

Constructivism in the Classroom: Epistemology, History, and Empirical Evidence

By William J. Matthews

Over the previous two decades the emergence of post-modernist thought (i.e., radical constructivism, social constructivism, deconstructivism, post-structuralism, and the like) on the American intellectual landscape has presented a number of challenges to various fields of intellectual endeavor (i.e., literature, natural science, and social science) (Matthews, 1998; in press). Nowhere is this challenge more evident and therefore more problematic than in the application of post-modernism (in the form of constructivist teaching) to the classroom. Employing constructivist teaching practices is problematic at two levels: (1) there is an absence of empirical evidence of effectiveness; and (2) employing this approach for which there is a lack of evidential support, means not employing instructional practices for which there

is empirical support. The purpose of this article is to present an overview and critique of constructivist teaching practices, followed by a brief review of evidenced-based practices in teaching.

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What is Constructivism?

There are numerous variations and definitions of post-modernist thought of which constructivism is a

subset (e.g., radical constructivism, social constructivism, and deconstructivism). With regard to educational practice, the theoretical perspective of Jean Piaget has had a significant influence. However, Piagetian constructivism is a subset of a larger historical challenge to modernist notions of objective reality in general and the use of empirically validated methods of teaching specifically. Much of American postmodernist/constructivist thought can be traced to the French philosophers, Jacques Derrida and Michael Foucault, whose views achieved prominence during the social upheaval in late 1960s France (Gross & Levitt, 1994).

Derrida founded the deconstructivist school of textual analysis. At its root, deconstructivism holds that true linguistic meaning is not possible. According to Derrida (c.f. Derrida, 1992), the notion that language in any way copies or reflects reality is simply false. There is no reality independent of text and text itself is without stability. Foucault, a philosopher of history, and like Derrida, was concerned about the problem of language and its attempt to construct reality. Foucault contended that social authority and power is itself created through language. As such, all human thought is trapped by the language in which it is encased (c.f. Foucault, 1973). Interestingly, Foucault came to this view after carefully examining the facts of social history — the implication being that there are *facts* to be observed in social history. While there are variations, post-modernist/constructivist thought argues that reality is: (1) socially constructed; (2) constituted only through language; and (3) organized and maintained through narrative (Anderson & Goolishian, 1988; Freedman & Coombs, 1996; Gergen, 1985, 1991; Kvale, 1992). In its essence, constructivism (a subset of post-modernist thought) contends there are no essential truths, and no objective reality (Gross & Levitt, 1994; Matthews, 1998).

The Problem of Constructivism

Whether stated explicitly, or as more often the case, implicitly, the implications of an epistemological view that contends there is no objective reality has a profound effect on how the process of education in the classroom is approached. An important and necessary question in the educational process must be, “How does one establish and evaluate knowledge?” In order to answer this question, we inherently assume that: (1) there is some correspondence between language and reality; (2) our propositions about our observations are logically coherent; and (3) there is a reliable and systematic method of testing our observations. If there is no reality other than that constructed by language and our narrative lacks internal coherence then the two criteria for verifying any observation have been eliminated and one is left with a relativistic nihilism.

This relativism makes no distinction between objective (i.e., verifiable) knowledge (e.g., astronomy) and superstition (e.g., astrology). As such, the merits of a given perspective are resolved through discourse (the methods of science being one form of discourse) within a particular community (i.e., the scientific or astrological)

(Gross & Levitt, 1994). In the absence of a verifiable reality not only are the tenets of science reduced to a relativistic narrative, so is, for example, history. The anti-realism of constructivism allows for historical revisionism independent of verifiable historical data (since such data are merely constructed). Thus, for example, the heinousness of American slavery becomes only one of many narratives deserving no more legitimacy than other possible narratives (e.g., that of the slaveholder).

There are no reasoning individuals who view slavery as anything but inhumane and brutal. With regards to American slavery, in order to make the argument of its horror, one must refer to the verifiable historical record. However, in so doing one assumes a correspondence between language and reality and that the historical text is determinant (i.e., contains an internal logical coherence). To argue otherwise places one in the untenable position of denying the historical record. How did constructivist thinking emerge in educational practice? Prior to considering the implications for constructivist notions in educational practice, let us consider the historical and epistemological context for much of today's constructivist thought.

The Historical Influence of Developmentalism

As stated earlier, constructivism as applied to education is a relatively recent phenomenon primarily derived from the work of Swiss developmental psychologist Jean Piaget (1973) and Russian psychologist Lev Vygotsky (1978). However, its underlying principles have had a long history in American education influenced by the developmentalist notions of 18th century French philosopher Jacques Rousseau, and later, the theories of John Dewey, G. Stanley Hall, and Arnold Gesell (Stone, 1996). Developmentalist teaching practices emerged as a reaction against the harsh educational practices employed in 18th and 19th century Europe and America. Understandably, few would describe the Puritan approach to education of children in the American colonies as particularly laudatory.

In its broadest conceptualization, developmentalism is a philosophical view that holds the individual's social, emotional, and cognitive development is the result of a progression of natural tendencies which have occurred as a result of natural selection and evolution. Developmentalist educational practice assumes: (1) humans have a natural proclivity for learning which is the result of the Darwinian process of natural selection; (2) there is a specific danger of interfering with these natural tendencies, the result being that; (3) learning experiences should emulate those believed to occur naturally.

In American education, few have had a greater presence or a continuing effect than John Dewey. For Dewey, since evolution had provided humans with certain naturally occurring characteristics evolved to fit certain naturally occurring contexts, teaching was a matter of providing the context for the child in which his or her naturally occurring characteristics could be optimized for the child's growth. Dewey stated, "Since growth is the characteristic of life, education is all one with

growing; it has no end beyond itself. The criterion of the value of school education is the extent in which it creates a desire for continued growth and supplies means for making the desire effective in fact" (cited in Stone, 1996, p.18). Dewey held that since the educational process was by definition, a function of naturally occurring developmental processes unique to a given child, the child's educational development had to emerge from the child rather than from an external agent (i.e., teacher) (Stone, 1996).

Without question, Dewey was a major force for progressive education in the United States. While his developmentalist theory was based more on common sense and anecdotes than empirical research, he provided the philosophical impetus for the neodevelopmentalists who followed, such as Jean Piaget, Lev Vygotsky, Carl Rogers, and Abraham Maslow, to name but a few. While each of these individuals had their own perspective on human development, they shared a common belief with Dewey's progressive approach to education, the purpose of which, in regards to education, is to facilitate the naturally developing tendencies and potential of the child.

In considering the key research findings of the developmental research of Erikson (1963), Piaget (1973) and, Vygotsky (1978), one typically finds a stage-based theory which suggests that children exhibit different interests, as one would expect, at different stages. Thus, during infancy the predominant activity involves emotional contact, at age two the child is involved in object manipulation, from ages three to seven years role playing develops, and from age seven to eleven years formal study in school occurs. Of course, in each of these theories, development continues through later maturity.

These findings of developmental research have been directly translated into educational (i.e., instructional) practice. Developmentalist practice can be found in "child-centered," "progressive" teaching practices in Canadian schools, "progressivism" or "Plowdenism" in the British schools (Stone, 1996), and developmentally appropriate practice advocated by early childhood educators (e.g., Carta, Schwartz, Atwater, & McConnell, 1991, cited in Stone, 1996). "Learner-centered" teacher education and "discovery learning," common to many colleges of education, are yet other examples of developmentalist practice as are the principles common to constructivist teacher education (e.g., authentic learning, hands on learning, context-based learning). Important to note for the present discussion is that while whole language and literacy emergent approaches to reading are not explicitly developmentalist, they do share similar perspectives in that these approaches to language literacy emphasize a natural, child-centered approach in learning to read.

Developmentalist practice suggests not only that an interventionist approach to a child's education would be ineffective but is likely to cause harm. Both the National Education Association and the National Association for the Education of Young Children are quite clear that the process of education is not only more important than performance but that to emphasize performance may be damaging to a life long learner (cited in Stone, 1996). The implications of developmentalism have given rise to a seeming reluctance on the part of many teachers and parents to

take direct responsibility for influencing the child's learning and educational development. However, the basic assumption of child-directed learning is not directly assessed but simply taken as an a-priori belief. The result of unchallenged developmentalist notions have provided a, "powerful restriction on scientifically informed educational improvement and more broadly on teacher and parent efforts to influence the developing child" (Stone, 1996, p.9). The remaining sections of this article will provide an alternative argument to the basic assumptions of developmentalism as they apply to constructivist teaching practice.

A Misunderstanding of Evolutionary Theory

The aforementioned principles of developmentalism reflect a basic misunderstanding of evolutionary theory and natural selection. The developmentalist notion is that native tendencies and characteristics (i.e., behaviors such as oral language, problem-solving, and pattern seeking) are desirable since such tendencies and characteristics exist as a function of natural selection. As such, since these behaviors would seem to occur naturally based on the development of the child, teachers can facilitate but should do nothing to interfere with them.

While empirical evidence would certainly suggest that humans have a natural proclivity to adapt to the environment as a function of natural selection, this evolutionary process has nothing to say about such recent human behavior as writing, computation, etc. That is to say, evolutionary adaptation is based on a process that occurred eons ago in the so-called environment of evolutionary adaptivity (EEA). From an evolutionary perspective current human behavior (e.g., aggression, mate selection, avoidance of predators) can be understood as a function of adaptive problem solving required in the EEA. Thus, evolutionary theory (cf. Diamond, 1992) on the development of language would suggest that oral communication was a function of natural selection which increased the likelihood of reproductive survival of the individual and the likelihood that those offspring would possess the genetic predisposition to speak.

This perspective says *nothing* about the development of such distinctly human skills as reading, writing, and the use of computers since such abilities are recent developments in human history and are not yet affected by the slow process of evolution and natural selection. Therefore while language has been shown to develop as a function of immersion (at least for the child) and requires only implicit direction, there is no evolutionary or scientific basis to assume the same is true for the skill of writing or mathematics. In fact the evidence strongly suggests that both skills are a function of explicit learning strategies and instruction and are unlikely to develop through only immersion for most children. Gough and Hillinger (1980) argue that literacy is an "unnatural act" and as such "training plays a far greater role in the learning process than it does for something with such a large biological contribution as language" (Foorman, 1995, p. 378). The overwhelming preponder-

ance of research strongly suggests that phonological awareness is highly predictive of reading achievement and that phonological awareness is set of skills necessary for successful reading achievement (Adams, 1990; Foorman, 1995; Grossen, 1997; Liberman & Liberman, 1990; Stanovich, 1986). Thus, while some aspects of human behavior are the consequence of natural selection in interaction with the environment, the assumption that all aspects of human behavior (e.g., reading and computation) are the result of natural selection is simply unwarranted based on the extant empirical evidence.

Education as a Scientific Endeavor

While most would agree with the developmentalist notion that the purpose of schooling is to foster human development, how this is done is viewed quite differently depending on one's epistemological assumptions. Significant differences emerge between developmentally appropriate practice and what can be termed educationally appropriate practice. Broadly defined, educationally appropriate practice are those teaching practices that focus on the instructional level of the learner without constraint of developmental theory. As such, the focus shifts from primarily a within-child developmental focus to an emphasis on the environment in which instruction occurs (i.e., teacher behavior) and curriculum (i.e., instructionally appropriate level and materials) (c.f. Carnine, Silber, Keemenui, 1996).

Underscoring the notion of educationally appropriate practice is the perspective that schooling is considered an intervention, designed to produce some observable, identifiable change on a range of different socially valued dimensions in the child's development (Deno, 1995). As an experimental intervention, schooling is expected to produce a significant effect relative to a no treatment control group (e.g., children who do not attend school). Individuals, trained as teachers, are given the specific responsibility to enhance the expected effect of attending school.

However, this seemingly straightforward notion of the interface between science and educational practice is not universally accepted by all educators. For example, Eisner (1999) suggests that over time the notion of research has broadened and science is recognized as one of many types of research. From Eisner's perspective, educational research does not belong only to the domain of science. In refuting this view, Mayer (2000) argues for the importance of keeping educational research firmly in the domain of science because to do otherwise would: (a) slow progress in educational theory and practice; and (b) diminish the reputation of the field. To Mayer's points I would add that to employ a particular educational practice (e.g., adoption of a particular curriculum, use of various assessment instruments to measure student achievement and/or for the classification of students with learning problems) in the absence of empirical data could be considered unethical, an inefficient use of limited educational resources, and as such, a potential disservice for the students who are at the mercy of such interventions.

Educational theory must undergo empirically based tests of refutation. In so doing, the self-correcting mechanism of the scientific method provides a process in which a particular theory and related practice can be accepted, modified, or discontinued. While few would disagree with the notion that science exists within a political context (i.e., which research receives funding, which does not), the scientific method is apolitical (i.e., employing tests of refutability based on internally coherent logic and systematic empirical observation). As Mayer (2000) observes, artists often seek to explore many of the same issues as the social scientist and often do so in illuminating and meaningful ways. However, a brilliantly written novel about the expression of human emotion and behavior does not constitute educational/psychological research upon which educational practice can be based. The notion that science is but one of many equally valid ways of understanding the naturalistic phenomena of the universe is reflective of the relativism discussed earlier and underscores constructivist educational practice. This view weakens the reputation of the field both in academia and in society in general. Let us now consider the key assumptions of constructivist educational practice and the empirical evidence regarding these assumptions and practices.

Constructivist Assumptions in Education:

Considering the Data

Developmentalist notions of the natural proclivity toward learning and the importance of not interfering with the natural learning process are key assumptions that underpin current constructivist teaching practices. One key notion contends that since the learner has an active role in interpreting the learning process, education *should be child directed not teacher directed*. According to Piaget (1973), children, as operational thinkers, progress through three stages of thinking: preoperational, concrete, and formal operational. Based on the assumed reality of these stages, *constructivist teachers need to adapt their teaching style, approach, and content to the specific developmental stage of the child*. As Waite-Stupiansky (1997) states: “Children need to progress through levels of representation at a rate that fit their levels of understanding. If highly abstract symbols are presented too quickly, such as flash cards with words printed on them, children may achieve only a surface-level of memorization without deeper understanding” (p.9).

Related to the above notion of the importance of deeper understanding in learning is the assumption that *social interactions and context is necessary for learning to occur*. Again Waite-Stupiansky (1997) states, “The context provided by social interactions among peers is a natural learning environment in which logical reasoning can develop. The feedback is usually immediate and the motivation to succeed is high” (p. 22).

Constructivist teaching practice assumes *the motivation to learn is internally generated by the child*. Waite-Stupiansky (1997) states, “Extrinsic rewards, fear of

punishment, and traditional grading systems work against the child's intrinsic motivation to make sense out of the world. If children work toward pleasing the teacher instead of satisfying their natural search for understanding, they will not progress toward intellectual autonomy" (p.23).

The aforementioned notions, in their current form, are value statements. However, with a little clarity regarding measurability and an operational definition or two, irrefutable value statements become empirically testable hypotheses. Constructivist teaching practices are relatively clear about the underlying assumptions however there is considerably less clarity regarding the empirical validity of those assumptions.¹

As mentioned above, a key notion in constructivist teaching is the importance of matching teaching style to student learning style. This idea has been referred to in the psychological literature as "aptitude by treatment interactions" (ATI). ATI is an idea, which has held great intuitive and practical appeal in the area of applied psychology. For latter half of the 20th century, the ATI approach has been the driving principle of special education. Thus for children who demonstrate problems in learning, various standardized tests (e.g., the Weschler Intelligence Scales for Children) have been used in an attempt to diagnose an underlying learning deficit (e.g., auditory processing) for which a specific treatment intervention will be applied. However, to date after much scientific effort, there is simply no empirical evidence supporting the notion that matching teaching and learning style has any effect on any educational outcome (Cronbach, 1957, 1975; Kavale & Forness, 1987; Yesseldyke, 1973). Matching teaching style to the child's aptitude for the general or special education student, while a tenet of developmentalism and constructivist practice, is not an empirically defensible practice.

A second assumption discussed earlier is the claim that context is necessary for learning to occur. The claims for contextualized learning are overstated and reject the huge body of research on the importance of decontextualized learning, as anyone who has ever played tennis, a musical instrument, or learned to drive a car will attest. There is well documented evidence that: (1) human cognitive processing breaks down large tasks into smaller ones; and (2) learning transfer and generalization occur and are more efficient than only stimulus specific context learning (c.f. Stone & Clements, 1990). For example, with regard to the use of context in early reading development, there is strong empirical evidence that suggests not only do poor readers use context but they show larger contextual use when compared to strong readers (c.f. Stanovich, 1986). Thus the whole-language based notion that the skilled reader barely looks at the words on the page (Smith, 1973) when subjected to empirical testing failed to receive support.

Finally, developmentally based educational proponents argue that drill, corrective feedback, and the use of incentives are inhibitory to the naturally occurring learning process (e.g., Deci & Ryan, 1985). However, a comprehensive review of the research literature by Cameron and Pierce (1994) concluded that the data simply

do not support the assertion that external incentives should be eliminated from the classroom. Most school psychologists and special educators have known the value of positive reinforcement for years. For example, in a comprehensive review of experimental interventions employed over the previous 30 years with students identified as learning disabled, Swanson and Hoskyn (1998) found significant and large effects for direct instructional models (i.e., skills-based behaviorally oriented instruction) with this population. The empirical literature is replete with considerable support for the claims that increased instructional time is directly related to improved student performance (c.f. Paine et al. 1983), external reinforcers can increase achievement performance (Cameron & Pierce, 1994), students can and do learn in decontextualized settings (c.f., Stanovich, 1986; Stone & Clements, 1998), and specific skills are required for various aspects of learning (e.g., phonological skills and reading fluency) (c.f. Adams, 1990; Stanovich, 1998; Foorman, 1995; Gough & Hillinger, 1980).

One might ask why the gap between evidenced-based and developmental/constructivist teaching practice? The answer lies in the fundamental and conflicting assumptions of each view. The goal of science is to eliminate error variance, or bias, in the explanation of the effect of the independent variable on the dependent variable. While such error variance or alternative explanations can never be entirely eliminated, through careful experimentation and based on probabilistic statements generalizable causal inferences can be made which have utility to inform the practice of teaching and student learning. However, as stated earlier, notions of an observable and objective reality are in direct conflict with the basic assumptions of a developmental/constructivist worldview. The developmental/constructivist *belief* is that learning is the result of an emergent process. Any process that is contrary to the belief in emergent learning is met with (non-empirical) skepticism. Since beliefs are not testable propositions, scientific methodology and its resultant data typically have little meaning for the developmental/constructivist educator.

What Works in Promoting Academic Achievement?

The assumption of this article is that since education is an expensive intervention in the child's development it is legitimate to ask what constitutes effective educational practice? In the absence of experimentally derived evidence to support a given theory, one is left with only speculative or anecdotal conjecture at best. Interestingly most teaching method texts have little to say on the necessity of experimental validation to support claims of effectiveness for a given instructional pedagogy or theory. In a review of textbooks widely used for primary, middle, and secondary teaching approaches to educational practice, Stone (1996) reported that these texts, "give little weight to experimentally demonstrated results as a basis for identifying effective teaching practices. Instead, they present an eclectic assortment of approaches colored by distinct distaste for methods that are structured, teacher-

directed, and result-oriented — characteristics that exemplify the experimentally vindicated approaches to teaching” (p.4). Stone’s observation notwithstanding, let us consider a review of teaching practices which have empirical support.

Project Follow Through was the largest experiment in education ever conducted (Stebbins et al. 1977). The project was begun in 1968 and completed in 1995. Over 75,000 children from 170 different communities participated in a project designed to systematically evaluate different approaches to educating children assessed for risk of academic failure in grades K-3. Nine models of education were compared to each other and to school districts used as no treatment control groups. Student outcomes were assessed on the Metropolitan Achievement Test, the Wide Range Achievement Test, the Raven’s Colored Progressive Matrices, the Intellectual Achievement Responsibility Scale, and the Coopersmith Self-Esteem Inventory.

Seven of the teaching models were based on learner-centered, cognitive/conceptual approaches to education (e.g., Cognitively Oriented Curriculum, Florida Parent Education Model, Tucson Early Education Model, Banks Street Model, Open Education Model, Responsive Education Model). Two of the models were teacher-centered, skill, behavioral, and outcome-based (Direct Instruction Model, Behavioral Analysis Model). The results were quite clear. The two teacher-centered outcome-based models significantly outperformed the learner centered/constructivist models on all the dependent measures. Perhaps more importantly, five of the learner-centered models did more poorly than the comparison no-treatment control groups. Interestingly, the outcome measures used included assessments not only of basic skills (e.g., MAT, WRAT) but measures of self-esteem and higher-order cognitive skills. The Direct Instruction and the Behavioral Analysis models outperformed the other models *even on those outcomes valued in the learner centered approach* (i.e., self-esteem and higher order cognitive skills). Remarkably, these data, while clear, have had little effect on the practice of American education. Yet, as observed earlier, the educational achievement of students continues to flounder, the functional illiteracy of our high school graduates is unacceptably high, and American students compare poorly with students from other industrialized countries in the areas of math and science.

Teacher-Centered vs. Student -Centered Approaches to Student Learning

In her last book, Chall (2000) reviewed the research of the last century regarding teacher-directed and student-directed approaches to learning. She described the teacher- centered approach as more formal, focusing on established standards (e.g., norm referenced tests, grades, formal and informal tests) for each grade level, in which the entire class is moved through the curriculum by teacher-lead activities. In contrast, the student-centered approach attempts to follow student interests as much as possible, integrating materials across subject areas. The teacher

is seen as a facilitator of learning, where students are permitted to move around freely, use of time is flexible rather than structured, and evaluation compares learners to themselves rather than to peers, with a deemphasis on formal testing. The student-centered approach is consistent with a constructivist teaching approach.

In summarizing her findings in the empirical literature, Chall (2000) noted that:

- (1) The effects on academic achievement (i.e., reading, writing, mathematics) of a teacher-centered educational approach was generally found to be more effective than the student-centered educational approach.
- (2) Research that compared the two approaches found an interaction with social class such that teacher-centered approaches were particularly beneficial for lower SES children. The data on the effect of the two approaches were either equivocal or non-existent for middle-class children. Interestingly, some data suggest that the student-centered approach may have a negative effect on the achievement level of low-SES children who are unable to engage in the desired behaviors required by this approach.
- (3) The advantages of individualized learning (i.e., different pace for different children, choice of what and how to learn about a topic, and learning style differences) have not found empirical support. This finding was particularly true for lower SES children.
- (4) Learning by groups and by teacher-led instruction leads to higher achievement.
- (5) The methods (derived from the work of E.I. Thorndike and B.F. Skinner) which have the greatest positive effect on achievement use cues, engagement, corrective feedback, and reinforcement and are more likely to occur in a teacher-directed context.
- (6) While there is a paucity of data on the comparative effects of teacher-centered and student-centered approaches at the secondary level, Chall speculates that the achievement effect of the teacher-centered approach would be predicted to be greater at the primary level since the elementary grades focus on skill acquisition and the secondary grades focus more on reasoning and problem solving.

Connecting Science and Educational Practice

As medical patients, we demand physicians be continuously informed by findings of current medical research. Few people would be comfortable in seeing a physician whose treatment approach to cancer was limited by the knowledge available during medical school training in 1970. What we do in education is, in many respects, worse. Teachers are typically not trained in the use of scientific methodology and as result are limited in their ability to evaluate the latest educational fad thrust upon them. In the absence of a verifiable method of data-based decision making, teachers and school administrators are left with unsupported beliefs, anecdotal experiences and/or current sociopolitical philosophizing regarding the value of various educational practices. Schools of education, with

some exceptions, have failed to train teachers in the application of the scientific method to the field of education, while continuing to espouse empirically unsupported developmental/constructivist teaching practices.

As such, it would seem reasonable to suggest that pre-service teacher education include training in the scientific method, such as, how to conduct research, how to control for threats to internal and external validity, and how to evaluate data. Relatedly, teachers and administrators are under intense pressure from parents, school boards, and state boards of higher education to improve student achievement as measured by high-stakes standardized tests. Teachers often respond to such pressure with a call for “authentic” and/or “performance based” assessments, yet seem to understand very little about the tenets of test construction, and interpretation. Teacher education curricula need to inform prospective teachers on the basics of test construction, test reliability, and issues related to construct validity. Finally, as an example to consider from another field, clinical psychology training programs approved by the American Psychological Association are required to teach at least two empirically validated methods of psychotherapy, in addition to any other approaches that may be taught. It would seem no less reasonable for schools of education to require their teacher education program to also teach two empirically-validated methods of pedagogy in addition to other experimental approaches. Physics, chemistry, biology, sociology, and psychology require verifiable empirical observation to support or reject a given theory or hypothesis. Those who are trained in these fields are steeped in the scientific tradition of knowledge construction. On what basis do we require less of our teachers and schools of education?

Note

¹ It is not within the scope of this article to provide a comprehensive review of the empirical literature on effective teaching practices. As such, the reader is provided with key citations which present overviews of the relevant empirical literature.

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