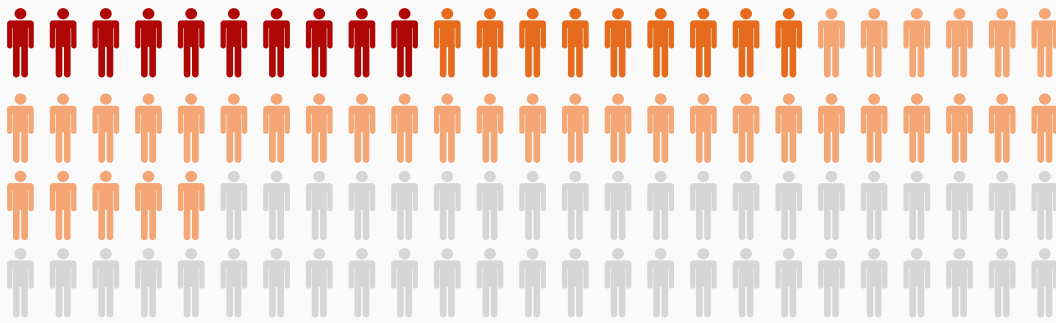# FUTURE JOBS AND THE SKILLS NEEDED TO GET THEM

See how the world of employment is changing and learn how schools can prepare learners for jobs that have not yet been created.

MOTIVATION

New reports from the World Economic Forum (WEF) and the Organisation for Economic Co-operation and Development (OECD) highlight the Global trends in workplaces and motivate new knowledge, skills, attitudes, and values needed for students to transform our society and shape our future. According to the WEF, globally, the skills required to perform a job will shift by 42% by 2022. Over 54% of employees require significant upskilling, of which 36% require up to 6 months, 9% require 6-12 months, and 10% require more than a year of upskilling. WEF estimates that by 2022, 75 million jobs will be lost to automation or redundancy. The bright side is that the WEF sees a growth of over 133 million jobs in new products and services by 2022 in roles that involve people leveraging machines and algorithms [2].

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10% REQUIRE MORE THAN 12 MONTHS UPSKILLING

The importance of acquiring new skills cannot be understated. According to the WEF, employers are twice as likely to hire new staff with the skills needed over retraining existing employees. The reality is that only 8% of at-risk employees are expected to obtain retraining meaning those most likely to need retraining, are also the least likely to receive it [2]. All the more reason why teaching these skills in school is imperative.

Schools are facing increased pressure to prepare students for rapid environmental, economic, and social changes to get jobs that have not yet been created; using technologies that have not yet been invented; to solve social problems that have not yet been anticipated [3].

The objective of this whitepaper is to examine what knowledge, skills, attitudes, and values will today's students need to thrive and what proven teaching approaches can be scaled to classrooms around the world using technology.

THE FOURTH INDUSTRIAL REVOLUTION

The first industrial revolution started with the advent of water and steam to mechanize production. The second industrial revolution used electric power for mass production. The third industrial revolution used electronics and information technology to automate aspects of production.

The WEF explains how the fourth industrial revolution uses exponential computing power and near-limitless storage to develop new industries through rapid disruption. TechCrunch author Tom Goodwin highlights two well-known examples of the Sharing economy: "Uber, the world's largest taxi company, owns no vehicles... Airbnb, the world's largest accommodation provider, owns no real estate," he goes on to explain " the world has developed complex supply chains... it's what allowed billions of products to be made, shipped, bought and enjoyed in all corners of the world. In recent times the power of the Internet, especially the mobile phone, has unleashed a movement that's rapidly destroying these layers and moving power to new places." [5] Companies are leveraging new technologies such as AI, Robotics, 3D Printing, Material Science, Nano/Bio-Technology, Energy Storage, and Quantum Computing to disrupt established industries [2].

1.0	2.0	3.0	4.0
⚙ MECHANICAL	💡 ELECTRICAL	📺 ELECTRONIC	01010 10101 DIGITAL
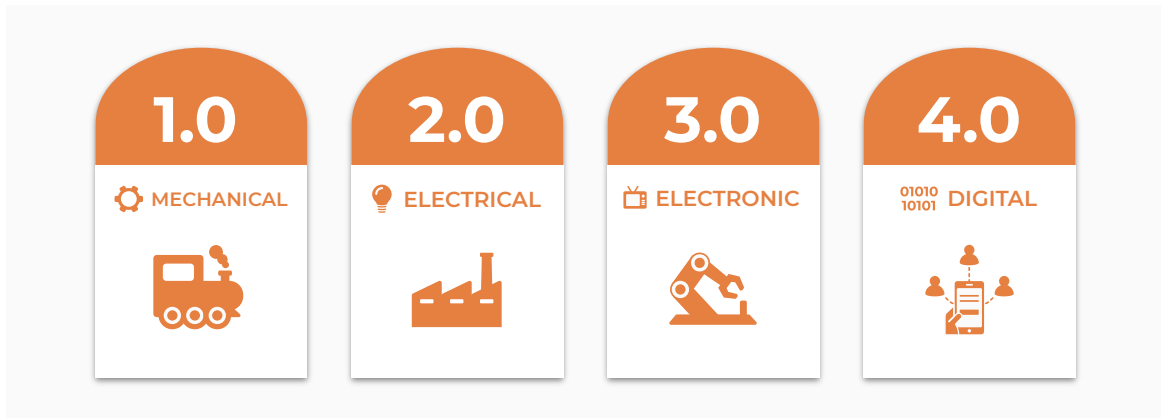
The fourth industrial revolution presents some global challenges. Growing inequality is predicted since technology produces higher returns on capital than a worker's return on labor. The WEF reports that the hollowing out of the middle class is leading to a stagnation of wages as the high skilled get paid more while the low skilled get paid less due to changes in demand [5].

In business, growing customer expectations are driving demand for regular product enhancements. Companies are using data and collaborative innovation to develop organizational structures that best leverage the global platforms available [5].

Governments face new criticisms with increased transparency. They increasingly struggle to regulate at the pace of technological disruption. Cyberspace is the new battlefield; governments are struggling to keep up with the information and communication technology arms race [6]. Governments are increasingly adopting environmental regulations that are making companies balance both customer and societal needs [2].

People are increasingly turning to technology for self-expression and identity. The popularization of smartwatches is making the quantified self a societal norm.

With increased data arrive issues of privacy and concerns from experts that technology is leading us to be less compassionate as the constant connection may deprive us of time to pause, reflect, and engage in meaningful conversation [5].

Growing pressure on keeping wages low is leading to a rapid increase in the amount of outsourcing and automation. Advances in robotics for manufacturing, supply chain, and even delivery are disrupting many industries. Another trend is the emergence of the middle class in developing countries, which is impacting global consumer demand [2].

The impact of the fourth industrial revolution is clear as 85% of companies surveyed by the WEF said that they were likely to adopt big data analytics by 2022, 75% would leverage apps and web-enabled markets, and 73% would adopt AI and Machine Learning. There is an increasing demand for workers with experience in data analysis, AI, IT, information security, social media, robotics, user experience, sales, and marketing.

INCREASING DEMAND FOR WORKERS WITH EXPERIENCE IN:

85% BIG DATA ANALYTICS BY 2022

75% APPS AND WEB-ENABLED MARKETS

73% AI AND MACHINE LEARNING

WORLD ECONOMIC FORUM

21ST CENTURY SKILLS

Numerous panels and committees have debated the skills needed for future employees to thrive in the fourth industrial revolution. Categories of skills have been developed by esteemed organizations including the OECD, the WEF, the International Society for Technology in Education (ISTE), and the Partnership for 21st Century Skills (P21). Attempts were made by P21 to simplify the listing of 21st Century Skills with 4Cs: Creativity, Collaboration, Critical Thinking, and Communication [8]. Researchers at Education Plus wanted to capture life skills and attitudes into a single list, so we detail the expanded 6C's of Creativity, Collaboration, Critical Thinking, Communication, Citizenship, and Character [7].

6 C'S OF THE 21ST CENTURY SKILLS

Creativity

Creativity is the highest level of cognitive learning, according to Bloom's Revised Taxonomy [9], and it is one of the most important skills in disrupting existing industries in the fourth industrial revolution [4]. Curious learners build knowledge connections through active learning. They pursue ideas in practice and seek entrepreneurial opportunities [7]. Often, creation will be limited unless there is a strong foundation of physical, practical, and vocational skills [3].

Critical Thinking

The growth of Social Media and the arrival of hyper-partisan news has put pressure on readers to think critically about the information that they see online [10]. Hypothesis testing, like a scientist, is a key skill in managing the unknowns of the fourth industrial revolution [4]. Programming teaches the language and processes of computers and provides insights into the world of automation and digitization [7].

Collaboration

The fourth industrial revolution is requiring us to work in teams to reconcile tensions and dilemmas. This means workers are constantly learning from others and contributing to the learning of others; they are seeing and evaluating the over-arching systems and looking at how they can be disrupted. They are working with others in different regions of the world online, synchronously and asynchronously. They will need to be willing to take responsibility and lead and make the best decisions possible with the available information.

Communication

Ideas are competitive, and often the ideas that are best communicated are the ones that get implemented, secure funding, and generate sales. Persuasion is a critical skill in the fourth industrial revolution that now takes on many forms, including direct selling, copywriting, presenting, social media, videos, and many new media. A key to convincing is to deeply understand the needs of the customer, and this requires a substantial degree of emotional intelligence (EI).

Character

A growing amount of uncertainty is driving the need for employers to seek staff who have strong personal attitudes of persistence and resiliency. A willingness to try, fail, and learn quickly is crucial to success. As products and issues become more complex, it's important to work effectively in a team; dependable team members need a strong foundation of reliability and honesty. Efficacy in an increasingly distracted world requires robust self-regulation. While competitiveness requires a willingness to take responsibility, solve problems, and adapt to new situations [3].

Citizenship

The future of our society depends on our ability to reconcile societal tensions and dilemmas in our everyday work. Issues such as equity/freedom, autonomy/community, innovation/continuity, efficiency/democratic process continue to challenge our society today. In addition to local citizenship issues such as environmental sustainability, we also serve as digital citizens and need to take responsibility for what happens on those platforms as well.

DESIGNING CURRICULUM

The many stakeholders involved in creating curriculum for schools often result in overloaded programs where there is little time for mastery of any particular skill. In addition, there is often a long time gap between curriculum reform and when we see an impact on learning outcomes. The OECD recommends three approaches to resolving these issues [3]:

Quality Content

It is difficult to arrive at a deeper understanding of the course materials if students are having a hard time grasping the basics. Having multiple means of representation means that learners have alternatives if they do not fully grasp the taught materials the first time. An understanding of the fundamentals is required to gain any deeper insights into the curriculum.

Balance Equity and Innovation

When it comes to homework as part of the curriculum, policymakers and instructional designers should ask the question: how will it benefit all students? If students don't have access to the Internet at home, any online assignments won't be accessible to them. The OECD recommends [11] "Schools and teachers should look for ways to encourage struggling and disadvantaged students to complete their homework. They could, for example, offer to help parents motivate their children to do their homework and provide facilities so that disadvantaged students have a quiet place to complete assigned homework if none is available in their homes."

Planning and Alignment

The OECD emphasizes that a coherent curriculum uses students' prior knowledge and skills to sequence the skills being taught [3]. Similar to a video game with varying levels of difficulty as the game progresses, it is important for learners to see the connections between the taught materials. We can focus on a rigorous grasp on a smaller number of topics if we prioritize the skills that are highly transferrable to other disciplines and tasks. When students are given the flexibility to work on a selection of projects, they need opportunities to reflect on what they did well and can improve [3].

Authenticity and Engagement

A concept on the syllabus will lack authenticity unless it is clear to students what the real-world application of that knowledge is. One approach is to show how the information taught applies to another discipline. Both teachers and students are more engaged in their work when they feel a sense of agency, so it's important for any curriculum, assignments, or assessments to provide opportunities for creativity [3].

TECHNOLOGY THAT WORKS

Many Educators use books, blogs, influencers, news articles, trial and error to identify teaching tools and technologies that best improve academic outcomes, increase persistence/course completion, and increase engagement. The U.S. Department of Education identified a need for independent verification of the scientific research on what teaching methods work best. The What Works Clearinghouse (WWC) is a division of the Institute of Education Sciences (IES) within the U.S. Department of Education. WWC published a guidebook on Using Technology to Support Post-Secondary Learning [13]. These suggestions are backed by multiple studies showing a significant benefit and be generalized to a broader educational context.

Research studies

Scientific Analysis

Improved Grades   **Engagement**   **Course Completion**
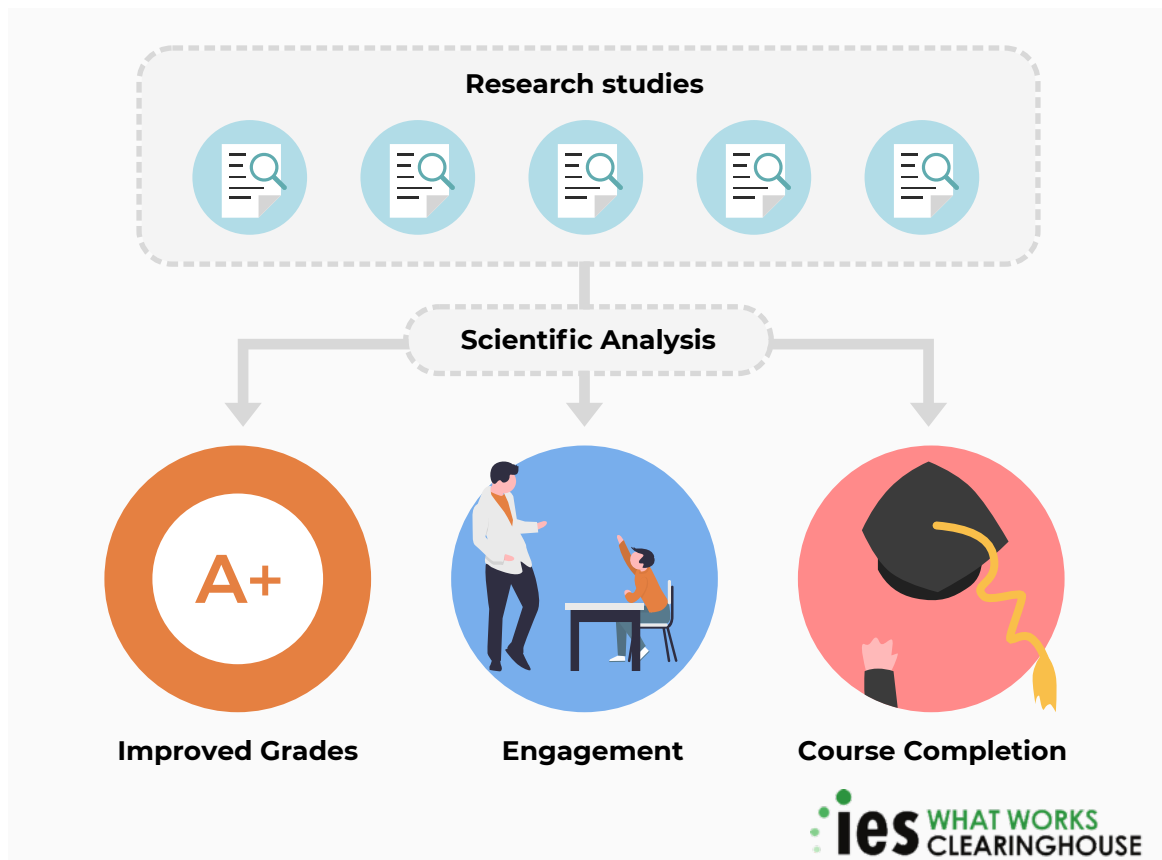
Increase Engagement, Belonging, and Interaction among Students and Instructors

A+ A+ 2 studies show significantly improved grades

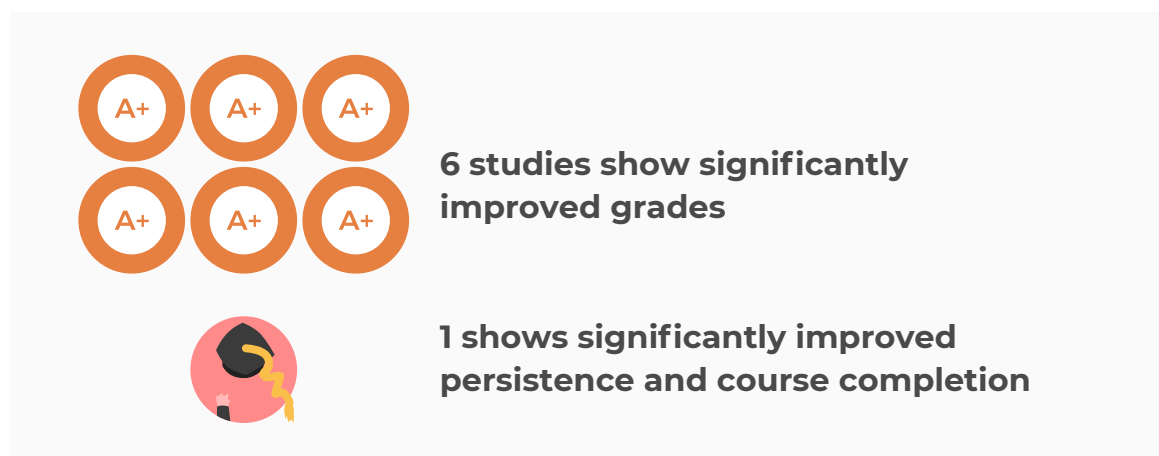1 study showed significantly improved engagement

1 study shows improved course completion

Blogs and Social Media can be used to improve connections and support deeper reflection among students and with the teacher. First, a teacher will select tools (e.g. synchronous, asynchronous, social media) that support the learning objectives, are recommended by teaching peers, and match students' preferences (e.g. through a survey at the beginning of the semester). The teacher lays out clear expectations on when/how to use the tool inside and outside of the classroom (e.g. by sharing rubrics for evaluation, respect, and privacy expectations). Teachers and students monitor participation and facilitate feedback (e.g. discouraging unhelpful criticism) and assess what works best [13]. Assessment questions can include: what are the characteristics of students who do not participate? Is the communication meaningful, timely, and contributing to teamwork?

Consider this microblog example, a teacher decides to use Twitter in class to increase engagement, belonging, and interaction. Students are provided with training on Twitter and the expectations of use during and after class. Students can ask questions using a tweet, and the teacher can view a live Twitter stream during class.

Students are also given assignments where the outcome is a new set of questions posted to Twitter with a specific hashtag. The class finds that question threads help to organize responses, while general comments tend to get lost. Only question threads are used for the second half of the semester.

Use Digital Resources to Blend and Package Course Content

6 studies show significantly improved grades

1 shows significantly improved persistence and course completion

Blended and Flipped Classrooms have grown in popularity and with good reason: research shows significant improvement in grades and course completion as a result of using this method. The objective is to package and sequence the content to scaffold the acquisition and application of taught concepts by presenting materials in multiple ways such as podcasts, simulations, videos [13]. Teachers communicate their expectations for the class by sharing what to do before, during, and after class. They monitor and evaluate effectiveness using tools such as the Practical Evaluation for Digital Learning [12].

Given that over 80% of the Internet traffic is video, educators are flipping the classroom with instructional media watched at home or at the beginning of class and activities used for most of the class time. This is needed to help students develop 21st Century skills. However,
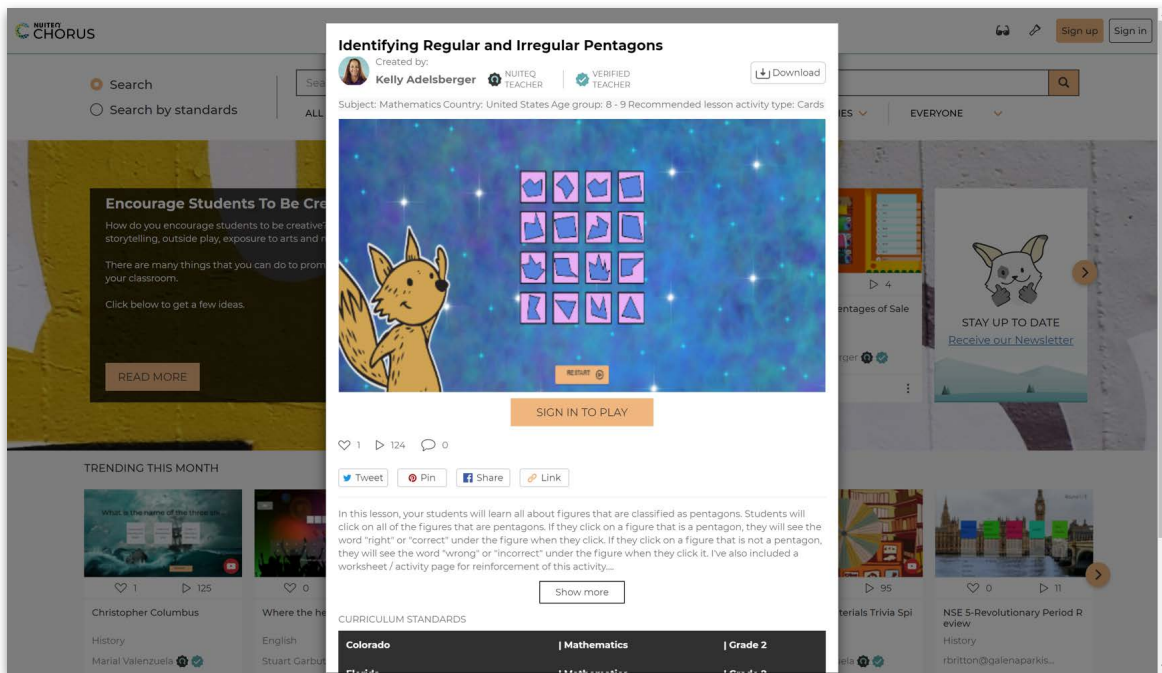
Figure 1. A standards-aligned lesson activity from chorus.nuiteq.com

creating a lesson that aligns with both the instructional media and the curriculum standards can be a significant amount of work. This is where lesson activities created by the teachers at NUITEQ can help to save teachers time. NUITEQ Chorus is an online video-based active learning platform that makes it easy for educators to engage the class using deep reflection to develop 21st Century skills (Figure 1). A video-based lesson activity assigned to students sets the expectation the homework is to watch the instructional material and complete the assignment before class begins. The teacher can use the results of the active learning activity to determine areas of confusion and misunderstanding using a live poll. Lesson links to online simulations can also be beneficial for improving student understanding of the curriculum.

Foster Self-Regulated Learning

3 studies show significantly improved grades

A growing number of tools exist that provide automatic feedback to the learner and suggest additional materials for self-study. Online training, intelligent tutoring, adaptive learning, and pedagogical agents all use input from the learner to inform the next activity or training that should take place. These particular tools are most effective when a teacher can send personalized suggestions, and the technology provides regular prompts, notifications, emails, and text nudges. Teachers should model best practices for self-regulated learning, and students should have opportunities to practice them in class before they get into the habit of applying them in practice. Tools need to be regularly assessed to see if they are effective for self-regulated learning, this can be done with data gathering techniques that monitor the time spent in different learning activities or an in-class poll [13].
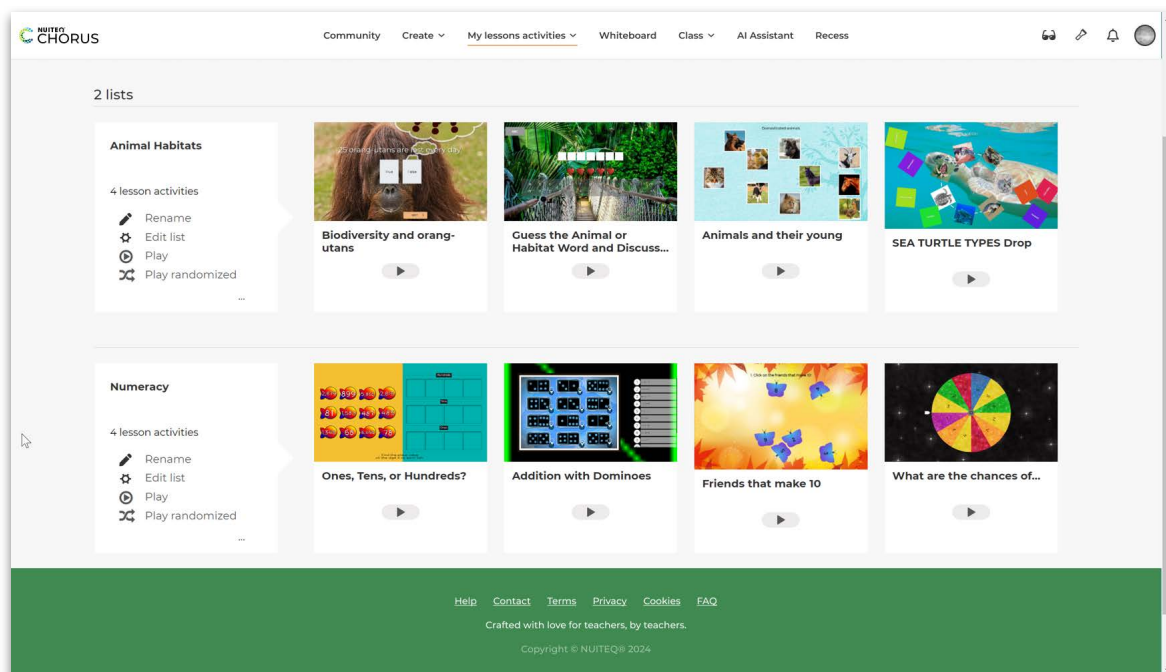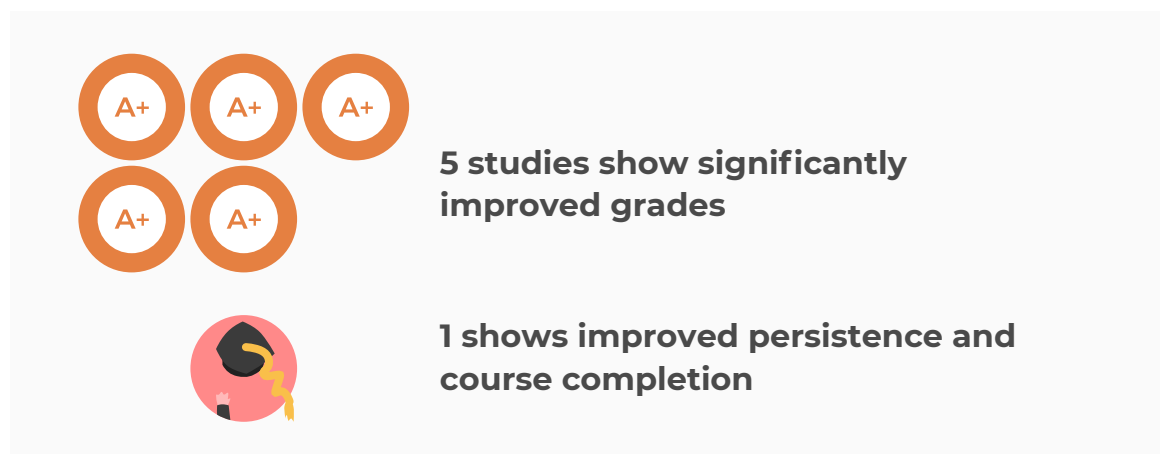

Figure 2. A list of lesson activities for self-regulated learning in chorus.nuiteq.com

Many students have a difficult time remembering all of the details of a long video. Chorus allows teachers to select the start and stop time of a video and add hands-on activities that align with the curriculum standards. These individual micro-learning lesson activities can be combined into a self-regulated learning plan comprised of a list of lesson activities. Activity lists allow students to skip directly to the parts they do not understand. Teachers can personalize the learning of each student through written feedback offered inside a graded assignment. This feedback could include links to additional lessons, articles, peer support, or in-class instruction. Students develop the habit of asking their peers for assistance in completing activities. Trying the assessment first helps to focus the learner on what they need to learn from the instructional materials.

Use Tools to Provide Timely and Targeted Feedback

5 studies show significantly improved grades

1 shows improved persistence and course completion

Live polls in the classroom are becoming increasingly popular, but some have also opted for asynchronous feedback from online activities that students do as assignments. It is important to consider factors such as the seating layout, the availability of WiFi, and the duration of the class when selecting the right feedback tools. Consider asking what type (e.g. synchronous, asynchronous) and format (e.g. multiple-choice, sequence, grouping, short text, image, video) of feedback works best for the

specific context of the curriculum? The OECD recommends using questions that will prompt deeper thinking along Bloom's Revised Taxonomy [9] so that students are required to think critically about the content being taught over simply recalling facts. Finally, use the feedback data to guide the topics of instruction and follow the pace of the audience [13].

Consider the example of a teacher that wants to improve timely and targeted feedback in class. Looking at the classroom seating layout, the availability of WiFi, and the duration of class, the teacher chooses a synchronous online polling tool; ansr.it.

FIGURE 3. A LIVE POLL FROM ANSR.IT

The format of the questions typically begins with multiple-choice questions to establish that the fundamentals are understood, followed by open text questions that require deeper reflection and critical thinking about the taught materials. The live feedback is used to identify areas of misunderstanding and set the pace of learning for the

class. A classroom evaluation finds that smaller polls after 5-10 minutes of instruction tend to improve recall over a single multi-question exit poll.

The recommended methodology for each of these techniques follows a similar pattern. To recap, they are:

1. Aligning the tool with the curriculum objectives
2. Making the expectations of technology use clear to students
3. Collecting feedback
4. Using the feedback to modify the way the class uses technology.

CONCLUSION

The fourth industrial revolution is driving the demand for a new set of skills, attitudes, and values to be taught in classrooms today. Developing these skills while students are in school is imperative because employees that most likely need retraining are also the least likely to receive it [2]. In this whitepaper, we outlined the 6C skills: Creativity, Collaboration, Critical Thinking, Communication, Character, and Citizenship. We then presented recommendations from the OECD on curriculum design and showed scientifically validated ways of using technology in classrooms to scale best practices.

Our objective is to encourage a new generation of educators, instructional designers, and policymakers to consider how the fourth industrial revolution is impacting work in their regions and how we can arm students with the sk ills they will need for jobs that have not yet been created; technologies that have not yet been invented; to solve social challenges that have not yet been anticipated [3].

For more information about Chorus and how it can be used to support 21st-century learning please visit; NUITEQ.com.

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