What do different perspectives on epistemology tell us about teaching and learning?

Ozden Sengul[1]

1 Bogazici University

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

> Literature provides several definitions of epistemology in diverse structures and developmental levels. The differences in epistemological perspectives lead to different methodologies in educational research. The methodological and epistemological diversity bring the question of how teaching and learning should be planned and occur in real classroom settings. This article discusses epistemological traditions and their contributions to teaching and learning in education.

Epistemology- as the branch of philosophy approaches the definition of knowledge in different ways. In *"The Theaetetus of Plato,"* knowledge is defined as perception; immediate perception is knowledge. In the context of Plato's knowledge, reality depended on perception that supports existentialism and the existence of multiple truths. In traditional approach, truth condition depends on "S knows that proposition if and only if S believes that proposition and S justifies that proposition." However, Dewey (1938) refused the traditional model of knowledge and referred epistemology as a valuable area of inquiry. Dewey, from a pragmatist perspective, defined knowledge as the result of situated process that requires time and achievement and involves habitual acts. Habitual activities are defined as daily routines as the activities done without thinking, but Dewey also defined non-routine habits that are the processes of how to solve a problem. Although Hegel has a certain model for problem-solving including "thesis-antithesis-synthesis" or "claim-question about the claim-solution/resolution," Dewey does not provide certainty for problem solving and provides multiple ways of interaction that may lead to different experiences and growth.

Inquiry is not static. Dewey supported the idea of "warranted assertibility" to represent an area of inquiry that is away from the traditional view of "pure knowledge." Dewey focused on "knowing" rather than "knowledge"; knowing as an activity to solve problems and knowledge refers to successful inquiry as the stabilized beliefs. Knowledge can be fallible in the process of making judgments, knowledge represents temporal suspension; it is tentative and situated within the context (concrete situatedness). In this view, it is important for teachers and students to engage in the practice of continual thinking to be active inquirers of the problems and defend their claims.

Boghossian (2007) addresses science as different ways of knowing the world: "The truth of a belief is not a matter of how things stand with an "independently existing reality"; and its rationality is not a matter of its approval by "transcendent procedures of rational assessment." Rather, a belief is knowledge necessarily depends at least in part on the contingent social and material setting in which that belief is produced" (p. 6). A belief about knowledge and learning is always a function of the contingent social setting in which it is produced; beliefs about knowledge and learning vary with domain and context. This notion of knowledge addresses different epistemic systems that can contradict to each other. It is possible for an epistemic system to fail to be coherent and to accept alternative systems based on objective and valid reasons.

In "*The Postmodern Condition: A Report on Knowledge,"* Lyotard (1984) addresses the role of knowledge in a computerized society. The nature of knowledge is transformed as society is progressed and caused knowledge to be more commercialized. This caused the decrease in productivity at laboratories and universities, and at the same time, lead to the demoralization of scientists. From a postmodern perspective, knowledge cannot be reduced to science or learning; learning involves different experiences and science is the subset of learning. Knowledge includes notions of "know how, knowing how to live, how to listen." Scientific knowledge addresses one type of language game depending on accuracy and proofs. Scientific knowledge is privileged as positivistic and includes prescriptions that increase the power of technology and reduce the human involvement in the problem-solving process. However, scientific knowledge has the capacity to form a social bond between society and the people through challenging people to think in different ways. Scientific research should interact with moral and political life and address the needs in the society.

In "*Ecological Thinking,*" Code (2006) rejects the notion of epistemic monoculture and opposes the practices of schooling as reinforcing individualism rather than collective meaning making. Code tries to create a conceptual framework for a theory of knowledge that is sensitive to human and historical-geographical diversity involving multiple epistemologies. In this perspective, it is difficult to have a unity of knowledge assumption; knowledge produces a human history of knowing, in which subjectivity is stronger. According to Code, schools supports the spectator theory of knowledge through standardized approach including content and method; students are required to learn necessary skills to get a job in the global marketplace and provide correct answers for similar questions. Code supports the idea of epistemic responsibility to reinforce scientific rationality and debate; teachers should be aware of what it means to teach for diverse communities to learn and to know. Schools should be places for exploration that address both context and student background as central component of process of knowing. Similar to Dewey, individualism and individuality are identified differently: individualism addresses the self-centeredness whereas individuality includes the individual while recognizing the world and people around the person. Therefore, from ecological perspective, natural sciences and social sciences should address epistemic, ethical and political concerns and inform each other.

In "*Knowing and Learning as Creative Action*," Stoller (2014) also refuses the "S knows that p" (SP) thinking model as the spectator theory of knowing. Stoller addresses Freire's banking model of education, in which students are the depositories and teacher is the depositor; students receive/memorize/repeat the information with lack of creativity and through the transformation of knowledge. Stoller thinks that SP model moves students away from their creative capacities in the process of learning. In the SP model, both person and environment are static and involve discrete objects that operate linearly. SP model eliminates dialogue and critical reflection to develop critical consciousness and hope in students. In other words, according to Stoller, knowledge arises as a result of the emergent conditions of lived experience that addresses objective natural conditions, cultural values and social meanings. The world is reducible to different discourses. Through referring to *Bildung*, Stoller defines knowledge that transforms both the individual and the larger community into an ongoing, ever-present dialogical motion. *Bildung* strives for a universal foundation of knowledge through critical thinking and creative action. It aims to develop a capacity for empathy and attempts to describe a way of becoming enculturation, recognize the cultural heritage and develop a capacity to transform the culture. *Bildung* is an action to contribute to the reconstruction of the current processes of subjectification and resistance to the production of dehumanization. *Bildung* involves history and carries history forward to transform and take reconstructive action;*Bildung* suggests active production and dialogic engagement between knowers and knowledge. Therefore, it is important to reduce the power within the classroom, reduce epistemological certainty, involve students and enhance student empowerment through shared control- giving students' roles in the construction of curricular activities. *Bildung* suggests a transformative education that requires a literal engagement with the world and places students into dialogical problem situations to empower them to take action and dialogically reconstruct themselves and the world around them.

The guide of different perspectives presented above has discussed the meaning of knowledge. It is difficult to have a certain epistemological perspective that can be taught to everybody. Different epistemological perspectives are legitimate in different contexts, and individual perspectives are influenced by the specific context. There are different perspectives on the nature and resources of knowledge based on the epistemological approaches to understand what knowledge is and how it is constructed. Some may treat knowledge as certain; others may treat as tentative or constructed depending on the context and domain. For example, in a classroom, students' epistemological perspectives inform the teaching and generation of knowledge claims. Teachers should develop strategies to elicit students' epistemologies through different approaches such as written, valid test instruments or interactive interviews. Teachers should promote different epistemological perspectives through diverse teaching strategies for empirical processes such as argumentation (supporting knowledge claims through evidences and justification). Teaching activities should promote student participation and make linkage between different practices and knowledge claims. Curricular activities should be designed to promote student participation and enhance knowledge generation. Students should be involved in learning situations that can enhance their participation and engage them into authentic scientific practice. This requires the selection of specific content knowledge and making particular features of epistemology explicit for students. Rather than forcing students to memorize certain facts, students should be guided to engage in practices of asking questions, predicting, evaluating explanations, constructing knowledge and critique, developing models, manipulating calculations and making links among those practices.

In science education, "epistemological knowledge" refers to the personal knowledge or personal epistemology that individuals use in given situations; this type of knowledge is also referred to "epistemological beliefs." Students have different beliefs to learn science that influence their knowledge construction. Students' epistemologies result in thinking science as consisting of certain facts and formulas. This epistemic framework influence their science learning and development of reasoning and scientific knowledge. In science classrooms, instead of accumulating the knowledge structures, they should engage in the cognitive, epistemic and social processes and learn how to communicate, represent the scientific knowledge. Teachers should be aware of the epistemologies that students bring to the classroom and implement instructional methods and curriculum materials accordingly. There may be no certain prescription for different epistemological perspectives, but teachers should give students opportunities to engage in science learning across three domains, cognitive, epistemic and social domains, to make students' thinking evident. Successful learning may include coherency, independence and the conceptual understanding rather than memorization. Beliefs about knowledge and learning may vary within a specific domain and context; knowledge is contingent on context and perspective. These perspectives should move the students from individuals (being self-centered) to individuality and give them opportunity to recognize their knowledge claims and make comparisons with people around them or within a society. A perspective on students' epistemology may provide teachers alternative lenses to improve instruction, curriculum and assessment and adopt the lesson based on students' needs.

According to Disessa (1988, 1993), specialization in physics education developed in parts depending on the knowledge-in-pieces perspective. This perspective argues that knowledge items have more diverse and small parts rather than the traditional and general approach available in textbooks. Growth and change involve both constructing and coordinating various knowledge items structurally. These elements are considered as ideas, models, concepts and categories that are not within the organized knowledge systems. Students' problem-solving skills may vary depending on the context: they may be able to solve a problem in one context but may not have enough knowledge to solve a problem in another context. It is therefore crucial to design instruction to promote productive activation of these knowledge elements in appropriate contexts.

Collins and Ferguson (1993) suggested the "*epistemic games and epistemic forms*" as a guide to inquiry process. In physics education literature, Tuminaro and Redish (2007) addressed epistemic games as two ontological components including knowledge base and epistemological form:

> *An epistemic game is not simply a structure or a set of associated knowledge; it is a pattern of activities that can be associated with a collection of resources. The collection of resources that an individual draws on while playing a particular epistemic game constitutes the knowledge base. The epistemic form is a target structure, often an external representation that helps guide the inquiry during an epistemic game (pp. 4-5).*

Students' epistemological stances may influence the way of solving the problems. Tuminaro and Redish (2007) defined different approaches to solve a physics problem as epistemic activities:

i. Mapping meaning to mathematics: Students work on a problem statement towards reaching a qualitative solution while relating mathematical symbols with conceptual understanding.
ii. Mapping mathematics to meaning: Students work towards developing a conceptual story from a mathematical equation
iii. Physical mechanism game: Students develop a story based on physical principles, not equations
iv. Pictorial analysis game: Students develop representations to construct a conceptual story
v. Recursive plug-and-chug: Students do not construct a conceptual story, but use quantities into physics equations to seek for numerical answers rather than conceptual understanding.

vi. Transliteration to mathematics: This addresses the similar kinds of problems that students can easily use equations for solution without having a conceptual understanding.

Is problem-solving limited to some activities in a specific domain? Can personal epistemology depend on the expectations or practices of a domain? According to Duschl (2008), science learning should focus on conceptual structures and cognitive processes to reason scientifically, address epistemic frameworks of individuals for the development and evaluation of scientific knowledge claims, and engage in social networks to shape the knowledge through communication and argumentation. Teacher education should put emphasis on how prospective teachers can develop to understand or be aware of possible counterproductive epistemologies implicit in instructional methods and curriculum. Teacher beliefs should be addressed to help them perceive diverse student needs and choose possible instructional intervention.

The questions for discussion are "How can we use an epistemological framework in teacher education?" "How should we use an epistemological approach in a specific domain (science, physics or mathematics or social sciences etc.) to improve teaching and learning processes?"

References

- Boghossian, P. (2007). *Fear of knowledge: Against relativism and constructivism* Clarendon Press.
- Collins, A. & William, F. (1993). Epistemic forms and epistemic games: Structures and strategies to guide inquiry. *Educational Psychologist*, 28, 25-42.
- Dewey, J. (1938). *Experience and Education.* New York: Macmillan.
- DiSessa, A. A. (1988). Knowledge in pieces. In G. Forman & P. Pufall (Eds.),*Constructivism in the computer age* (pp. 49-70). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- DiSessa, A. A. (1993). Toward an epistemology of physics.*Cognition and instruction*, *10*(2-3), 105-225.
- Duschl, R. (2008). Science education in three-part harmony: Balancing conceptual, epistemic, and social learning goals. *Review of research in education*, 32, 1, 268-291.
- Lyotard, J. F. (1984). *The postmodern condition: A report on knowledge* (Vol. 10). U of Minnesota Press.
- Stoller, A. (2014). *Knowing and learning as creative action* (pp. 55-75). Palgrave Macmillan US.
- Tuminaro, J., & Redish, E. F. (2007). Elements of a cognitive model of physics problem solving: Epistemic games. *Physical Review Special Topics-Physics Education Research*, *3*(2), 020101.