Challenge

Teaching mathematics and science requires much more than imparting core knowledge and ideas. Until recently, it's been difficult to measure problem solving skills because traditional math and science assessments contain test items that are scored, based on a student's final answer. Although scoring rubrics allow you to assign points based on the degree to which the response or response part is correct (fully, partially, or not at all), this type of score does not provide the rich data that would enable an educator to determine how their students arrive at their answers for given problems.

Solution

By deploying digital assessments that include interactive items built using Portable Custom Interactions (PCIs), it's possible to see a student's thought process throughout an entire problem-solving activity. Assessment and learning software applications that incorporate the PCI standard give users the ability to create problem-solving items and to include an unlimited number and type of (QTI standard based) interactions, like hot-spot, drag and drop, text entry, and graph, in the item. These standards also ensure that the item's content and data are interoperable within an institutions' digital environment.

The Assessment, Forecasting and Performance Directorate at the French Ministry of Education (Direction de l'évaluation, de la prospective et de la performance [DEPP]) has released a number of model interactive items using the PCI standard. One of these items assesses knowledge and skills related to the Relativity of Movement and allows the student to interact with the on-screen characters to see the movement in the scenario from each character's perspective.

The questions included in interactive items capture students' thought process via rich log data, such as the time at which students start and stop their work, mouse movements, the use of different onscreen tools, idle time, and a screenshot of the last actions, allow educators to gain deep insight into how students approach the problem, and identify areas that might require additional focus.

Learning Impact Outcomes

PCIs and their log data can provide excellent feedback to the educational community—including teachers, researchers, and policy-makers—into students' level of engagement, understanding of the subject areas, and how they approach problem-solving.

The DEPP, Luxembourg Ministry of Education, and their contractors Vretta and Wiquid, collaborated to create a number of multi-step PCI items using TAO. The goal was to introduce these items in CEDRE (the cycle des évaluations disciplinaires réalisées sur échantillons/Cycle of Sample-based Subject Specific Assessments), which are annual low-stakes tests in France given in a variety of subjects, that include history, geography, science, math, foreign languages, and French.

In May 2016, the DEPP introduced for the first time three math and two science PCIs to a nationwide standardized test, which was administered to 8,000 9th grade students. DEPP worked with Capgemini to analyze the resulting log data from the three math PCIs and uncovered rich observations with respect to the strategies the students used to solve the interactive questions.

Return on Investment

In the spring of 2017, when the DEPP took the practice a step further and increased the scale both in terms of the number of PCIs administered and the number of student participants. This time, 12 science PCIs were administered to 10,000 students, while 25 math PCIs were administered to 11,000 students. Because TAO is built on open source, The DEPP can also now leverage additional resources contributed by the user community.

"We're actively collaborating with the National Institute of Statistics and Economic Studies to find solutions to the storage and analysis of all the rich log data we've collected from PCIs. It will provide deep insights into not just what students have learned, but how they learn, which will subsequently influence how we teach—and all of this will form a healthy and continuous feedback loop between teaching, learning, and assessment." – THIERRY ROCHER Deputy Head of the Office for Student Assessments

Video

Lake area map interaction: https://www.youtube.com/watch?v=0O8_CjaObAU