1992). The beginning science teacher: Classroom narratives of convictions and constraints. *Journal of Research in Science Teaching*, 29, 471-485.

[12] Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18, 42.

[13] BROCKMETER, M. A. 1998. "The impact of an extended inquiry-based in-service programme on the beliefs and practices of beginning secondary science teachers". Iowa City: The University of Iowa. Doctoral Dissertation.

[14] Brouwer, N., & Korthagen, F. (2005). Can Teacher Education Make a Difference? *American Educational Research Journal*, 42(1), 153-224.

[15] Bruner, J. (1996). *The Culture of Education*. Cambridge, MA: Harvard University Press.

[16] Calderhead, J., & Robson, M. (1991). Images of teaching: Student teachers' early conceptions of classroom practice. *Teaching and Teacher Education*, 7, 1-8.

[17] Driver, R. (1989). In R. Miller (Ed.), *Doing Science: Images of Science in Science Education*. New York: Falmer.

[18] FRANKE, M.L., CARPENTER, T., FE NNEMA, E., ANSELL, E. and BEHREND, J. 1998. Understanding teachers' self-sustaining, generative change in the context of professional development. *Teaching and Teacher Education*, 14: 67-80.

[19] Farnham-Diggory, S. (1994). Paradigms of knowledge and instruction. *Review of Educational Research*, 64(3), 463-477.



- [20] Fetterman, D. M. (1989). *Ethnography step by step*. Newbury Park, CA: Sage.
- [21] Fraser, B. J., (1994). *Research on Classrooms and School Climate*. In Gable, D. (Ed.) *Handbook of Research on Science Teaching and Learning*. New York: Macmillan, p. 527.
- [22] Gardner, D. F., & Bodner, G. M. (2006). *The existence of a problem-solving mindset among students taking*
- [23] *quantum mechanics and its implications*. In T. Schoolcraft and M. Ellison (Eds.), *Reforming the Physical Chemistry Curriculum*. Washington, DC: ACS Press.
- [24] Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). *What makes professional*
- [25] *development effective? Results from a national sample of teachers*. *American Educational Research Journal*, 38(4), 915-945.
- [26] Garfinkel, H. (1967). *Studies in ethnomethodology*. Englewood Cliffs, NJ: Prentice-Hall.
- [27] Herron, J. D. (1984). *Using research in chemical education to improve my teaching*. *Journal of Chemical Education*, 61, 850-54.
- [28] Jeanpierre, B., Oberhauser, K., & Freeman, C. (2005). *Characteristics of professional development that effect*
- [29] *change in secondary science teachers' classroom practices*. *Journal of Research in Science Teaching*, 42(6), 668-690.
- [30] Kagan, D. (1992). *Implications of research on teacher belief*. *Educational Psychologist*, 27(1), 65-90.
- [31] Keys, W. C., & Bryan, L. B. (2001). *Co-constructing inquiry-based science with teachers: essential research for*
- [32] *lasting reform*. *Journal of Research in Science Teaching*, 38, 631-645.
- [33] Lotter, C., Harwood, W. S., & Bonner, J. J. (2007). *The influence of core teaching conceptions on teachers' use of inquiry teaching practices*. *Journal of Research in Science Teaching*, 44(9), 1318-1347.
- [34] Loucks-Horsley, S., Hewson, P. W., Love, N., & Stiles, K. (1998). *Designing professional development for teaching of science and mathematics*. Madison, WI: National Institute for Science Education.
- [35] Luft, J. A. (2001). *Changing inquiry practices and beliefs: The impact of an inquiry-based professional development programme on beginning and experienced secondary science teachers*. *International Journal of Science Education*, 23(5), 517-534.
- [36] Macklin, A. S. (2007). *Communities of practice*. In G. M. Bodner and M. Orgill (Eds.), *Theoretical frameworks for research in chemistry/science education*. Upper Saddle River, NJ: Prentice Hall.



[37] Marton, F. (1981). Phenomenography — Describing conceptions of the world around us. *Instructional Science*, 10, 177-200.

[38] NATIONAL RESEARCH COUNCIL (NRC). 1996. *National science education standards*, Washington, DC: National Academy Press.

[39] O'BRIEN, T. 1992. Science in-service workshops that work for elementary teachers. *School Science and Mathematics*, 92(8): 422–426.

[40] PAJARES, M. F. 1992. Teacher' beliefs and educational research: cleaning up a messy

construct. *Review of Educational Research*, 62(3): 307–332.

[41] PIZZINI, E. L., HUHER, R. A. and SHYMANSKY, J. A. 1988. *Science odysseysfor the journeys in science programme*, River Forest, NJ: Laidlaw Educational Publishers.

[42] PIZZINI, E. L., SHEPARDSON, D. P. and AHELL, S. K. 1989. A rationale for the development of a problem solving model of instruction in science education. *Science Education*, 73(5): 523–534.