



Knowledge Facilitating Epistemic Game Moves

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Abstract: This paper introduces a new category of knowledge, which integrates ideas from two existing frameworks: *epistemic forms and games* and *knowledge in pieces*. This category features knowledge elements that facilitate the enactment of moves made in epistemic games. Resources for *epistemic game moves* work synergistically with epistemological and conceptual resources during the enactment of epistemic games. The paper introduces the two foundational theoretical frameworks and then introduces the new category of knowledge.

Introduction

The importance of prior knowledge in learning is widely accepted. Constructivist perspectives view students' pre-instructional knowledge as abundant with resources for the construction of more formal knowledge. Research has documented resources for building knowledge of different kinds across a range of domains. This includes resources for developing both *conceptual* and *epistemological knowledge* (Goodhew et al., 2019; Hammer & Elby, 2002). Yet other research has documented resources for productive engagement in *scientific practices*, including argumentation (Hudicourt-Barnes, 2003), inventing and critiquing representations (diSessa et al., 1991), and conducting scientific inquiry (Warren et al., 2001). While this body of work describes a rich terrain of moves students enact during their productive engagement in scientific knowledge-construction practices, it does not model the knowledge underlying these moves. This paper offers a first-iteration description of knowledge underlying and facilitating such moves.

Theoretical foundations

Collins and Ferguson (1993) characterized the knowledge-building work of scientists as epistemic games. Just as the game of tic-tac-toe is constrained by the cross-hatch structure, epistemic games are constrained by corresponding epistemic forms. The forms are templates, which drive the moves scientists use to fill them out. Collins and Ferguson unpack the example of a list game. The list game is played to fill out the list form, which the scientist uses to answer the question: "What is the nature of X?" Playing the list game consists of moves such as adding elements to the list, removing elements, merging elements that are similar, and decomposing elements into more primitive elements. For example, a scientist trying to answer the question: "What is the nature of the Spotted Owl?" might generate a list of known characteristics including the owl's size, shape, color pattern, diet, and behavior.

Knowledge in pieces (KiP) is a theory of knowledge and learning that views knowledge as a complex system of smaller elements, which are drawn together in networks in response to the sense-making demands of a given context (diSessa, 1993). Novice knowledge systems are highly context dependent, meaning knowledge elements are activated inconsistently across contexts for which experts would draw on the same knowledge. The transition from novice to expert (i.e., learning) is characterized as a process of reorganization and refinement of the knowledge system. For this reason, KiP views elements of novice knowledge as *resources* for the construction of more expert knowledge. A goal underlying KiP research is the construction of theoretical machinery for producing computationally explicit models of human knowledge and learning. Towards this, a number of knowledge categories have been defined and populated with elements. This includes categories of conceptual knowledge (e.g., phenomenological primitives; diSessa, 1993) and epistemological knowledge (e.g., epistemological resources; Hammer & Elby, 2002).

A new category of knowledge

This paper introduces a new category of knowledge, which facilitates the enactment of moves made in epistemic games. For simplicity, I call the elements of knowledge in this category *epistemic game moves*. I hypothesize that these knowledge elements can be more precisely described as primitive elements. A number of these elements facilitate reasoning-specific moves and may therefore be described as reasoning primitives.

Epistemic game moves work synergistically with epistemological and conceptual resources to facilitate the play of epistemic games. Imagine the scientist trying to answer the question: "What is the nature of the Spotted Owl?"



The scientist must draw on epistemological resources to know that the question can be answered by producing a list, and to know the nature of the list form and the rules for filling it out. The scientist must draw on conceptual resources to know the characteristics of the Spotted Owl. The scientist must draw on knowledge of epistemic game moves to fill out the list form by adding and removing characteristics of the owl, and possibly merging and splitting characteristics. Knowledge facilitating the addition and removal of characteristics involves discerning characteristics that belong to the owl's nature from irrelevant characteristics (e.g., number of owl sightings in a given year). Knowledge facilitating the merging or splitting of characteristics involves recognition of similarity.

There are many epistemic games, including temporal and spatial decomposition games, hierarchical list games, compare and contrast games, cross-product games, agent-based modeling, and analogical modeling. Each of these games can be described in terms of moves played to fill out a corresponding form or template. These moves are facilitated by knowledge belonging to the category introduced in this paper. In the case of temporal and spatial decomposition games, the moves involve knowledge that facilitates dividing a larger entity into smaller components. In the case of hierarchical list games, the moves involve knowledge that facilitates organizing elements according to nested relationships. In the case of the compare and contrast game, the moves involve knowledge that facilitates the identification of meaningful similarities and differences. In the case of the cross-product game, the moves involve knowledge that facilitates the organization of elements along multiple dimensions. In the case of agent-based modeling, the moves involve knowledge that facilitates the identification of system elements and the articulation of the rules governing their behavior and interactions. In the case of analogical modeling, the moves involve knowledge that facilitates mapping between elements common to both the phenomenon of interest and an analog. Considering the knowledge underlying the enactment of moves across epistemic games suggests a general relationship to knowledge involved in processes of analysis and synthesis.

Discussion

This work introduced a new category of knowledge, which facilitates the enactment of moves made in epistemic games. By studying the *epistemic game moves* of novices, we can design classroom experiences that build on students' resources to foster their development of expertise with epistemic games. While students' productive engagement in particular epistemic games has been described in the literature, the present work adds to the discussion by characterizing the knowledge underlying the moves involved in these games. The work is only in its infancy and while the theoretical constructs are inspired by classroom data, more systematic investigation is necessary.

References

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