



Ontologies for Human Learning REQUEST FOR PROPOSALS

Ontology has for millenia been concerned with asking what kinds of things exist and how they may be classified and related to one another. In information and computing sciences, ontology typically includes naming and defining the categories, properties and relations between concepts, data and entities.

One can imagine an ontology serving as the foundation of a standardized system for representing human learning experiences. This ontology would enable a diversity of academic and industry researchers to align on ground truths, measurements, and data interpretation from registrations of activities. It could well enable a collective optimization of pedagogies, content, hardware/software systems, and feedback for both physical and virtual learning experiences.

mediaX seeks to fund concept-proving research that can lead to ontologies for human learning. We invite Stanford thought leaders and research groups across all disciplines to propose projects that will establish an **ontological** model of human learning and education.

Proposals can address any of a number of varieties of learning such as explicit or implicit, declarative or procedural, observational or imaginative, and may include physiological/neurological concomitants and embodied cognition.

Proposals should be designed to establish or contribute to an ontological framework that will allow scholars and practitioners to go beyond sequence definition models for content mastery to guided flows for exploration and adaptive learning environments. Potential applications of the ontology might extend to association learning, contextual learning, dialogic learning, holistic judgment, analogical and/or critical thinking, perceptual learning, creativity, performance, or socio-emotional intelligence. We encourage proposals that reference a specific use case for application and have the potential to be applied more broadly.

We welcome proposals for ontologies based on documented expertise as well as those that might be autogenerated using advanced computational approaches with large datasets. Proposals for ontologies that describe knowledge sharing and acquisition in collaborative learning environments are also welcome, as are ontologies with relevance to legal frameworks that describe access to and uses of personalized learning data. We anticipate that progress toward an ontological framework for human learning will support K-12 learning and facilitate the development of metrics for 21st Century learning, living and working success.

INSTRUCTIONS

Proposals from teams including one or more eligible faculty members are invited for projects of \$15K to \$60K, starting no earlier than September 15, 2019 and finishing by June 15, 2020. Awards will be announced the week of September 10, 2019.

By August 19, 2019, 11:00PM PST send a two to three-page description of the research question and plan to address it, identifying potential for thought leadership as well as relevance to the learning sciences and practice, identification of application potential, and including brief bios of the project team, to Elizabeth Wilsey (ewilsey@stanford.edu).

By August 19, 2019 by 11:00PM PST, using the same title as your proposal, separately send a description and justification of requested resources to Elizabeth Wilsey (ewilsey@stanford.edu).



BACKGROUND

Ontologies play an important role in enabling knowledge sharing within domains, and they can facilitate collaboration across domains. An ontology creates a formal framework that describes something by establishing the classes, relationships and constraints that act on concepts and entities within a given system. An ontology is the system of classes and relationships that defines what exists and describes the structure of that data - the rules, if you will, that prescribe how a new category or entity is created, how attributes are defined, and how constraints are established. For example, in *Game of Thrones*, dragons, giants, zombies, and all sorts of other fantastic creatures behave according to established rules. Such rules are important in decisions about how each element interacts with another, influencing overall design and management of metadata.

Another example: the Experience API (xAPI) lets applications share data about human performance by capturing data on human performance, along with associated instructional content or performance context information. By tracking data about combinations of actor + verb + object, xAPI applies human (and machine) readable “activity streams” to provide sub-APIs access to stored information about the state and content of the application. Digital learning tools rely on such information, from user actions as well as embedded sensors, in order to execute the interactive experience.

Today’s sophisticated digital tools can now detect several categories of users’ states, including emotional response, engagement and some contextual cues. In the best of all worlds, this additional information could be leveraged to facilitate learning. Such information could be used by researchers from many fields (neuroscience, psychology, communication, education and computer science, to name a few) as well as by developers and teachers. However, several challenges exist. An established ontology to structure the concepts and metadata of human learning has yet to be developed. Objects being described in mixed reality environments may lack an actual physical representation, and instead refer to traces of physical events that involve one or several entities. Additionally, learning itself includes both a progression of contextualized experiences, as well as an individual learning output from a specific event.

Imagine a world in which metadata about a user’s emotional responses generated in a VR game can be accessed by a curriculum designer to inform a learning intervention. . . In which cognitive skill data from a mathematical instruction app can help pedagogical designers create better tutorial systems and aid teachers in coaching learners. . . In which the sensory perception of the novice musician can be assessed in comparison to a master musician’s manual techniques to guide instruction for beginners. A universal ontology for human learning could make this possible.

Three trends encourage a need for an ontology for human learning: the integration of multiple computing desktops, mobile and immersive media (VR, AR, XR); the near-term explosion of machine learning and big data applications for understanding the world; and workforce shifts that accompany our transition to a knowledge economy. By establishing an ontology for human learning that can be applied to both the physical and the virtual worlds, scholars and practitioners may be able to better collaborate and integrate, therefore accelerating innovations that cultivate engagement, motivation, understanding, and performance for critical thinking, problem solving and social emotional intelligence – key skills for the future.

We recognize the complexity of this challenge. And optimistically, we anticipate that results from projects funded through this RFP will contribute to a new framework for measuring and expressing cognitive and emotional states in human learning. Both industry and academic researchers need this. A clear, universally-applicable descriptive language that can power a range of applications could enable nontechnical designers of human-centered systems to define goals, model processes and measure success.

Note: An ontology is different from a taxonomy. Taxonomies are often hierarchical, such as the Dewey Decimal System. The limitation of such a hierarchy in the interactive world of mixed media is that it is possible for the same entity, actor or action to have more than one categorization, depending on context and other factors.

FOR MORE INFORMATION

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