Leverage Portable Custom Interactions to Foster the Link Between Teaching and Learning

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CHALLENGE

The teaching of mathematics and science requires much more than simply imparting core knowledge and ideas. Students must be immersed in practices that allow them to develop cross-curricular skills such as calculating, modeling, problem-solving, and reasoning if they are to succeed in a world that increasingly utilizes science and technology in the workplace and in everyday life.

Until recently, it's been difficult to measure problem-solving skills because traditional math and science assessments are comprised of test items that are scored based on a student's final answer. Although scoring rubrics can allow points to be assigned 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 the educator to determine how the students have arrived at their answers. In addition, even as assessment has transitioned to a digital environment, the types of math and science items that are commonly used today are predominantly multiple-choice and constructed-response: item types that are relatively straightforward to develop and can easily be administered in a large-scale setting.

SOLUTION

This is where your choice of technology can really make a difference. By deploying digital assessments that include interactive items built using Portable Custom Interactions (PCIs), it's possible (even easy!) to open the window to more creative and immersive testing experiences and make it possible to see a student's thought process throughout an entire problem-solving activity.

It wasn't long ago that Technology-Enhanced Items (TEIs) required a large investment of time, money, and programming expertise in order to even be considered as a component of a learning or assessment environment. However, it's no longer the case. For those new to this concept, PCI items are simply technology-enhanced items that are built to the "PCI open standard." Assessment and learning software applications that incorporate the PCI standard give the user the ability to create problem-solving items, as well as the flexibility to include an unlimited number and type of interactions, e.g., hot spot, drag and drop, text entry, AND graph, in the item. These same PCI standards ensure that the item's content and data are interoperable within an institutions' digital environment.

In practical terms, item authoring modules that are compliant with the PCI standard—such as TAO's Item Creator module— allow the item author(s) unlimited creativity to conceptualize problem-solving tasks that leverage any number of interaction templates from the entire range. These rich, and seemingly complex items, can be used to measure how students interact in a given situation to analyze and solve a problem.

For example, 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. As an example, one of these items assesses knowledge and skills related to the Relativity of Movement,

SOLUTION (cont.)

and allows the student to interact with the on-screen characters to see the movement in the scenario from each character's perspective.

Screen Shot from a DEPP Science Interactive Item, "Relativity of Movement"

The exercises and questions included in interactive items engage the students on multiple levels, and capture not just their answers, but their thought process as well. In fact, the rich log data captured by these items, 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.

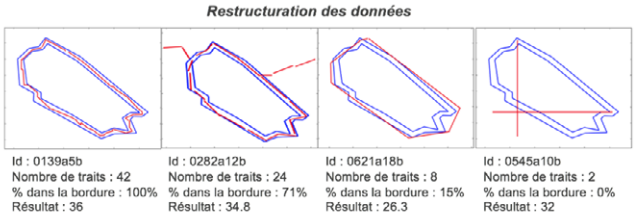
In other words, PCIs make it possible to collect much more than just the digital answers and provide data to facilitate the feedback loop between teaching, learning, and assessment.

RESULTS

With this in mind, the DEPP, the Luxembourg Ministry of Education, and their contractors Vretta and Wiquid, collaborated to create a number of multi-step PCI items using TAO. Vretta developed the math PCI items, and Wiquid developed the science PCI items. 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. The CEDRE exams were paper and pencil when they were first introduced in 2003, but migrated to digital format in 2016 and are now administered on desktop computers.

The science and math exams each contain between 50 and 60 items from a 300-item bank. 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. This exercise provided very rich and interesting observations with respect to the strategies the students used to solve the interactive questions.

For instance, one question asked the students to estimate the circumference of a lake. The log data collected showed that oftentimes students confused "circumference" with "area", judging by the steps they took to solve the problem. Below are samples of log data gathered from four student responses. The data collected for each response shows the lines that each student traced in his or her attempt to solve the problem, the percentage that were within the border (or circumference) of the lake, and the student's estimate of the measurement.



Fast-forward to 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.

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CONCLUSION

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

> 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
DEPP

ABOUT TAO

Redefining Digital Assessment: Open Source, Open Standards, Open Possibilities. TAO, from Open Assessment Technologies, is the leading assessment solution for education and career advancement. Break free from proprietary data silos, eliminate expensive licensing fees, gain full control of your testing resources, and enjoy enterprise level support. Learn more at taotesting.com.

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