

**Authentic Assessment in Action**

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In a conceptual analysis of the literature related to performance assessment and authentic assessment, Palm (2008) describes several common features of authentic assessment: they are useful in some context outside of the classroom, they are aligned with curriculum and teaching practice, and should either result in effective learning or guide further instruction (p. 6). The terms performance assessment and performance-based assessment are often used to mean the same thing as authentic assessment (Myers, 2021a). However, a more nuanced approach suggests that while there is significant overlap between the range of possibilities represented by each term (as per definitions found in the literature), we should consider performance-based assessment to be a common *category* of authentic assessment, while also noting that not all performance assessments are necessarily considered authentic (Palm, 2008). At any rate, if one accepts the axiom that learning things that are of use in the real world is valuable, then the intrinsic value of authentic assessment is evident from its description, whichever definition from the literature is chosen. The value of switching from traditional assessment to authentic assessment is perhaps best summarized by Wiggins (1990), who argues that it “improves teaching and learning: students have greater clarity about their obligations (and are asked to master more engaging tasks), and teachers can come to believe that assessment results are both meaningful and useful for improving instruction” (p. 2). This paper will describe what common assessment types look like in an authentic assessment context and examine ways of incorporating them into an integrated curriculum mathematics and design unit.

## **Defining Authentic Assessments**

Each of the following assessment types will be used in the integrated curriculum unit, and thus brief definitions of each through an authentic assessment lens will be presented.

## **Formative Assessments**

Formative assessment can be thought of as any assessment that has the following characteristics: it is ungraded (or at least does not contribute to reported grades), gives students feedback on their learning, and gives teachers information that allows them to modify subsequent instruction (Tamah, 2020). Formative assessment can be informal and take the form of “frequent, interactive assessments of student understanding” (Organisation for Economic Co-operation and Development, 2005, p. 1), or they can sometimes resemble more conventional, summative assessment practices, as long as they are only used for the formative purposes described above (Myers, 2021b). In an authentic assessment context, all formative assessment has at least one feature in common with authentic assessment, in that it guides further instruction (Palm, 2008). Authentic formative assessment will often use rubrics to give students feedback on project work at intermediate stages and also their development of 21<sup>st</sup> century skills (Myers, 2021a).

## **Summative Assessments**

The key distinguishing features of summative assessments is that they are used to make judgements about student achievement levels and generally occur at the end of any given unit or episode of learning (Myers, 2021b). Summative assessment results can be used for the same purposes as formative assessments; the only difference being that a result is generated alongside all the other purposes that an assessment serves (Tamah, 2020). Some definitions of authentic assessment assert that it can only be formative (Palm, 2008); however, a more flexible definition of authentic summative assessment might be that it includes at least one of the elements of authentic assessment such as being framed in a realistic real-world context, requiring students to produce something useful, or involving processes and conditions that simulate those of an adult workplace (Palm, 2008, p. 6).

## **Performance Assessments**

A performance assessment can be defined as a task or collection of tasks that requires students to demonstrate proficiency by doing or producing something (Perie, 2020, p. 35).

Performance assessments are often associated with project-based learning but can also include any task that requires the use of higher order thinking skills, such as a science investigation or an analytical essay (Maier et al., 2020b, p. 3). As Palm (2008) notes, due to the many different ways that the word “performance” can be interpreted, some definitions of performance assessment in the literature even include traditional assessments such as multiple-choice tests (p. 3). However; in this paper, only performance assessments that include Palm’s common features of authentic assessment (2008, p. 6) will be considered.

## **Culminating Assessments**

The word “culminating” appears as a qualifier in front of the phrase “performance assessment” in Maier et al.’s recent report on their case studies of performance assessments in several California school districts (2020a), suggesting that a culminating assessment is a specific sub-category of performance assessment. Exhibitions, a public demonstration of mastery at the end of a period of sustained inquiry (Davidson, 2009), are a common form of culminating assessment. However, culminating assessments can also take the form of, for example, an extensive, curated portfolio or a capstone project such as an original research paper, which often involve some kind of “defense” by presenting to or interviewing with a panel of experts (Maier et al., 2020a). Brigham Young University’s Center for Teaching and Learning suggests that culminating assessments should provide opportunities for students to “put it all together” and engage in the authentic practice of the discipline (2021). In this way, we can think of culminating assessments as being both summative *and* performance-based, and also as being larger in scope

than regular summative assessments and generally only occurring at significant milestones in students' learning journeys.

### **Assessment Plan**

The interdisciplinary mathematics and design unit for which assessment details are described below synthesizes the disciplinary topics of Voronoi diagrams and algorithms in the context of an app development project. Inspiration for the unit culminating assessment came from articles by Tran (2020) and Churiyah et al. (2021), as well a real-life mathematics task created by the author that involves overlaying Voronoi diagrams on city maps. The lessons have been numbered to align with the unit plan template used in this course; however, it should be noted that a project of this scope would need to occur over a much longer sequence of lessons, and Table 1 below can be considered to be a form of “highlights reel” for the unit, in the same way that a movie compresses real-time events from life into a much shorter timeframe than what actually would have passed in reality.

**Table 1**

*Assessment Plan for Mathematics and Design Integrated Curriculum Unit*

	Assessment Type	Implementation
Lesson 1	Formative	In class, synchronous, online Voronoi maps activity
	Summative	Students submit a “looks-like” prototype (see Assessment Design section below) of their main app screen, constructed in Geogebra with real-world data for their chosen brand
Lesson 2	Formative	Online Diagnostic Questions multiple-choice quiz on algorithms and Python
	Summative	Students submit a “works-like” prototype of their app constructed in Python

Lesson 3	Formative	Online tutorial in Figma, an app development platform that is free for educational use
	Summative	Students submit their app user interface design in Figma
“Shark Tank”	Performance	Simulated early round venture capital event in which students present a pitch deck to a panel of hypothetical investors
App Launch	Culminating	Students exhibit their app demo and website, including a promotional video and FAQ, at a trade show-style event

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## Assessment Design

### Formative Assessment

An example of a formative assessment for checking students’ understanding of the mathematical content required for the project is Bezaire’s (2019) Desmos activity that introduces students to the concept of a Voronoi diagram as it relates to regions of closest proximity to certain locations on a map. The Desmos Classroom Activities allows students to explore new mathematical ideas and interact with input and ideas generated by their classmates while teachers monitor progress and check for misunderstandings. For algorithms and Python coding fundamentals, appropriate multiple-choice questions from Diagnosticquestions.com that are directly related to the skills and knowledge they will need to apply to the project can be assigned to students. The Diagnostic Questions website is a free question bank of mathematics, science and computer science multiple-choice questions that are specially designed to uncover student misconceptions (Barton, 2015).

### Summative Assessment

Key (2015) describes two types of prototypes that are commonly created in the early stages of product development – “looks-like” prototypes, which give investors an idea of what

the final product will look like but do not actually demonstrate how it functions, and “works-like” prototypes, which might not look like the final product but which demonstrate how the internal mechanisms of the product actually function (p. 93). As a mathematics summative assessment, students create a “looks-like” prototype in Geogebra because it can overlay a shaded Voronoi diagram over an actual map of the city. However, Geogebra’s automated Voronoi diagram command cannot be used in the final product, hence students create the Python code that will implement this as a summative design assessment.

### **Performance Assessment**

Student teams present and submit their “pitch deck” slides, which would address each of the criteria in a generic social entrepreneurship project evaluation rubric (see Figure 1 below), and include their analysis of search traffic, download and user survey data.

### **Culminating Assessment**

Products to be developed for the culminating assessment include a working version of the mobile app, and a product website that includes a short promotional video, frequently asked questions and any other user technical support documentation. If time and facilities allow, student teams could also design a product logo and 3D print merchandise samples.

### **Other Evidence**


Alongside the culminating assessment, student teams would also be asked to submit their project documentation as evidence of process. Throughout the unit, teams will collaborate and store their documentation on an online platform of their choice that is used by web development professionals in real life, such as Asana or Basecamp. Both of these offer free versions that are suitable for student use. Possible documents to be submitted include a changelog, self-evaluation against project success criteria and a lessons learned file.

### Performance Task Rubric

An example of a rubric that could be used to grade student pitch decks is shown in Figure 1 below. Note that the actual rubric used, if the unit were to come to fruition, would need to include graduated level descriptors (with the number of levels reduced to three or four) and shift the focus of the criteria towards the quality of presentation and analysis.

**Figure 1**

*Example Product Pitch Deck Rubric*



Forum 2.0 | **Rubric 320**

	Project 1	Project 2	Project 3	Project 4
<b>Social Entrepreneurship Factor</b> - to what extent could it become a force for good? Does it solve a genuine problem or need?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Impact potential</b> - how many lives could it affect, and to what extent?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Scalability</b> - how easily could it be reproduced, automated or "rolled out"?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Originality</b> - to what extent does the idea display "out of the box" thinking, creative insight and/or synthesis of new ideas from existing knowledge?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Monetization potential</b> - does the idea naturally lend itself to generating revenue streams?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Sustainability</b> - to what extent does the product or system attempt to minimise its ecological footprint?	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
<b>Totals</b>				

*Note.* Created by the author for a recent event that they organized.



## **Conclusion**

Using multiple forms of authentic assessment to evaluate student progress and learning can improve student engagement and workforce readiness in ways that traditional assessment cannot (Barlowe & Cook, 2016). An authentic assessment paradigm can be applied to all types of assessment, not just performance-based ones. By thoughtfully sequencing assessments throughout a project-based learning unit, learning that not only aligns with curriculum standards but is also relevant, meaningful and useful to students can take place.

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