# Work-in-Progress: A Review of the Type, Breadth, and Limitations of Publicly Available Educational Technology Products in 2022

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## Goals and Methodology:

- The goal of this work-in-progress is to identify some of the reasons for why an integration of learning technologies specifically into higher education is progressing at a slow pace.
- We are compiling a database with a large number of education-based software products, web-pages, and web-services, with a commensurate analysis of the type, breadth, and respective strengths and limitations of the products. The intent is to develop an ontology of the types of available products and services.
- To evaluate the ontology, we presented the preliminary findings to engineering faculty and solicited their feedback.

## EdTech Overview: (10 of 15 Categories)

- **Learning Management Systems (LMS)** - An LMS is a software or online-tool that bundles standard "housekeeping" chores for instructors. The LMS typically provides access to functions and services such as document sharing, assessment, communication with students, student tracking, gradebooks, course structuring etc.
  Examples: `Canvas, Blackboard, Moodle`
- **Grading Tools** - Grading tools assist instructors in creating (electronic or paper) quizzes, exams, or assignments. Students can complete the exams either in person or remotely. The work of the students is submitted through the software for grading. Some tools support automatic grading (e.g. via scanned bubble sheets), others require (electronically supported) manual grading by the instructor.
  Examples: `GradeScope, TurnItIn`
- **Feedback Tools** - Feedback tools are separate from Grading Tools and specifically focus on helping to provide written or spoken feedback to students on assignments. The feedback is intended help students understand how to improve their work, what is going well, and what may require further attention on their part. There is the variety of modalities for which feedback can be created and with which feedback can be provided, including text, audio, images, and video.
  Examples: `GoReact, Peergrade`
- **Discussion Tools** - Discussion tools are designed to enable and foster critical engagement between students, in and outside of the classroom. Students and instructors can upload videos, comment on class readings, or respond to questions via these tools. Some tools provide automatically generated analytics of the discourse for the instructor.
  Examples: `Piazza, Flipgrid`
- **Reading Tools** - Instructors can use these tools to assign readings and ask students questions throughout the readings. Students can annotate as they read and also see what other students say about the reading and respond to them. Reading tools provide a means to directly assess the level of student engagement on a reading assignment.
  Examples: `Perusall, Hypothes.is`
- **In-Class Tools** - There are a few products that are specifically geared towards use inside of a classroom. These tools help fostering engagement and participation, and provide a low-stakes way of gauging and tracking understanding.
  Examples: `Google Classroom, Kahoot`
- **Communication and Task Management Tools** - Educational technology can also be used for effective and time-critical communication between peers, students & teachers, as well as for task and project management.
  Examples: `BaseCamp, Trello`
- **External Resources** - The tools in this category are used by students outside of class time for studying, projects, homework, and lab assignments. The instructor does generally not provide and/or manage the available materials, yet data shows that students are using and valuing these tools.
  Examples: `Chegg, Course Hero`
- **Dashboard Programs** - For instructors it is not only important to deliver course-content to students and/or provide students with computer assisted functionality and services, but also to track student performance, aggregate scores, and generate informative graphical representations of student progress in various categories. Graphical dashboard tools can provide such services.
  Examples: `Domo, Tableau`
- **Autograding Tools** - The automatic grading of multiple choice and numeric answer questions in quizzes and exams are a common feature of many of the previously mentioned platforms. Very few platforms, however, provide more sophisticated types of autograded questions. An advanced (potentially AI supported) algorithm is needed when answers are provided in terms of a mathematical expression, a piece of programming code, or an essay for example. In our ontology, we have explicitly separated this category from both Grading Tools—which focuses on assessments with some automated grading features—and Feedback Tools—which support richer feedback to students—as this category seeks more sophisticated grading automation and has a large growth potential.
  Examples: `Webwork, Repl.it`

## Faculty Interviews:

In the one hour-long faculty interviews, example questions included:

1. How do you want students to have changed at the end of your class, in terms of knowledge and skills, as well as attitudes and beliefs?
2. How do you measure/assess the effectiveness of the activities you do in class? What are the advantages and disadvantages of the chosen types of assessment?
3. How do you get from what you are doing now to your ideal course/class structure? What is stopping you?
4. What are the best technologies you have used in the classroom that help you meet your goals? What have been your most problematic experiences with technology?

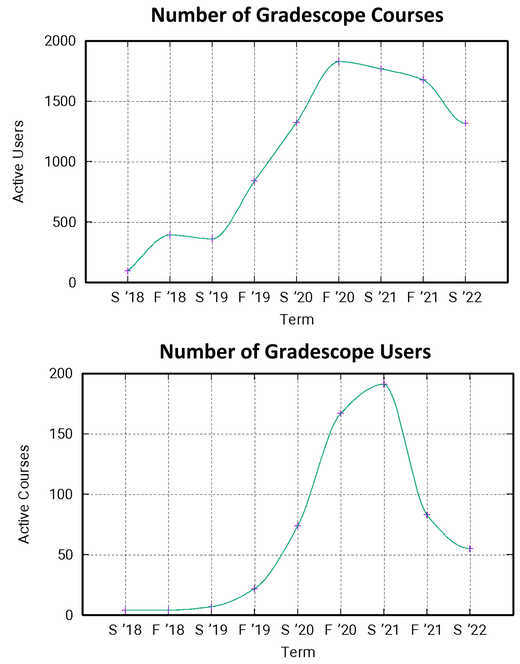


**Figure 1:** Active number of courses and users of the online grading tool Gradescope on a small, liberal arts campus over time.

## Key Takeaways:

- Work on the EdTech database is still ongoing. It currently encompasses close to **100 products** across **15 categories** (including *Digital Textbooks, P-12 Tools, Circuit Design Tools, Chatbots, and Optical Character Recognition (OCR) Tools*). A complete snapshot of the current state of the database is publicly available. A web-link provided in the paper.
- Based on the faculty interviews, we found that critical in the evaluation of educational technology is: (1) what functions/services are included, (2) how well these functions/services are integrated, and (3) how well the respective user interface supports the maintenance of the functions/services. Without these factors, technology can counter-intuitively hamper and even interfere with faculty achieving their instructional goals due to frustration, time-consuming manual integration, and a sunk-time-cost.
- The initial time investment required to adopt a new tool is often claimed as a reason for why instructors do not use new technology. A contradiction to this reasoning can be seen in Figure 1. The use of Gradescope increased at Bucknell due to the switch to remote/hybrid teaching during the pandemic. Many users, however, dropped Gradescope again when the University went back to in-person teaching in the fall of 2021. The initial time barrier is, thus, not sufficient to fully explain why educational technology is not that widely used in higher education.
- At many schools, it is generally the respective IT divisions that drive decisions for software adoption for the faculty and not vice versa. We feel, however, that it should be the other way around, i.e. that faculty should drive these decisions. For that to happen, though, it would require new faculty adopters to receive information and support from seasoned users, potentially via some type of online community. This paper could serve as a step towards that development.

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