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Tech to Teach Guide Book for Teachers

2023



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CHAPTER 1

TECHNOLOGY IN EDUCATION: DECIDING APPROPRIATE TECHNOLOGICAL TOOLS & INTEGRATING INTO THE LESSON

1.1 Introduction

With the Digital Revolution in the 21st century, the term “Industry 4.0”, originally formed in Germany, has been disseminated by the World Economic Forum (WEF) to describe the trends toward technologies and processes. These technologies and processes can be seen in Table 1.

Table 1. New Technologies and Processes in Industry 4.0

Cyber-physical systems	Internet of things	Computer-generated product design	Smart factory and intelligent factory
Cloud computing	Artificial intelligence	Smart sensors and places	Autonomous robots
Biotechnology	INDUSTRY 4.0		Nanotechnology
Simulation	Virtual reality	Augmented reality	3D printing
Digital twin	Drones	Big data	Blockchain

The Ministry of Education and Research in Germany underlined that in Industry 4.0 “equipment, machines and single components continuously exchange information” along the value chain (Tikhonova & Raitskaya, 2023).

1.2. Skillsets in Education 4.0

Industry 4.0 necessitates professionals who are adaptable to change, proficient in acquiring fresh knowledge, and enhancing their skill sets. Educational approaches for professionals within this paradigm should evolve, incorporating novel models for teaching and learning that emphasize interdisciplinary Skills (Kipper et al., 2021). One of the skillset lists is introduced by the WEF headlined “The 10 skills you need to thrive in the Fourth Industrial Revolution: Top skills in 2020” (World Economic Forum, 2016) which can be seen in Table 2.

Table 2. Top 10 Skills

Complex problem solving	Critical thinking	Creativity	People management
Coordinating with others	TOP 10 SKILLS		Emotional intelligence
Judgement and decision-making	Service orientation	Negotiation	Cognitive flexibility

Various researchers also introduce a range of skills such as self-management, flexibility, adaptability, communication skills, initiative, collaborative work, teamwork, interdisciplinary collaboration, problem-solving, creativity, giving and receiving feedback, leadership, and additional capabilities (Kipper et al, 2021; Chigbu et al., 2023; Karpenko et al., 2021; Teo et al., 2021).

1.3. Teaching and Learning in Education 4.0

Since most professions started to disappear because of the technologies related to Industry 4.0, learners within Education 4.0 must get prepared for Industry 4.0 and Work 4.0. The concept of Education 4.0 implies “self-regulated learning, critical thinking, collaborative and teamwork skills supported by digital expertise” (Thite et al., 2021).

After this Digital Revolution, education has been not based on just the classroom. It is observed that Education 4.0 requires the wide use of ICT tools in educational contexts (Oliveira et al., 2023). Moreover, many terms came up, such as online learning, distance learning, e-learning, m-learning, remote learning, blended learning, hybrid learning, hyflex learning, i-flex learning, and bichronous learning, etc (Burns, 2021). More terms are electronic-based (e-learning or internet-based learning), self-regulated learning, project-based learning, and revised face-to-face learning to provide for a combination of face-to-face, remote, and online interaction (Oliveira et al., 2023).

It is mentioned that Education 4.0 is based on the “concept of learning by doing, in which students are encouraged to learn and discover different things in unique ways, based on experimentation.” (Almeida & Simoes, 2019). Therefore, active methodologies that aim to centralize the student’s role in the educational process are needed. Active methodologies refer to educational practices that enable students to engage in reflection, questioning, and the pursuit of knowledge by applying it in authentic contexts (Silva et al., 2021). Some examples of active methodologies are listed in Table 3 (Santana & Lopes, 2020; Silva et al., 2021).

Table 3. Active Methodologies

Project-Based Learning	Collaborative-Based Learning	Problem-Based Learning	Blended Learning
Digital Game-Based Learning	Creative Learning	Flipped Classroom	Simulation-Based Learning

1.4. The Technology Being Developed or Applied for Education 4.0

Oliveria et al. (2023) prepared seven categories for the technologies developed or applied for Education 4.0. These categories and the technologies can be seen in Table 4.

Table 4. Technology Being Developed or Applied for Education 4.0

1. Learning Systems			
Adaptive Learning System	Learning Management System	Technology-based Learning System	Mathematica
Edmodo	Smart Hybrid Learning System	Android-based Learning Application	Web-Based e-Learning Tool Confirm-A
Kahoot!	Virtual Learning Environment Supported by a Remote Laboratory	Software Twine	Smartphone Apps EduKits 4.0
Moodle	Learning System	Mobile Learning Ku App	Learning System
Schoology	Quizizz	Padlet	Structure
2. Laboratories and Factories			
Learning Factory		Digital Manufacturing Laboratory	

Teaching Factory	Remote Laboratory in Virtual Reality Environments
Training Laboratory	3D Factory Simulation
Industry 4.0 Technologies Laboratory	Power Electronics Experiments Laboratory
Remote Laboratory	Electro-Pneumatic Laboratory
Virtual Learning Factory	Web-based Virtual Laboratory
Remote and Virtual Labs	

3. Simulation-Related Technologies

Minecraft	Simulation Game
Integrated System for Simulation	3D Simulation Application
360-Degree Videos to Virtual Reality Simulation	Augmented Reality Application
3D Animation-based Augmented Reality Technology	Virtual Reality-Based Training Methods
Twin Version of an RFID-measuring-chamber	Tools to Develop Digital Twin Technology

Digital Learning Environments in Virtual and Augmented Reality

4. Artificial Intelligence

Machine Learning Techniques	Decision Support System	Adaptive User Interface	Model for Graduation Course Evaluation
Chatbot	App Orai	Advanced Correction and Validation System	Learning Analytics Technologies

5. 5. Multimedia

E-modules	E-handouts	Project-based multimedia learning media	App Goodnote
Instructional iBook iBakery		Android-based Instructional Media	Development of Music Videos

6. Internet of Things

IoT System	Wearable Devices Framework	Ontology for a Smart System with Internet of Things Based Architecture	
7. Robotics			
Collaborative Robots	LEGO Mindstorms	Automated Guided Vehicle	
Other technologies that could not be fitted into the categories			
Programming Tool	Cloud Platform	3D Printing Technologies	Engine for Virtual Electrical Engineering Equipment
Instructional Model to Meeting Integration	CATIA Software	Software Study Plan	Computational Programs on Molecular Modeling and Visualization
Workbench-scale Systems	Framework to a Manufacturing System	Procast Software	Computerized Testlet Instrument
Virtual Business Projects Model			

In the literature, especially the following technologies are highly connected to Education 4.0 (Bongomin et al., 2020; Keser & Semerci, 2019):

- Simulation: An instance includes the use of an Augmented Reality application to enhance geometry teaching in elementary schools (Cazzolla et al., 2019).
- Artificial intelligence: Illustrated by the Orai app, offering English audio models and interactive speaking exercises with immediate feedback (Ibrahim et al., 2019).

- Internet of things: An application involves monitoring students' physiological signals in real-time using various sensors, allowing the study of their behavior and response to learning conditions without causing distractions (Ciolacu et al., 2019b).
- Robotics: Exemplified by an Industry 4.0 Laboratory featuring a collaborative robot and automated guided vehicle (Poór et al., 2019).

1.5. Always Connected Generation/Digital Natives and Their Learning Needs

Rishi (2007) highlights how students are always connected through mobile phones, computers, and other technological devices; nevertheless, education providers cannot reach and retain their attention through "traditional" means.

More than 5 billion people worldwide use mobile devices (Weiss, 2017); such as cell phones, iPods, laptops, Tablet PCs, and wireless technologies (Wi-Fi, Bluetooth, GPS, 3G, 4G, satellite systems). Today's students who are always connected to the internet are defined as digital natives. Therefore, the learning needs of these digital natives are different from traditional learners.

Here are some of the learning needs of digital natives:



1. They need to be active in their learning process.

2. They need collaborative learning to apply their knowledge in many situations.

3. They need enriching educational experiences inside and outside the classroom (diversity, collaboration, internships, etc.).
4. They need to be engaged in online courses. Some of the indicators of engagement are interest, enjoyment, improved confidence, attitudes, and improved relationships with peers and teachers are the indicators of engagement (Henrie, Halverson & Graham, 2015). Teachers can use discussion forums, recorded lectures and chat games, discussion boards, chat rooms, and blogs to increase engagement (Bond et al. 2020; Banna, Lin, Stewart & Fialkowski, 2015).
5. They need more flexible learning environments. Teachers can use flipped classroom to let students study at home and do implementations at school.
6. They need personalized learning for their specific needs.

1.6. An Introduction to Technology-Based Active Learning

Utilizing instructional methods that foster active student engagement through meaningful discussions, listening, writing, reading, and reflection on academic subjects promotes deeper levels of thinking and enhances encoding, storage, and retrieval compared to traditional lectures. Active learning is defined as "any strategy that involves students in doing things and thinking about the things they are doing" (Bonwell & Eison, 1991). In essence, students are required to participate in higher-order thinking tasks such as analysis, synthesis, and evaluation to become active learners.

McKeachie and Svinicki (2014) listed the following benefits of active learning:

1. Accessing prior knowledge, which is a key to learning.
2. Finding personally meaningful problem solutions or interpretations.
3. Receiving more frequent and immediate feedback.

4. Retrieving information from memory rather than simply recognizing a correct statement.
5. Increasing self-confidence and self-reliance.
6. Learning to work with other people of different backgrounds and attitudes.

With the usage of Education 4.0 technologies in face-to-face and online classes, students' being active while using them become an issue for both teachers and researchers. The integration of technology in teaching and learning necessitates the incorporation of educational videos, simulations, data storage, database usage, mind-mapping, guided discovery, brainstorming, music, and the World Wide Web (www) to enhance the learning process, making it more fulfilling and meaningful (Ghavifekr & Rosdy, 2015; Kearsley & Shneiderman, 1998; Sherman & Kurshan, 2005). Implementing technology-based teaching and learning put Technology-Based Active Learning (TBAL) on the research agenda of education providers and researchers.




TBAL intends to significantly improve the learning process in face-to-face courses by letting students use different technological devices, such as private smartphones, tablets, or laptops. TBAL has the following characteristics:

1. Establishing an atmosphere conducive to active and experiential learning.
2. Empowering each student to select their preferred technological device.
3. Fostering collaboration and teamwork.
4. Connecting everyone to classroom activities.
5. Generating numerous opportunities for all students to actively engage and express themselves.

With TBAL, students are not bounded to the limited curriculum and resources. On the contrary, there are technology-based hands-on activities in which students can stimulate their understanding of the subject. Moreover, it leads teachers to design more effective, creative, and interesting lesson plans which make students more active learners. Some research shows that technology-based teaching enhances students' learning process and abilities in active learning. For example, Ghilay and Ghilay (2015) indicated that courses grounded in TBAL principles enhanced the learning process for students, providing a highly experiential approach and making a substantial contribution to improved participation, collaboration, and teamwork. Another research highlighted that integrating technology in classes establishes an active learning environment, making the educational experience more engaging and effective for both educators and students (Jadhav, Gaikwad, & Patil, 2022).

TBAL also motivates and engages students of digital natives. On the other hand, teachers need training and support to engage students in highly rich technological environments, such as online classes. You can see the list of videos on engaging students in online classes in Table 5.

Table 5. List of videos on engaging your students in your online classes



Content	QR Code
A simple trick to engage your students during your online classes by Matt Dochniak	
Six tips by Edutopia to engage your students in virtual settings	
Three engaging ways to start your online class by Ashlee Espinosa	

Considering that online teachers are also moderators, Thormann and Fidalgo (2014) provide several fundamental strategies to help teachers in moderating online learning activities (Thornmann & Fidalgo, 2014, p. 385):

1. Foster an environment where students can freely share ideas, take risks, and feel secure and respected.
2. Incorporate synchronous interactions and group assignments.
3. Demonstrate interactions, posing thought-provoking questions as a model.
4. Possess a strong grasp of the course material and structure the course to encourage and expand student learning.
5. Employ introductory or ice-breaker assignments.
6. Be prepared for demanding and dedicated efforts.
7. Encourage student engagement, value diverse perspectives, and offer timely feedback.
8. Collaborate with students in sharing teaching responsibilities and intentionally build a sense of community.
9. Utilize communication and collaboration tools to facilitate personal connections.
10. Clearly outline course guidelines, objectives, and expectations.

In addition to the tips above, Some other sources that can be referred to while moderating the activities in your online classes can be seen in Table 6.

Table 6. Tips for moderating learning activities in online classes

Content	QR Code
Six tips for running online courses by Kirsteen Donaghy, provided by the British Council	
5-Step E-Moderating Model by Dr. Gilly Salmon	

CHAPTER 2

**ENHANCE STUDENTS' BASIC SKILLS THROUGH THEIR ACTIVE INVOLVEMENT
IN THE LEARNING PROCESS (TBAL)**

2.1 Introduction

Basic skills have a crucial effect on the overall development of students. They can be considered as the combination of foundational skills and life skills which are suggested by the WHO that help students to actively engage in the education system and succeed in both the education system and the personal life. Foundational skills can be exemplified as fundamental reading, writing, and mathematical skills. Foundational skills constitute the basis for intellectual and academic development because they are not specific to any academic discipline, on the contrary, they are transferable skills that support the overall development of students in various educational contexts.

Life skills have the equal importance in the development of a student because those skills contribute to the development outside the classroom, in social and emotional dimensions. Communication and interpersonal skills, critical thinking, digital literacy, creativity, adaptability, collaboration and teamwork, resilience, and problem-solving skills are considered as the fundamental skills that enable them to actively navigate in various situations.

The integration of TBAL offers a dynamic approach because by integrating technology such as tools, devices or applications into educational environments, students' foundational and life skills are nurtured. Teachers find unique opportunities and platforms to engage them and draw their full attention to learning. For example, they can participate in collaborative projects and enhance their interpersonal and teamwork skills. Also, teachers can provide them with real-life problems in a digital environment to sharpen their critical thinking and problem-solving skills. This learning approach helps teachers to equip their students with necessary skills that are essential for success and happiness in their lives by providing active engagement to the education.

Teachers can utilise many digital platforms and educational applications to engage students in the activities, so they can support their students' basic foundational skills. Also, life skills can be supported by incorporating technology in the learning process. You can find some examples of how those skills supported by technology integration:

- Digital reading platforms and interactive writing tools support their literacy skills, for instance, they can create digital texts, take part in online discussions, collaborate on writing tasks.
- Educational applications or online tools can be used for interactive maths exercises such as problem-solving scenarios to apply the mathematical calculations into real life-like problems.
- Online quizzes or case studies sharpen their critical thinking skills by providing them an opportunity to analyse, evaluate and decide.
- Collaborative projects by using virtual platforms where students work together, share, and contribute to the task foster their interpersonal and teamwork skills.
- Some multimedia tools and digital platforms encourage students' creativity with presentations or writing/storytelling activities.

2.2 Strengthening Foundational Skills

According to UNESCO's definition, foundational skills (reading, writing, and numeracy skills) are defined as the fundamental learning skills that make the learning possible. Those skills are critical for students because they can't progress in learning without mastering the basics first as the learning happens cumulatively. These skills provide the essential framework for academic success, and personal growth and students have the ability to engage in more complex subjects in the end.

These skills can be supported by technology-enhanced activities because technology ensures self-improvement and autonomy, as well as innovation. You can find some suggestions on how to support skill-building with technology-enhanced activities here:

- e-Books or digital libraries provide access to a wide range of reading materials for different levels and interests. Besides, audiobooks can be helpful for the students who are learning a new language or with hearing impaired.
- Teachers can combine digital books or audiobooks with online interactive reading apps, so they can assign books, comprehension questions, and support collaboration of students on an online platform.
- Online writing platforms provide an environment for collaborative writing and help students work together on a task/project and give feedback to each other. Furthermore, creativity and self-expression skills can be supported by these tools.
- Teachers can use some educational apps that offer interactive math games and activities to engage numeracy skills practice in an enjoyable way.
- Some online platforms that offer virtual manipulatives can be used to visualize the mathematical concepts and improve understanding.

You will find three examples of technology-enhanced teaching activities for each skill below:

(Teacher: T, Student: S)

Table 7. Example of technology-enhanced teaching activities for Reading Skills

Activity Name:	Virtual Book Club
Activity Level:	This activity can be adaptable to a variety of age groups/ levels.
Objective:	To promote collaborative reading and discussion among students using an online platform.
Previous Preparation:	T chooses a book that aligns with the level and interests of the students. T gets familiarized with the chosen online platform.
Necessary Materials/ Technology Tools:	<ul style="list-style-type: none"> ● Selected book ● An online discussion platform <p>(Padlet will be used in this activity: https://padlet.com/)</p>
Instructions:	<ol style="list-style-type: none"> 1. T chooses a book that aligns with the level and interests of the students. 2. T creates a Padlet board for each book. Ss can have their own notes on the board where they can share their thoughts and responses to the reading. 3. T assigns the reading tasks and sets the schedule for Ss to complete the reading. 4. T prepares the discussion prompts for each reading section. These prompts can focus on the characters, themes, plot events, etc.

	<p>5. Ss post their responses and thoughts on the discussion board on Padlet. Also, they can comment on each other's posts.</p> <p>6. At the end of the activity, T and Ss have a reflection session so they can share their overall thoughts on the book. T facilitates the discussion with guide questions.</p>
Benefits:	<ul style="list-style-type: none">● Online platforms provide a safe and controlled learning environment.● This activity encourages students to actively engage with the book and share their insights.● Ss develop critical thinking, analysing, and discussion skills.● The activity promotes collaboration, and respectful communication.

Table 8. Example of technology-enhanced teaching activities for Writing Skills

Activity Name:	Digital Storytelling
Activity Level:	This activity can be adaptable to a variety of age groups/ levels.
Objective:	To encourage creative writing using an online platform
Previous Preparation:	T choses the appropriate online platform for the activity and gets familiarized with it.
Necessary Materials/ Technology Tools:	<ul style="list-style-type: none"> ● An online platform for creating digital stories. <p>Storybird will be used in this activity: https://storybird.com/</p>
Instructions:	<ol style="list-style-type: none"> 1. T chooses a theme that addresses the interests of the Ss. The theme could be related to any specific topic, character, genre, or scenario. 2. T creates a class on Storybird and assigns the theme/topic to the class. T provides students with the class code to join. 3. Ss have time to select images as visuals and write captions accompanying the images. They create their stories. 4. T reviews the draft stories and provide feedback on clarity, coherence, and the language use. 5. T has Ss present their stories in the classroom and other Ss comments on the story to provide feedback. T facilitates the discussion with guide questions.

Benefits:	<ul style="list-style-type: none"> • This activity combines writing skills and digital skills, and it addresses Ss with different learning styles. • It also encourages creativity.
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Table 9. Example of technology-enhanced teaching activities for Numeracy Skills

Activity Name:	Virtual Patterns Building
Activity Level:	This activity can be adaptable to a variety of age groups/ levels.
Objective:	To reinforce Ss understanding of patterns and sequences using virtual tools.
Previous Preparation:	T choses the appropriate online platform for the activity and gets familiarized with it.
Necessary Materials/ Technology Tools:	<ul style="list-style-type: none"> • An online platform or application that enables Ss to manipulate virtual objects. <p>NLVM will be used in this activity: http://nlvm.usu.edu/en/nav/vlibrary.html</p>
Instructions:	<ol style="list-style-type: none"> 1. T begins with explaining the concept of patterns and sequences. 2. T explains them that patterns are repeating sequences of objects, numbers, or shapes. 3. T has Ss access the platform/app and gives them some time to explore the features. T instructs Ss how to use virtual manipulatives, how to arrange the sequences by using shapes numbers or colours.

	<ol style="list-style-type: none"> 4. T asks Ss to use the virtual manipulatives to create their own patterns. For example, they can create a pattern using numbers (3-5-7-9) or colours (red-blue-yellow-red). 5. T encourages Ss to share their patterns with their friends and ask them to explain the rule behind the pattern. 6. As the final step, T provides Ss with a few patterns and challenges them to solve these patterns using the virtual manipulatives.
Benefits:	<ul style="list-style-type: none"> ● This activity provides concrete understanding with a tangible representation of patterns. ● It fosters collaborative and interactive learning.

2.3 Using Technology to Facilitate Active Learning Strategies

Incorporating active learning strategies into the teaching process can have a wide range of benefits for both students and educators. These benefits go beyond just academic outcomes and positively impact the overall learning experience. Active learning is an approach that encourages students to participate actively in their learning experience rather than passively absorbing information. It supports students' engagement, critical thinking skills, communication and collaboration, etc. By incorporating active learning strategies into their teaching process, educators can create a more stimulating and effective learning environment that nurtures students' intellectual growth, curiosity, and love for learning.

Technology allows for personalised learning experiences, catering to the individual needs, preferences, and pace of each student. Adaptive learning platforms can assess a student's strengths and weaknesses, and then provide customised content and learning paths

to optimise their understanding and engagement. Interactive learning materials, such as videos, simulations, animations, and virtual reality, make the learning process more captivating and memorable. Visual and auditory aids can enhance comprehension and retention, particularly for complex subjects. Gamified learning platforms leverage elements of game design to make learning enjoyable and motivating. By incorporating rewards, achievements, and competition, students are encouraged to actively participate and progress in their studies.

Technology-based active learning is a student-centred approach to education that leverages various technological tools and resources to engage learners actively in the learning process. This approach goes beyond the traditional passive learning methods, where students simply receive information from teachers or textbooks. Instead, it encourages students to become active participants in their own learning journey, fostering critical thinking, problem-solving skills, and a deeper understanding of the subject matter. By integrating technology effectively into the learning experience, educators can create dynamic and engaging educational environments that foster a deeper understanding and retention of knowledge among students.

2.3.1 Integrating Technology in Problem-Based Learning


Problem-based learning is a student-centred approach where students learn about a subject by working in groups to solve an open-ended problem. Using technology to facilitate problem-based learning can greatly enhance students' critical thinking and problem-solving skills. Here are some strategies to achieve this:

- Online Simulations and Virtual Labs
- Using Digital Tools
- Collaborative Problem-Solving with Online Tools

- Web-Based Research and Information Analysis
- Game-Based Learning
- Debates and Discussions with Online Tools
- Flipped Classroom Techniques
- Data Analysis and Visualization Tools

By leveraging these technology-driven strategies, educators can create an engaging and dynamic learning environment that fosters critical thinking, problem-solving, and analytical skills, preparing students to tackle real-world challenges effectively. On the other hand, online simulations, virtual experiments, and real-world case studies are excellent technology tools that facilitate problem based learning.

Table 9. Example of technology tools that facilitate problem based learning

Online Simulations	PhET Interactive Simulations (https://phet.colorado.edu/) 	It is a platform developed by the University of Colorado Boulder that offers a wide range of interactive simulations across various subjects like physics, chemistry, biology, and mathematics.
Virtual Experiments	The Virtual Chemistry Lab	It is an online platform that offers virtual chemistry experiments. Students can practice various laboratory



	<p>(http://chemcollective.org/vcl)</p> 	<p>techniques and perform experiments using virtual chemicals and equipment</p>
Real-World Case Studies	<p>Harvard Business Publishing</p> <p>(https://hbsp.harvard.edu/collections/case-studies)</p> 	<p>It offers a vast collection of real-world case studies covering business management, entrepreneurship, marketing, and more.</p>

2.3.2 Leveraging Technology for Project-Based Learning

Technology can significantly enhance project-based learning experiences by providing tools and resources that foster collaboration and creativity among students. It not only enhances collaboration and creativity but also empowers students to take ownership of their learning, develop essential 21st-century skills, and apply their knowledge to real-world scenarios in innovative ways.

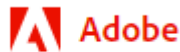
Here you can find some popular and versatile tools for project planning, multimedia creation, and presentations:

Table 10. Example of some popular and versatile tools for project planning, multimedia creation, and presentations

Project Planning	
<p>Trello (https://trello.com/)</p> 	<p>Trello is a visual project management tool that uses boards, lists, and cards to organise tasks, deadlines, and progress. It's great for individual or team-based project planning, allowing users to track project stages and collaborate effectively.</p>
<p>Asana (https://asana.com/)</p> 	<p>Asana is another popular project management platform that enables users to create tasks, assign them to team members, set deadlines, and monitor progress. It offers a wide range of integrations with other tools, making it suitable for larger projects and teams.</p>
<p>Microsoft Planner (https://www.microsoft.com/en-us/microsoft-365/business/task-management-software)</p> 	<p>Part of Microsoft 365, Planner is a task management tool that integrates well with other Microsoft applications. It's especially useful for those already using Microsoft's suite of productivity tools.</p>

Multimedia Creation

Adobe Creative Cloud
(<https://www.adobe.com/creativecloud.html>)



Adobe's suite of creative applications includes Photoshop for image editing, Illustrator for vector graphics, Premiere Pro for video editing, and more. These tools are industry-standard for multimedia creation.

Canva (<https://www.canva.com/>)



Canva is a user-friendly graphic design platform that offers a vast library of templates, images, and design elements. It's suitable for creating social media graphics, posters, infographics, and other visual content.

Powtoon (<https://www.powtoon.com/>)







Powtoon is a cloud-based tool for creating animated presentations and videos. It's ideal for adding an engaging touch to presentations and explaining complex concepts through animations.

Presentations

Microsoft PowerPoint
(<https://www.microsoft.com/en->

PowerPoint is a widely-used presentation software that provides a range of templates, slide designs, and multimedia

<p>us/microsoft-365/powerpoint)</p> 	<p>integration. It's suitable for both simple and sophisticated presentations.</p>
<p>Google Slides (https://www.google.com/slides)</p> 	<p>Google Slides is a free cloud-based alternative to PowerPoint, offering collaboration features and easy sharing. It's excellent for collaborative group presentations.</p>
<p>Prezi (https://prezi.com/)</p> 	<p>Prezi is a dynamic presentation tool that uses a zooming user interface to create visually engaging presentations. It's especially effective for storytelling and non-linear presentations.</p>
<p>Keynote (https://www.apple.com/keynote/)</p> 	<p>Keynote is Apple's presentation software, known for its sleek design and ease of use. It's available for macOS and iOS devices.</p>

Each of these digital tools brings its unique features and capabilities, allowing users to plan and execute projects efficiently, create visually appealing multimedia content, and deliver engaging and compelling presentations. Depending on individual preferences, project requirements, and platform compatibility, users can choose the tools that best suit their needs.

2.3.3 Enhancing Inquiry-Based Learning with Technology


The internet is a treasure trove of information, and technology allows students to access a wide range of online resources such as websites, educational databases, digital libraries, and academic journals. They can conduct research, find answers to their questions, and explore diverse perspectives on various topics. Search engines like Google, Bing, and specialised databases make it easy for students to find relevant and credible information quickly. Technology enables students to refine their search queries, filter results, and explore specific topics in-depth, supporting their curiosity-driven inquiries. What is more, Virtual reality (VR) and augmented reality (AR) technologies offer immersive learning experiences. Students can virtually visit historical sites, explore ecosystems, or travel to different parts of the world, fostering curiosity and enhancing research skills through interactive and hands-on learning. Access to a plethora of educational apps and games that engage students in interactive and inquiry-driven learning experiences technology is the best way. These apps and games often present challenges, puzzles, and simulations that prompt students to think critically and investigate to find solutions. Adding to these, Technology facilitates online discussion forums and collaboration platforms promote collaborative inquiry and allow students to learn from one another. Creating blogs or vlogs can encourage students to share their findings, ideas, and reflections on various topics. In content creation and dissemination, technology allows students to showcase their research skills and share their discoveries with a broader audience.

Adding to this, massive Open Online Courses (MOOCs) and online learning platforms provide opportunities for students to explore their interests and curiosities beyond the traditional classroom setting. Technology offers various digital note-taking and organisational tools, such as Evernote, Microsoft OneNote, and Google Keep. Students can use these tools

to organise their research, jot down ideas, and keep track of their sources efficiently. Citizen Science projects are the best resources to allow students to contribute to real scientific research, fostering curiosity and research skills in the process.

By leveraging technology in these ways, educators can create an environment that encourages curiosity, nurtures research skills, and empowers students to take ownership of their learning journey through inquiry-based exploration. Technology enhances the learning experience by providing students with the tools they need to investigate, question, and delve into subjects of interest while fostering a lifelong love for learning.

Table 11. Examples of online research databases, data visualisation tools, and interactive learning platforms

Online Research Databases	
<p>PubMed (https://pubmed.ncbi.nlm.nih.gov/):</p> 	<p>PubMed is a free resource for accessing biomedical literature. It provides access to millions of research articles from reputable journals and includes a wide range of topics related to medicine, health sciences, and life sciences.</p>
<p>IEEE Xplore (https://ieeexplore.ieee.org/Xplore/home.jsp)</p>	<p>IEEE Xplore is a digital library for accessing research articles, conference papers, and standards in the fields of engineering, computer science, and technology.</p>

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JSTOR (<https://www.jstor.org/>)



JSTOR offers a vast collection of academic journals, books, and primary sources in various disciplines, including arts, humanities, social sciences, and more

Data Visualization Tools

Tableau Public

(<https://public.tableau.com/en-us/s/>)



Tableau Public is a data visualization tool that allows users to create interactive and visually appealing charts, graphs, and dashboards. It's widely used for presenting data-driven insights and stories.

Infogram (<https://infogram.com/>)



Infogram is an easy-to-use tool for creating infographics, charts, and maps. It offers a variety of templates and customization options for visually representing data.

Datawrapper

(<https://www.datawrapper.de/>)

Datawrapper is a simple yet powerful data visualization tool that enables users to create interactive charts and maps. It's

Datawrapper

designed for journalists, researchers, and educators to visualize data effectively.

Interactive Learning Platforms:

Khan Academy

(<https://www.khanacademy.org/>)



Khan Academy offers a wide range of interactive lessons and exercises in subjects like mathematics, science, history, arts, and more. The platform provides personalized learning paths and tracks students' progress.

Coursera (<https://www.coursera.org/>)



Coursera is an online learning platform that partners with universities and organizations to offer courses, specializations, and degree programs. It provides interactive video lectures, quizzes, and assignments to facilitate learning.

Duolingo (<https://www.duolingo.com/>)



Duolingo is a popular language-learning platform that uses gamification and interactive exercises to teach languages. It offers bite-sized lessons and tracks users' language proficiency.



*Web-based digital education tools teacher guide book
prepared by the Republic of Turkey General Directorate
of Secondary Education

2.4 Assessment in Technology-Based Active Learning

Assessment helps the students to demonstrate their learning, provide feedback on their errors, and provide opportunities to better their performance. It has a crucial importance in the acquisition of targeted competence because it helps to measure learning, understand the learning gaps and errors, motivate the learners, evaluate the teaching quality, provide feedback, and increase the overall improvement.

Integration of technology has become inevitable these days because of the unexpected challenges such as the pandemic we face. Apart from the necessity, it provides several benefits for the assessment: a more complete picture of students' needs and abilities than a traditional assessment procedure. Technology-based assessment has a unique contribution, for example:

- It allows teachers to use a variety of question types instead of traditional assessment ways.
- Complex competencies can be assessed together.
- Teachers can provide real-time feedback.
- It increases accessibility.
- Assessment can be adapted to the students' ability and learning style.
- It eases to embed the assessment with the learning process.

Despite all the advantages, there might be some challenges such as technical problems, inequality in accessing technology, being distractive for students, and lack of authenticity. However, effective assessment in technology based activities can be implemented effectively with teacher training and awareness.

There are two types of assessment used in education to evaluate student learning: Formative and summative assessment.

- **Formative Assessment:** It aims to collect ongoing feedback on student learning during teaching and it helps to monitor student progress and identify the areas of improvement. It helps students actively engage with the material and make continuous improvement. Also, they receive real-time feedback so they can correct misconceptions and errors.
- **Summative Assessment:** It aims to evaluate what students have learned at the end of a specific period and it is used to evaluate the final student performance. It provides a comprehensive picture of what they have learned, and it is generally used for certifying student success.

Table 12. Differences of formative and summative assesment

FORMATIVE	SUMMATIVE
<ul style="list-style-type: none"> · During the learning · Usually not graded · Various techniques and measures 	<ul style="list-style-type: none"> · After the learning · Graded · Limited variety of techniques and measurs

Evaluating the final level of learning and certifying the success is quite important for formal reasons, yet, the effective assessment should be identifying and responding to the students' learning needs, in other words, it should be formative.

Most of the teachers adopt some aspects of formative assessment but it is not generally practised systematically. It is shown that formative assessment is highly effective in raising the level of student engagement and improving the ability to learn. Teachers can adapt their teaching method to meet the needs and address the different learning styles of each student during teaching with the help of formative assessment. It also provides an opportunity to give real-time feedback and correct misconceptions or errors before they become permanent. It also contributes to "learning to learn" skills by emphasising the process of learning and involving students as partners in that process.

In line with these assessment types, there are several methods to adopt in technology-based activities:

- Teachers can create rubrics to define the level of comprehension during or at the end of the learning activity.
- Portfolio assessment can be used to get a comprehensive view of a student's progress over time.
- Incorporating some online platforms that allows students to evaluate the other's work and give feedback can be beneficial for peer assessment.
- Self-assessment is another way of these methods, and it can be integrated in tech-based activities. Teachers can use checklists, journals, or forms to help students' self-reflection.
- Project or task-based assessment can be beneficial to identify the level of understanding and learning in a period.

- Online quizzes or tests that include different types of questions can be helpful for assessment.
- Teachers can have their students present a topic to see the student's ability to communicate and showcase the work.
- Online discussion platforms could be useful to assess various aspects of learning.

Ensuring an effective assessment in technology-based active learning environments requires a systematic approach and careful planning. You can find some suggestions to smooth the assessment process in TBAL:

- Always be aware of the learning objectives of the activity and make sure that assessment aligns with them.
- Using merely one type of assessment limits the information you can gather. You should incorporate a variety of assessment methods to get different aspects of student learning.
- It is crucial to inform students about the assessment criteria in advance.
- Encourage self-assessment by having students reflect on their own learning and ask them to evaluate their performance.
- Remember that assessment is two-folded, you should assess both the process and the final acquisition of the targeted knowledge/competence.
- Create an environment for collaborative projects to encourage peer assessment.
- Utilise technology tools that are designed for assessment such as online quizzes, and platforms.
- You should provide timely and constructive feedback to enhance the learning experience.

- Analyse the data collected from the assessment and reflect on them to adjust the teaching strategies, modify the content, and provide additional support.

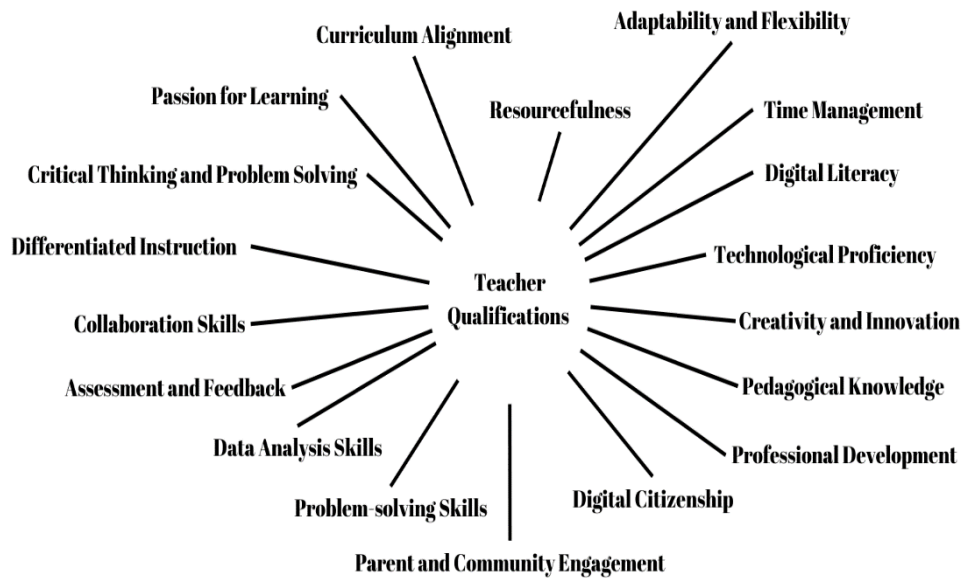
By following these suggestions, teachers can implement effective assessment of TBAL activities and enhance active learning, critical thinking and gain valuable insights into the student progress.

CHAPTER 3

EFFECTIVE USE OF NEW TECHNOLOGIES

3.1 Introduction

Table 13. Qualifications of the teachers



To effectively integrate technology into education, teachers should possess the following qualifications and skills:

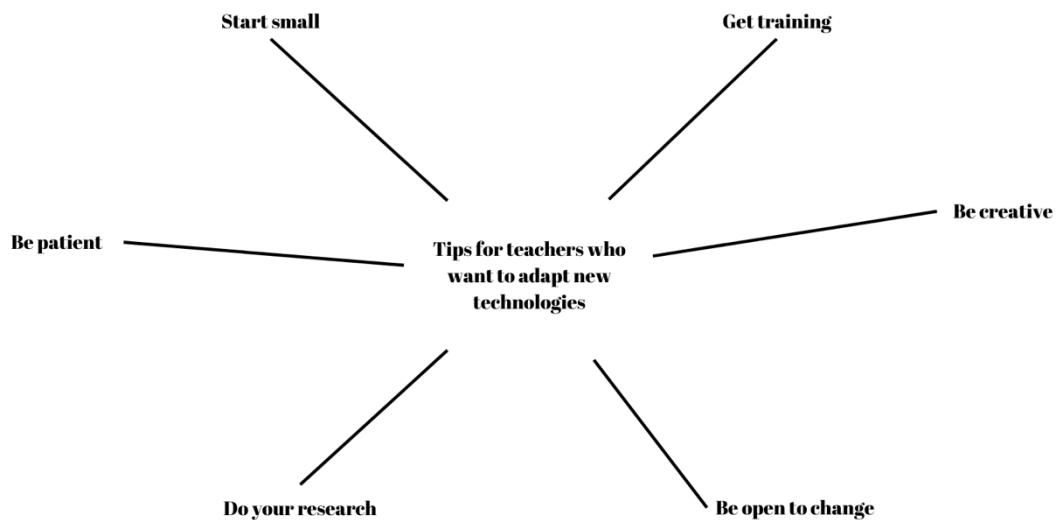
- **Technological Proficiency:** Teachers should be proficient in using various forms of technology, including computers, tablets, educational software, and online platforms.
- **Digital Literacy:** They should have a strong understanding of digital tools, internet safety, online research, and digital communication.
- **Pedagogical Knowledge:** Teachers should understand how to incorporate technology into the curriculum to support learning objectives and engage students effectively.
- **Adaptability and Flexibility:** Being able to adapt to new technologies and being open to experimenting with different tools and platforms is crucial.
- **Curriculum Alignment:** They should know how to align technology usage with curriculum standards and learning objectives.

- **Critical Thinking and Problem Solving:** Teachers should be able to guide students in using technology to solve problems and think critically about information.
- **Differentiated Instruction:** Knowing how to use technology to cater to different learning styles and abilities is important for personalized learning.
- **Collaboration Skills:** Encouraging collaboration among students through technology is essential for group projects and discussions.
- **Assessment and Feedback:** Teachers should be able to use technology for formative and summative assessment, as well as providing timely and constructive feedback.
- **Data Analysis Skills:** Understanding how to analyze data from educational technology tools to track student progress and make informed instructional decisions.
- **Digital Citizenship:** Teaching students about responsible and ethical technology use, including issues like online safety, cyberbullying, and digital privacy.
- **Creativity and Innovation:** Being able to use technology in creative and innovative ways to enhance learning experiences.
- **Professional Development:** Actively seeking out and participating in ongoing professional development opportunities related to educational technology.
- **Parent and Community Engagement:** Communicating with parents and involving them in discussions about technology usage in the classroom.
- **Problem-solving Skills:** Troubleshooting technical issues and finding solutions independently or with the help of IT support.
- **Time Management:** Effectively managing time to plan lessons that incorporate technology, as well as allocating time for students to use technology in a productive manner.

- **Resourcefulness:** Being resourceful in finding and using technology tools and resources that are suitable for the classroom.
- **Passion for Learning:** Having a genuine interest in staying up-to-date with new technologies and their potential applications in education.

Having these qualifications and skills enables teachers to not only use technology effectively, but also to inspire and engage students in meaningful learning experiences. Additionally, ongoing professional development and a growth mindset are important for staying current in the ever-evolving landscape of educational technology.

Table 14. Tips for teachers who want to adapt new Technologies in Education

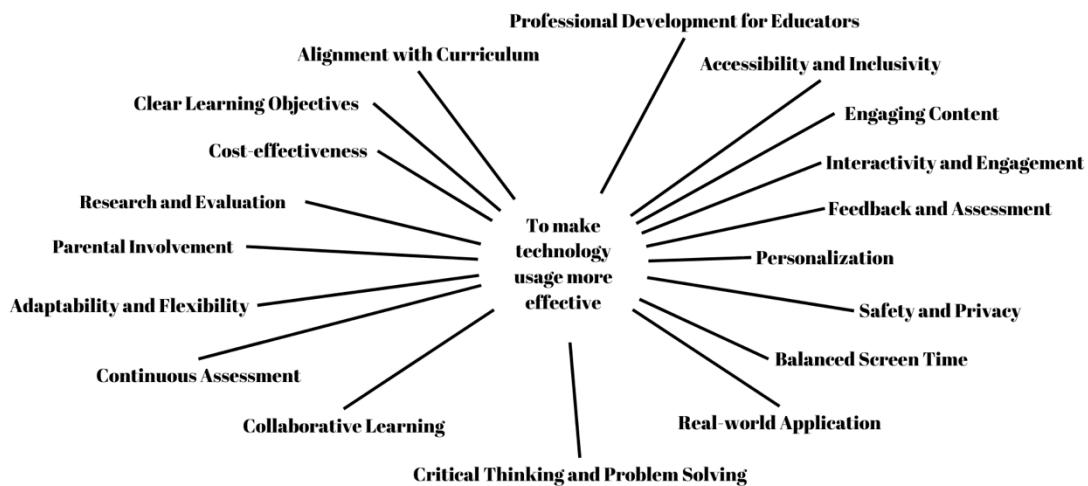


Here are some tips for educators who want to adopt technology in the classroom:

- **Start small.** Don't try to change everything at once. Start by incorporating a few technology-based activities into your lessons.
- **Get training.** If you're not familiar with the technology you want to use, get training. There are many resources available to help you learn how to use technology in the classroom.
- **Be patient.** It takes time to learn how to use technology effectively in the classroom. Be patient with yourself and with your students.
- **Be creative.** There are endless possibilities for using technology in the classroom. Be creative and find ways to use technology that are engaging and meaningful for your students.
- **Be open to change.** Emerging technologies are constantly evolving. Be open to change and be willing to adapt your business as needed.
- **Do your research.** Before you adopt any emerging technology, it is important to do your research and understand the risks and benefits.

The future of education is digital, and educators who want to prepare their students for success need to embrace technology adoption. By using technology in the classroom, educators can help their students develop the skills they need to succeed in the digital world.

Table 15. Essential Factors for Effective New Technology Use in Education



To make the usage of technology effective in education, consider the following important points:

Clear Learning Objectives: Define specific educational goals and outcomes that technology will support and enhance.

Alignment with Curriculum: Ensure that the technology used aligns with the existing curriculum and supports the learning objectives.

Professional Development for Educators: Provide training and ongoing professional development for educators to effectively integrate and utilize technology in their teaching practices.

Accessibility and Inclusivity: Ensure that the technology used is accessible to all students, including those with diverse learning needs.

Engaging Content: Use technology to deliver content in a way that is interactive, engaging, and relevant to the students.

Interactivity and Engagement: Incorporate interactive elements that allow students to actively participate and engage with the content.

Feedback and Assessment: Utilize technology to provide timely and constructive feedback to students, and to assess their progress and understanding.

Personalization: Leverage technology to tailor learning experiences to individual student needs, interests, and abilities.

Safety and Privacy: Implement measures to ensure the safety and privacy of students when using technology, including compliance with data protection regulations.

Balanced Screen Time: Maintain a balance between screen-based learning and other forms of educational activities to prevent over-reliance on technology.

Real-world Application: Use technology to simulate real-world scenarios, allowing students to apply their knowledge and skills in practical contexts.

Critical Thinking and Problem Solving: Encourage the use of technology to foster critical thinking, problem-solving, and analytical skills.

Collaborative Learning: Facilitate collaboration among students through the use of technology, allowing them to work together on projects and assignments.

Continuous Assessment: Implement ongoing formative assessment practices facilitated by technology to monitor student progress and adjust instruction as needed.

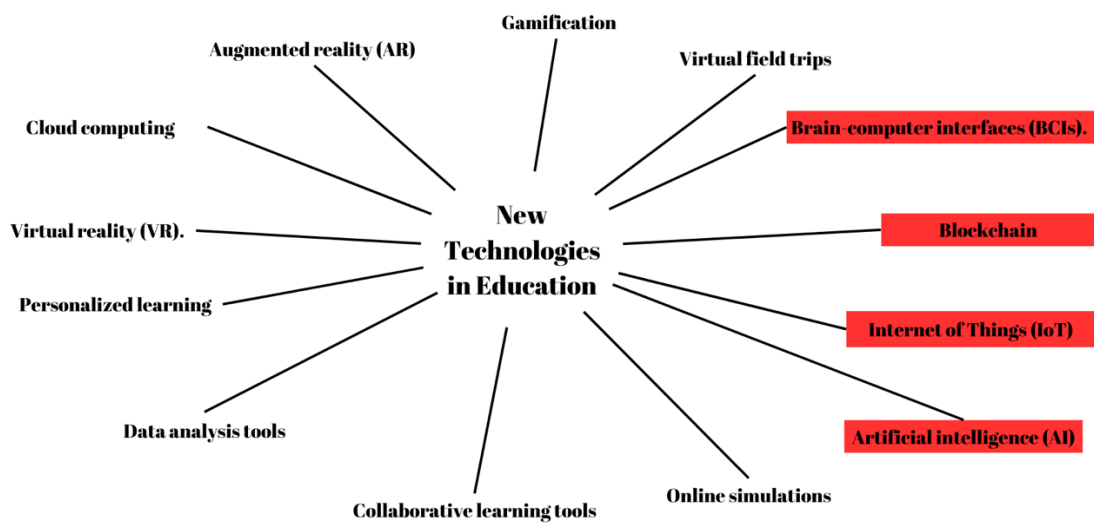
Adaptability and Flexibility: Stay open to adopting new technologies and adapt to changing educational needs and trends.

Parental Involvement: Involve parents and guardians in understanding how technology is being used in education and its benefits for their children.

Research and Evaluation: Continuously assess the impact of technology on learning outcomes and make data-driven decisions to refine and improve its effectiveness.

Cost-effectiveness: Evaluate the costs associated with adopting and maintaining technology, ensuring that it provides value and benefits to the educational institution. By addressing these important points, educators and institutions can effectively leverage technology to enhance the learning experience and prepare students for success in a technology-driven

Table 16. Integration of New Technologies in Educational Environments*



**Technologies shown in red box are not being used widely for education for now.*

As mentioned in previous parts, there are several technologies be used in the classrooms. The most important thing is the effective usage of the technologies. For all technologies, there are some tips that make usage of the technology more effective.

These are;

1. Choose the right technology that is aligned with your curriculum.

There are many different technologies available online, so it is important to choose one that is relevant to the topic you are teaching. This will help students to make connections between what they are learning in the classroom and the real world.

2. Set clear learning objectives for using technology.

What do you want your students to learn from the experience? Once you know your objectives, you can tailor the technological advantages to meet those needs. For example, you might want to pause the video at certain points to ask students questions or have them complete activities.

3. Prepare your students for using the technology.

Talk to them about what to expect and what they should be looking for. You may also want to provide them with a handout or worksheet to help them focus their attention during the class.

4. Make the usage of technology interactive.

Encourage students to ask questions, make observations, and discuss what they are seeing. You can also have them complete activities during or after the class, such as writing a reflection, creating a presentation, or designing a model.

5. Follow up on the technology usage.

After the class, take some time to discuss what students learned and how they can apply that knowledge to their own lives. You may also want to have them complete a project or assessment to demonstrate their understanding.

6. Give feedback.

Once students have completed their tasks, be sure to give them feedback on their work. This will help them to learn from their mistakes and improve their ability to use technology.

Extra tips for using some new Technologies effectively in class;

- 1. Virtual field trips:** Students can use technology to take virtual field trips to places they would not otherwise be able to visit, such as historical sites, museums, or even other countries.

 - ✓ Use a projector or large screen so that all students can see the virtual field trip clearly.
- 2. Online simulations:** Students can use online simulations to learn about complex concepts or to practice skills in a safe environment.

 - ✓ If you are using an online simulation that is interactive, make sure that all students have access to a device that they can use to participate
- 3. Collaborative learning tools:** Students can use collaborative learning tools to work together on projects or to share ideas.

 - ✓ Students can use a collaborative learning tool to work on a group math problem. They can share their work on a whiteboard, and then discuss and solve the problem together
- 4. Data analysis tools:** Students can use data analysis tools to learn how to collect, organize, and interpret data.

 - ✓ Use technology to enhance the learning experience. There are many great online resources and tools available to help students learn about data analysis.
- 5. Virtual reality (VR) :** VR allows students to experience different environments and situations in a realistic way. This can be used to teach students about different cultures, historical events, or scientific concepts.

 - ✓ Be prepared to answer students' questions and help them to make connections between the VR experience and their classroom learning.

6. Augmented reality (AR) : AR overlays digital information onto the real world. This can be used to help students learn about their surroundings, or to provide them with additional information about a topic.

- ✓ Encourage students to be creative and think outside the box when responding to the AR experience.

7. Gamification

Gamification uses game-like elements to make learning more engaging and fun. This can be done by creating points, badges, or leaderboards for students to earn, or by using games to teach concepts.

- ✓ Don't rely too heavily on a single game element, such as points. Instead, use a variety of different game elements to keep students engaged.

8. Personalized learning

- ✓ Personalized learning uses technology to tailor instruction to each student's individual needs. This can be done by using adaptive learning software, or by providing students with different learning materials and activities based on their interests and abilities.

- ✓ Be flexible. Personalized learning is not a one-size-fits-all approach. Be willing to adjust your plans as needed to meet the needs of your students.

9. Cloud computing.

Cloud computing allows students to access educational resources from anywhere. This can be used to give students more flexibility in their learning, or to provide them with access to resources that would not be available in their school.

- Use cloud computing to enhance your existing teaching practices. Don't try to replace your existing teaching practices with cloud computing tools. Instead, use cloud computing to enhance your existing practices and to make them more effective.

10. Robotics: Robotics is a rapidly growing field with many potential applications in education. Educational robotics is the use of robots in the classroom to teach students about science, technology, engineering, and mathematics (STEM).

- Provide training for teachers and students. If you are new to using robots in the classroom, it is important to provide training for teachers and students on how to use the robots safely and effectively.

11. Coding: Coding education is the process of teaching students how to write code. Coding is the language of computers, and it is used to create software programs, websites, and apps.

- Start with the basics. Don't expect students to be able to code complex programs right away. Start with the basics, such as loops, conditional statements, and functions.

These are just a few of the many innovative educational technologies that are being used in classrooms today. As technology continues to evolve, we can expect to see even more innovative ways to use technology to improve learning.

Here are some additional innovative educational technologies that are emerging:

- **Blockchain:** Blockchain is a secure and transparent way to store data. This could be used to create tamper-proof records of student transcripts, or to track the progress of students through a learning program.
- **Artificial intelligence (AI):** AI can be used to personalize learning, provide feedback to students, and even grade assignments. AI is still in its early stages of development, but it has the potential to revolutionize education.

- **Brain-computer interfaces (BCIs):** BCIs allow users to control computers and other devices with their thoughts. This could be used to help students with disabilities learn more effectively, or to create new ways of interacting with educational content.
- **Internet of Things (IoT):** The IoT is a network of physical devices that are connected to the internet. These devices can collect and share data, which can be used to improve efficiency, safety, and productivity.

These are just a few of the many innovative educational technologies that are emerging. As technology continues to evolve, we can expect to see even more innovative ways to use technology to improve learning.

Finally, by adopting technology in the classroom, educators can help their students develop the skills they need to succeed in the digital world. They can also help students become more engaged in their learning and more prepared for the challenges of the future.

3.2.Exploring Robotics in Education

There are many different ways to use robotics in education. Some common activities include:

- **Designing and building robots:** Students can use their creativity and engineering skills to design and build robots.
- **Programming robots:** Students can learn how to program robots to perform tasks.
- **Using robots to solve problems:** Students can use robots to solve real-world problems, such as finding the best route to deliver a package or sorting recyclables.
- **Competing in robotics competitions:** There are many robotics competitions that students can participate in. These competitions can help students develop their skills and learn from other teams.

Educational robotics is a valuable tool that can be used to teach students about STEM and prepare them for the future workforce. If you are interested in using robotics in your classroom, there are many resources available to help you get started.

If you are interested in using educational robotics in your classroom, there are many resources available to help you get started.

Here are a few websites that you can check out:

- FIRST: <https://www.firstinspires.org/>
- Robotics Education in the Schools: <https://www.roboticseducation.org/>
- The National Robotics Education Association: <https://www.nrea.org/>

Here are some additional resources that you may find helpful:

- FIRST: <https://www.firstinspires.org/>: FIRST is a non-profit organization that provides robotics programs for students of all ages.
- Robotics Education in the Schools: <https://www.roboticseducation.org/>: Robotics Education in the Schools is a website that provides resources for teachers who are interested in using robotics in their classrooms.
- The National Robotics Education Association: <https://www.nrea.org/>: The National Robotics Education Association is a professional organization that provides support and resources for robotics educators.

3.3 Embracing Coding Education

Embracing coding education can provide students with many benefits. By learning how to code, students can develop problem-solving skills, creativity, and prepare for a career in technology.

Here are some additional resources that you may find helpful:

- Codecademy: <https://www.codecademy.com/>
- Khan Academy: <https://www.khanacademy.org/computing/computer-programming>
- Scratch: <https://scratch.mit.edu/>
- Code.org: <https://code.org/>

Despite these challenges, the potential benefits of leveraging emerging technologies are significant. Businesses that are able to successfully adopt these technologies will be well-positioned for the future.

3.3 Considering the pros and cons of technology use in the design of active learning in and out-of-school contexts

Table 16. Educator's Guide to Leveraging Technology-Based Active Learning

<p>↗ TBAL provides positive outcomes for in-school context in the form of personalized education, instant feedback, reduced burden of administrative tasks for teachers, higher student engagement, motivation and collaboration;</p> <p>↗ The use of interactive content, such as VR, video games, but also Online social networks (OSN) is essential to promote the positive outcomes of TBAL;</p> <p>↗ As for the Out-of-School, flexibility, higher range of resources, promotion of Digital Literacy, lifelong learning, collaboration and ecological validity the main positive outcomes of TBAL;</p> <p>↗ Use of multimedia content, video games, simulations, OSN, surveys/quizzes, VR/AR solutions, gamification, collaborative and communication tools improve motivation and engagement in both contexts;</p>
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- ↗ Avoid over-reliance, distraction and misuse, and fight health concerns by mixing digital activities with traditional face-to-face non-digital activities;
- ↗ Teacher and schools should work to have digital equipments dedicated to learning to avoid distractions, namely the ones posed by notifications from social media and other apps;

3.3.1. The positive role of technology in learning: making the case for TBAL

- Benefits of technology-based active learning (TBAL) in both in-school and out-of-school contexts.

As mentioned before, TBAL assumes itself as a powerful tool in the context of education as it becomes increasingly implemented. Promoting student engagement in active learning with integrated technology offers a myriad of advantages, namely in two radically different contexts: in-school and out-of-school contexts:

3.3.1.1. In-School Contexts

Technology can be an enabler of **personalized education** since it increases the potential for tailored content that is set on individual student needs and pace of learning. With this, not only the best students can achieve an even higher level of learning, but it also enhances the learning of students with disabilities or the ones who often struggle with the broad standards defined for their classes. In this regard, **feedback** is often seen as extremely relevant. Technology speeds up this process through the use of simple tools, such as questionnaires, surveys, or task performance that would without the use of technology take a lot of time to assess. Concomitantly, it saves time for teachers and reduces the **burden of administrative tasks** that often act as a diversion for teachers from the important task of actually teaching. This also is interlinked with the promotion of **engagement** that the use of

technology can draw. Technology is pervasive in the lives of learners, namely school-aged students. Using the potential of video games, Virtual reality/augmented reality/mixed-reality, gamified environments, and online social networks (OSNs) can boost **participation and engagement** through increased motivation and a familiar context mostly associated with leisure activities. OSNs can seemingly connect students from all over the globe while improving the potential for **collaboration** (a key feature of TBAL), namely in addressing very complex problems. All the above mentioned features have one thing in common: **interactive content**. This is an extremely important feature of TBAL, that can be achieved also with more simple technology-based solutions, such as interactive videos, simulations, and role-playing. Visual elements can simplify abstract concepts by creating a context in which they can be materialized and easily depicted.

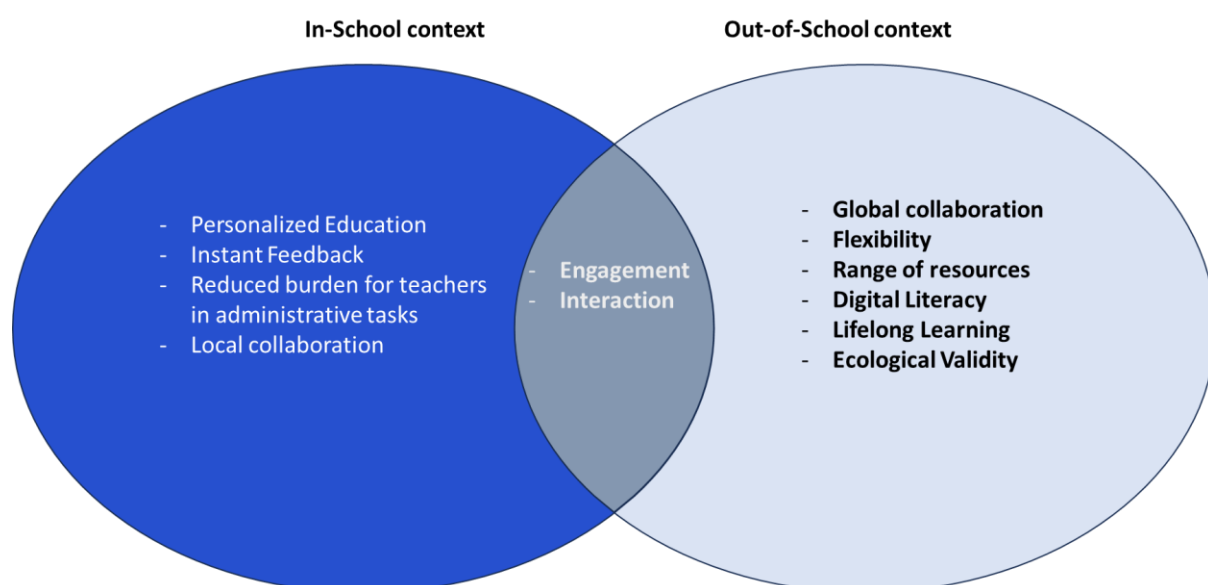
3.3.1.2. Out-Of-School Contexts:**

Out-of-school contexts (OOSC) can also benefit from some of the abovementioned advantages of TBAL but can also benefit from others. If differentiated pacing is often seen as hard in in-school learning, the **flexibility** offered by TBAL can be harvested in a more evident fashion in OOSC, in which the student's pace and needs can be more evidently accounted for -location, schedule, and activities can be individualized, empowering students as key actors in the learning process. The **range of resources** that can be harvested by students is considerably increased by TBAL, in comparison with traditional learning. However, videos, blogs/Vlogs, MOOCs, or interactive books (e-books) can add to the arsenal of tools at the disposal of teachers and learners to improve learning outcomes and are not exclusive to the OOSC. An added value and arguably unintentional positive outcome of this is the improvement in **digital literacy**, often overlooked in traditional curricula. TBAL breaks the barriers of conventional education and is a fundamental tool for **lifelong learning**, in which

MOOCs have shown their incredible potential, again improving **collaboration**, and the sense of belonging and extending students' access and reach to educational actors not accessible in in-school learning. Lastly, OOSC can take students out of the frequently artificial context of school learning and take them to a context in which skills can be translated into reality, often defined as **ecological validity**.

As can be seen in Table 17, there is a clear and desirable overlap between in-school and OOSC, in which features such as **engagement** and **interaction** are common.

Table 17. Advantages of TBAL in both the in-school and Out-of-school contexts



The above mentioned advantages are clearly demonstrated by previous research, and while the outcomes for students are frequently the focus (Stranford et al, 2020; Ghilay & Ghilay, 2015;), active learning with the use of technology can also have positive outcomes for lecturers (Tien & Hamid, 2020; Sitthiworachart et al, 2022).

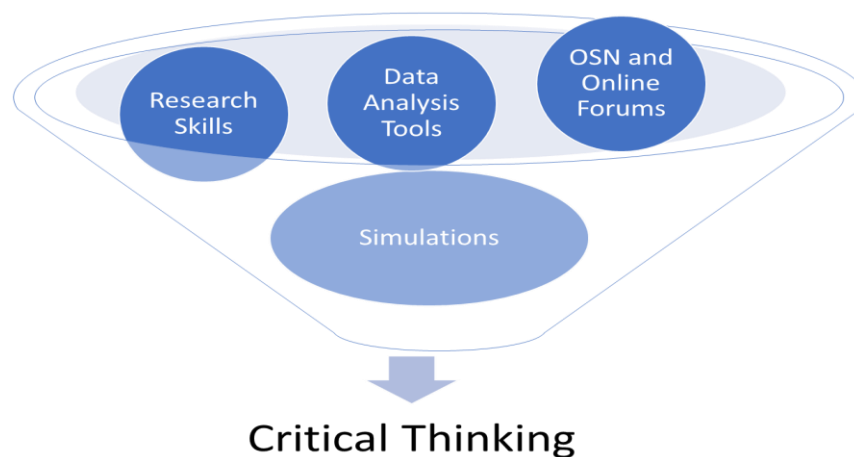
- Beyond engagement and collaboration, critical thinking development through technology inside and outside the classroom.

The use of technology, as mentioned above, can have a significantly noticeable effect on students' learning as it creates a context that is familiar, engaging, and flexible. The impact of technology on **engagement** -through familiar and interactive solutions such as multimedia content, video games, simulations, OSN, surveys/quizzes, VR/AR solutions, and gamification- has been asserted in this chapter, as well as its impact on **collaboration**, in which collaborative tools (i.e. Google Suite, Office 365, Padlet), OSN (i.e. Facebook, Instagram, TikTok) and dedicated communication tools (i.e. Discord, Zoom, Microsoft Teams) are key elements on the positive influence of technology, namely on in-school learning. However, the impact of technology can be felt also in shaping the way information is apprehended and the changes in the thought process. In this regard, technology can be integrated into both in-school and OOSC.

At a time in which **critical thinking** has become increasingly important, technology assumes itself as an enabler of more profound changes in the student's profile, improving skills and the translation of traditional learning into the real-world context in which they will ultimately have to apply their knowledge. Figure XX2 synthesizes information on this important role. In societies in which information can be overwhelming, and is consumed superficially and at a rapid pace, developing students' **research skills** is paramount for critical thinking. Technology facilitates access to information and fosters curiosity and critical reflections on events, news, and opinions. To assist, **data analysis tools**, ranging from simple online dashboards to complex Excel, SPSS, R, and other statistical software outputs and statistical analysis can provide students with much-needed data to be able to analyze reality in a more objective and robust fashion. This can be incremented even further if **simulations**

are used, namely, the ones related to complex problem-solving affecting their everyday lives (i.e. climate change, war, digital transition). Lastly, being confronted with similar and, most importantly, different opinions and perspectives in **online forums and OSN** public discussions can significantly increase reflexive thought, and questioning, essential for critical thinking skills. Specifically for OOSC, the role of MOOCs (i.e. Coursera, Edx, LusofonaX), online forums, and OSN is easily identified as a facilitator of education.

Table 18. Technological tools and features as enablers of Critical Thinking Development



- Examples of technology integration into active learning.

Regardless of the learning environment, technology integration into active learning can have a positive impact on learning outcomes and student engagement and motivation. From the use of interactive whiteboards in K-12 education to the role of Learning Management Systems (LMS) in most educational contexts, and simulations/virtual labs, VR/AR, and gamification in higher education and professional training environments, there is no denying the evidence to support the role of technology as a contributor for success. In OOSC, virtual field trips (i.e. museums, historical sites), MOOCs, and coding platforms (i.e.

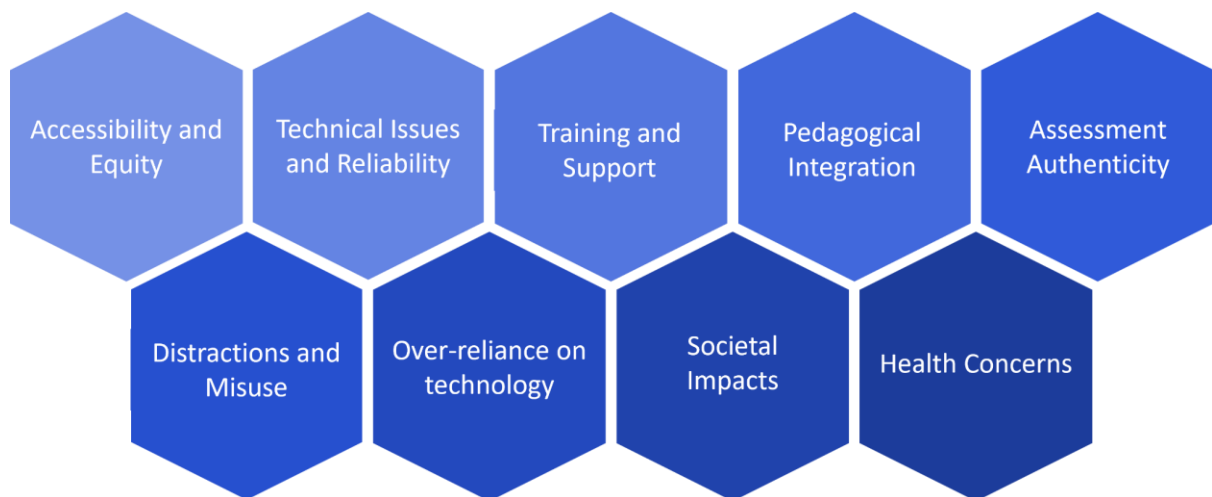
Scratch, Code Academy, Tynker, Leet Code) can provide new tools for teachers' educational arsenal.

A study in physiology learning (Ma, Cheng, Chan & Tipoe, 2023) shows the positive outcomes of using VR by promoting engagement, discussion, peer support, and problem-solving. Hernandez-Campos et al (2023) show how Virtual Tours to an assembly line can increase students' motivation and engagement, while also improving the translation of knowledge to the real-world setting. De Moura, De Souza and Viana (2021) studied the impact of using MOOCs in Blended Learning. Not only did they identify the increase in motivation, but also they were able to formulate a model that shows that MOOCs are perceived as functionally favorable for learning for students, although this is influenced by the perceived quality of the MOOC, it increases the reach of the teacher and increases the range of offers to students. Regarding the use of gamification, evidence amounts to the potential to improve active learning in different contexts, from higher education as a whole (Murillo-Zamorano et al, 2021) to the role of gamification in shaping new skills which can therefore influence positive social change (Marin, Lee & Landers, 2021). Lastly, the use of OSN and social media in medical learning has been shown to have true potential to improve communication with teachers, between students, motivation, and learning outcomes (Shen, 2022).

3.1.2 The dark side of technology: Negative outcomes on the use of technology in education

As discussed in the previous section, the integration of technology in education has multiple benefits. However, it also introduces a new set of challenges.

Table 19. Challenges associated with technology use in education.



Technology enables students to access learning materials when and where it's most convenient. However, not all students have equal access to the required devices or to a reliable internet connection (Talib, Bettayeb & Omer, 2021). **Unequal access** might cause students to fall behind in their studies or to miss out completely on fundamental learning opportunities .

Also, technology is not entirely **reliable** and requires constant **technical support**. Software errors and underperforming systems impact the communication flow disrupting the learning experiences (Talib, Bettayeb & Omer, 2021). Also, there is a learning curve when using a new technology. Educators and students require appropriate **training** to use a new tool effectively and benefit from its educational potential (de Carvalho, 2021; Johnson, Jacovina, Russell & Soto, 2016).

Since technology integration might require development resources, training and ongoing technical support, a thorough assessment of its **pedagogical integration** is needed.

One can easily fall into the trap of using technology for its own sake instead of using it for its pedagogical benefits. Educators must also be aware of how technology impacts **assessment authenticity**, especially in out-of-school contexts. Without certainty that students are completing assessments by themselves, one should be aware of the potential inaccuracy of how the results actually reflect the students abilities and knowledge.

In addition to educational content, technology, especially the internet, provides an endless source of **distracting content**. With games waiting to be played and a constant flux of social media notifications, students are constantly being tempted to move away from lessons into more entertaining activities. These distractions affect learning efficiency and hinder the student's academic performance (Bjornsen & Archer, 2015; Glass & Kang 2019).

Over-reliance on technology is another challenge to consider. Dependency on digital tools might hinder true comprehension of the content. Also, students who over-rely on digital tools might struggle when performing non-digital tasks. In addition, the **overuse** of online interactions might affect students' interaction skills in real-world contexts. And prolonged **screen time** might compromise students' physical and mental well-being.

Solutions and suggestions:

The use of TBAL can be a powerful force in promoting all the positive outcomes mentioned in the previous sections. To achieve this, schools and educators should be trained, have a consistent curriculum and understand that TBAL is a tool and not an end in itself. Therefore, it is essential to combine TBAL with more conventional approaches to education to ensure that technology is a promoter of positive outcomes and does not become a problem in education.

The discussion on the use of smartphones and other technologies lead to complex discussion on the possible alienating role of technology. Therefore, educators should rely on their experience and pedagogical training to ensure that technology does not become a distraction and that it is not at the core of the development of health issues, namely overuse. Technology should be used in the exact measure and not more than that.

<https://bokcenter.harvard.edu/technology-and-student-distraction>

- Distractions, over-reliance, and potential effects on student well-being in and out of the classroom.

The integration of technology in education has reshaped the learning environment in many positive ways, but it also introduced potential pitfalls, including distractions, over-reliance, and implications for student well-being. As previously mentioned, educators should ensure that **distractions** that are somewhat promoted through the use of smartphones but mainly social media do not overwhelm students. Constant notifications from OSN, emails and other apps can be a problem and teachers should be aware of this. Having dedicated digital equipment should be the goal for schools. Too many distractions can impact the flow of attention, something that is a current concern in education. Empowering students and making them have the initiative is essential to promote attention (Grammer & Lenartowicz, 2021). Also, the use of technology can be a source of stress and anxiety for students, namely the ones that are not trained in their use (Zhang, Russo & Fallon, 2015). Most importantly, teachers should be comfortable with technology to avoid negative outcomes of IT use (Fernández-Batanero et al, 2021; Khilail et al, 2023).

As previously mentioned, over-reliance is a concern and should be a concern for teachers. Mixing activities and avoiding overuse of technology should be present in the curriculum development.

Some unwanted outcomes can be observed in the use of technology in the classroom. Beyond the physical issues -namely concerns with eye-strain and postural issues- and the impact on mental health -overuse can lead to anxiety, stress and some forms of addiction, as well as impact sleep patterns-, social skills should be promoted in TBAL. The use of technology should never impact the essential role of interaction and play during the learning process (World Economic Forum, 2016; Suryani et al, 2021). Lastly, cyberbullying has been identified as a concern. Although not specific to education, the use of technology in the classroom should account for this possibility and strategies should be in place to fight it (Machimbarrena & Garaigordobil, 2018; Marín Suelves, et al, 2023).

To address these challenges, educators, parents, and students themselves need to be proactive. Balanced technology use, digital detox periods, regular physical activity, and comprehensive digital education (including digital etiquette and safety) are essential. Schools can play a pivotal role by integrating technology mindfully, ensuring that it's used to enhance the learning experience rather than dictate it.

For every positive outcome of technology, there is an associated concern. Educators and schools should always consider those when designing the curriculum. Concerning engagement and education, and addressed previously, technology can have a positive role. However, should not limit the potential for traditional learning without TBAL, leading to issues with attention. Having an education process designed for each student promotes good outcomes, but again should not hinder social skills development and collaborative learning activities. Concerning access to information, the internet provides an array of resources as

never before. Educators should however consider that a significant part of the information available online is not verified, and steering students search for information to avoid fake information and or just unreliable sources of information is paramount to achieve the desired outcomes of TBAL. The use of MOOCs again can be a powerful tool, but research has shown the high dropout and solutions on how to fight it (Zhang et al, 2021; Borrella et al, 2022).

In conclusion, while technology holds vast potential to revolutionize education, it's essential to recognize and address its inherent challenges. A balanced approach, which combines the best of digital and traditional methods, seems most promising. It's also crucial to continuously update the research base, as technology and its implications for education are ever-evolving.

3.1.3 Weighting the pros and cons of technology: Bridging the generational gap and improving student motivation and engagement

3.1.3.1 Bridging the Generational Gap while Improving Student Motivation and Engagement with Technology

Technology integration in education offers a myriad of opportunities, as described above. However, some risks remain as previously discussed. Nevertheless, technology is a particularly interesting breeding ground to fight the generational gap that is often attributed to the use of technology itself. Regarding this, and as profoundly addressed in this chapter, teachers of all generations should pursue training while pacing themselves on the inclusion of technology in education. This may be easier for younger teachers, who are in some cases, digital natives. However, the experience gained by more experienced teachers is essential to finding the right balance between technology use and a more traditional approach to education. Regardless, there is now enough evidence to support the positive outcomes of

TBAL in engagement, motivation, feedback, connection, and collaboration, while offering both students and teachers different educational content that can match each learner's needs and promote a more individualized and arguably, effective educational context. For more experienced teachers, fighting over-reliance and the distractions offered by technology is assumed as an essential dimension in this transformative approach to education. Another concern is the mental health outcomes that emerge in some users due to excessive screen time and online exposure. Most importantly, namely in countries with significant wage gaps and asymmetrical access to technology, it is paramount to fight the impact of the great digital divide between those students and teachers who have access to equipment and those who have not, as seen during the recent COVID-19 pandemic (Golden et al, 2023; Sun et al, 2022). Reducing the generational gap will require active public policies, and personal investment, namely by teachers, but also clear objectives, agenda, and timelines. Professional development (digital literacy), mentoring, and sharing of experiences and resources have the potential to improve the large-scale implementation of TBAL. One way to also facilitate this process is to use blended learning as a way to test and find the right balance between traditional and more technology-focused education. It is essential that some activities require a “digital disconnect” to ensure that students develop a different set of skills and to stem the increase of mental health issues associated with the misuse of technology. Also, schools and teachers should not be afraid to take a step back each time a specific use of technology is identified through peer or student feedback as not promoting the expected results. Therefore, the individualization of the educational offer should also account for the specificity of the teacher's profile, and not only the student's individual characteristics.

3.1.1.2. Strategies for technological integration for in-school and out-of-school contexts.

To achieve the right balance, technology should be used in the right amount. Blended learning is a great way to achieve this, by balancing independent learning, the use of technology and face-to-face learning. Professional development, as previously mentioned, is essential for teachers to feel at ease with technology and foster a positive learning environment with students. Also, teachers should provide students with learning materials on the use of technology, namely in cybersecurity, and how to interact with others in cyberspace. Students should also be made aware of their digital footprint, especially in search engines and OSN, to avoid that in the future they can feel the backlash of some less mindful decisions. Ethical use of technology, especially the Internet, should be integrated in the curriculum. Keeping students safe is essential to the good use of TBAL. Lastly, schools and educators should not leave students behind. Ensuring that schools have the right technological infrastructure is key, but ensuring that all students have access to technology and internet outside school is also essential.

In OOS contexts, having parents engage in the task can generate positive outcomes. A concern is obviously online safety, but collaboration between parents and students can achieve good things. As previously mentioned, the right combination of synchronous and asynchronous activities should be pursued. Moreover, and although TBAL is set on technology use, promoting offline activities is essential for a sound physical, social and psychological development of the students.

In OOS and in-school learning contexts, fostering open communication between educators, students, and parents is of high importance. As technology and its role in

education evolve, continuous assessment and adaptation of these strategies will ensure that students receive a comprehensive, engaging, and safe learning experience.

CHAPTER 4

TRANSNATIONAL COOPERATION - OUR GLOBAL EXPERIENCES

4.1 Introduction

Technology has fundamentally reshaped education, transforming it into a powerful tool that connects students and teachers across distances and facilitates collaborative learning experiences. This digital transformation exemplifies the evolving nature of education, driven by the integration of technology into the learning process.

The "Tech to Teach" project serves as a testament to this recognition, emphasizing that educators are not merely disseminators of knowledge but also architects of dynamic learning environments. This realization became particularly prominent in the wake of the global COVID-19 outbreak, where traditional classrooms transitioned to remote and blended learning models, requiring educators to quickly adapt to new challenges.

As highlighted by Wanner and Palmer (2015), today's educators must possess a deep understanding of their subject matter, technological proficiency, and pedagogical acumen. The Tech to Teach project aims to bridge this gap by offering a comprehensive suite of professional development initiatives. These initiatives guide educators through the intricacies of technology integration, helping them adapt to the ever-evolving educational landscape. Continuous professional development equips educators with the tools to create vibrant educational spaces that nurture critical thinking, collaboration, and digital literacy.

Moreover, the Tech to Teach project acknowledges that professional development is an evolving process. This fluidity ensures that educators are equipped with the agility to navigate the ever-changing educational landscape, positioning them as torchbearers of innovation and excellence. It's not a static journey but a continuous evolution, where educators remain at the forefront of educational innovation. This journey not only empowers educators but also translates into enriched learning experiences for students, creating a ripple

effect that amplifies the project's impact. When educators embrace technology, they enable transformative learning experiences that foster curiosity and exploration among students.

In conclusion, the Tech to Teach project aims to empower educators to use technology effectively, equipping students with the skills and mindset they need to thrive in a constantly changing world.

4.2 Building International Partnerships

Since the 1980s, the Council of Europe has made recommendations on educational visits and exchanges of pupils (1980), promoting the awareness of Europe in secondary schools (1983), European cultural identity (1985), and the European dimension in education (1989). These recommendations encouraged member states to foster cooperation in education and include it as part of their curricula. Supported at both national and international levels, educational exchanges have enabled hundreds of thousands of young people to discover Europe and establish personal ties. The programs launched by the European Commission, such as Socrates (1995), Leonardo da Vinci (1994), and the Lifelong Learning Programme (2007), significantly increased and improved exchanges and dialogue between educational institutions, teachers, pupils, and decision-makers. These programs serve as implementation tools for the European policy in education and training outlined in the strategic framework for European cooperation in education and training – ET 2020.

The aims of these programs are to:

- Make lifelong learning and mobility a reality;
- Improve the quality and efficiency of education and training by enabling all learners to acquire the basic skills and competences needed for their employability;

- Promote equality, social cohesion, and active citizenship through quality, inclusive education;
- Enhance creativity, innovation, and entrepreneurship at all levels of education and training by promoting the development of key competences and encouraging cooperation between all sectors of education and the world of work.

Erasmus+ 2021-2027, the European Union's program for Education, Training, Youth, and Sport, continues with a budget of almost €28 billion. It offers experiences to more participants and funds mobility and transnational cooperation projects, contributing to the personal development and enhancement of participants' skills, their participation in democratic institutions and processes, and their successful transition to the labor market. It promotes high-quality and inclusive education and training, leveraging formal, non-formal, and informal learning, and supports the modernization of education, training, and youth systems, offering opportunities for cooperation between organizations. Erasmus+ is inclusive, with a focus on individuals with fewer opportunities, such as people with disabilities, migrants, and citizens living in remote areas or facing socio-economic difficulties.

eTwinning, launched on January 14, 2005, has become probably the most popular and successful European initiative promoting school partnerships through the use of ICT. Initially aimed at facilitating partnerships between pre-university education institutions, it has grown into a professional community, bringing together over 150,000 teachers from Europe. eTwinning Action is part of the Lifelong Learning Programme – Comenius.

4.3 Sharing Experiences and Best Practices

The general objective of the TECH TO TEACH project is derived from the digital capacity of the world and the inclination of European youth towards technology and their

engagement. The project aims to develop teachers' and educators' competencies in technology usage, positioning students as the real actors. Tech to Teach strives to cultivate a more digital and technology-based education environment where active learning occurs. Active learning involves problem-solving, doing, exploring, and is superior to passive learning because it engages the brain, connecting information and fostering comprehension. Technology-based active learning concerns the larger design of the lesson, enabling "learning by doing" at scale and engaging today's technology-native generation in a format that resonates with their expectations and mentalities.

The added value of transnational partnerships enhances the internationalization of institutions. At the same time, these collaborations strengthen education missions and increase the mobility of both students and staff. Important benefits include developing new skills in students, enhancing their employability, increasing the quality and relevance of the educational offer, improving the capacity of teaching staff, and facilitating the mobility of students and staff. International collaborations also attract foreign students, increase the level of scientific excellence, and produce more interdisciplinary research. Working together with individual academics, organizations, or nations across national boundaries to integrate an international, intercultural, or global dimension in research and teaching activities brings new opportunities and adds value. The international partnership has added four dimensions to our project:

Academically: including an international dimension in teaching or research; enhancing quality through students enjoying and learning from a period of study abroad; extending the academic horizon; increasing the institutional reputation or status; meeting international standards; improving researchers' skills; and greater impact of research.

Economically: increasing the institution's attractiveness; sharing resources (equipment, data) efficiently (also with respect to developing and exploiting Intellectual Property Rights); sharing risks, and making use of available incentives and greater access to potential resources (e.g., European funding).

Politically: improving national security; supporting international diplomacy; supporting peace and mutual understanding, and promoting national or European identity.

Socially and culturally: developing a national and transnational cultural identity; supporting intercultural understanding; supporting citizenship development; and supporting social and community development (capacity building).

The internationalization of the curriculum and the need for mutual recognition of learning outcomes are essential since TECH TO TEACH is based on an international issue related to the coronavirus. Sharing the experiences and adding value from a transnational dimension widens the scope, application, research, and feedback of the project.

The project partnership consists of four local and three transnational partnerships. Despite the number of local partnerships, all the institutions differ within the scope. Akdeniz University provides academic support from a more academic perspective, İstanbul Valiliği, the governorship of the most populated and multicultural city of Turkey, creates a miniature Turkey for project application, and high schools from two different cities of Turkey; one from Antalya which is under our construction for better application and observation and the other one is Tavşanlı Fen Lisesi with a great number of applications and degrees in science and robotics contests nationally and internationally wide. The school is located in a small town, which is disadvantaged geographically and socioeconomically. International partnerships consist of an overseas university (Portugal), a local education authority from Greece, and a

high school from Western Macedonia for transnational experience and application of the project.

4.4 Overcoming Challenges

Implementing technology in schools across various regions presents numerous challenges. Differences in infrastructure, access to resources, and varying levels of teacher training can impede the effective use of technology. To address these issues, we have identified common obstacles and collaborated with our transnational partners to develop strategies and solutions that foster successful implementation.

- **Adaptability and Flexibility:** One of the key lessons learned through the Tech to Teach project is the importance of adaptability and flexibility in diverse educational contexts. Solutions tailored to specific local needs, taking into account cultural, economic, and infrastructural differences, have proven most effective.
- **Strategies and Solutions:** Our transnational partners have shared several strategies that have facilitated the overcoming of these hurdles:
- **Resource Sharing:** Utilizing digital platforms for sharing teaching resources and best practices among educators, thus reducing the impact of limited physical resources.
- **Training and Support:** Providing ongoing professional development and technical support tailored to the specific needs of teachers in different regions, ensuring they are equipped to handle and adapt to new technologies.
- **Community Engagement:** Encouraging community involvement in educational initiatives to garner support and resources, which has been crucial in regions with limited government funding.

By focusing on these strategies, the project has managed to mitigate some of the major barriers to the integration of technology in education, thereby enhancing the overall teaching and learning experience.

4.5 Empowering Teachers through Professional Development

Professional development plays a pivotal role in empowering teachers with the necessary skills to effectively utilize technology in the classroom. The Tech to Teach project has placed significant emphasis on equipping educators with both technological skills and pedagogical knowledge through a variety of professional development programs.

Impact of Training Sessions, Workshops, and Webinars: Our initiatives include regular training sessions, workshops, and webinars that have significantly impacted educators' ability to integrate technology into their teaching practices. Feedback from participants indicates a marked improvement in confidence and competence with digital tools following these sessions.

Ongoing Support and Resources: Beyond initial training programs, the Tech to Teach project provides continuous support to educators through:

Online Learning Communities: These platforms allow educators to exchange ideas, solve problems collaboratively, and share new teaching methods and resources.

Updated Training Material: Regular updates to training materials ensure that educators stay current with the latest technological advancements and pedagogical strategies.

Personalized Coaching: Offering personalized coaching sessions to address individual challenges faced by educators in implementing technology.

Through these comprehensive professional development efforts, the Tech to Teach project fosters a supportive environment for educators globally, enabling them to enhance their teaching methods and engage students more effectively.

4.6 Evaluating Progress and Impact

The path to improved education is illuminated by evaluation. In the Tech to Teach project, evaluation acts as our guiding compass, enabling us to track progress and discern the impact of our efforts in enhancing education through international collaboration. To match the complexity of our project, we employ a range of evaluation tools. Surveys play a pivotal role in our process. The Technology Implementation Questionnaire (TIQ) (Abrami, Venkatesh, & Lysenko, 2012) was utilized as part of a pre-post survey conducted by the Erasmus+ consortium of the 'Tech to Teach' project, led by the Antalya Directorate of National Education. Our project's primary objective is to equip teachers with new tools in a recent and technological way, with the aim of benefiting their students by seamlessly integrating Technology-Based Active Learning into their teaching activities, ultimately setting students as active learners where active learning happens.

Online platforms play a significant role in our evaluation efforts. Our website and TwinSpace page allow us to measure engagement and interaction. They offer insights into the level of interest in our project, the extent of utilization of the materials we provide, and the benefits derived. These platforms serve as virtual meeting places for sharing thoughts and feedback, enriching our discussions. Our impact extends far and wide through dissemination activities, including an upcoming e-conference. Our work garners attention in local and national press as well as online news platforms, amplifying our success beyond borders and validating the effectiveness of our project. Reports and evaluation sheets, authored by participating institutions, provide substantial evidence of our project's impact. Our evaluation

process is not confined by geographical boundaries; it is an integral part of our transnational meetings. We measure our impact by examining reports from participating institutions, providing a qualitative assessment. Social media and online platforms maintain our project's visibility as we share our outputs in real-time. Every piece of content generated becomes a measure of how our project is effecting change. Educators themselves play an indispensable role in our evaluation process. They employ questionnaires to assess the effectiveness of our training programs, measuring satisfaction and alignment with participants' needs (Hou, 2020). Beyond questionnaires, knowledge transfer is a key metric. One hundred trained teachers disseminate their learning to students and peers. We measure this impact through interviews, observations, and follow-up meetings. Our evaluation forms a constellation of indicators, each demonstrating how our project is making a difference. From feedback loops to success in coding, from participation in national competitions to improvements in foreign language skills, our evaluation process encompasses various facets of educational excellence.

4.7 Looking Ahead: Scaling Impact and Sustainability

As we stand on the threshold of educational transformation, it is crucial to chart a course that encompasses not only the achievements of the Tech to Teach project thus far but also its future trajectory.

To scale our impact effectively, we envision a multi-pronged approach (European Commission, 2018). Firstly, geographic expansion forms a cornerstone of our strategy. By broadening our project's reach to encompass a more diverse array of educational settings, we aim to foster cross-cultural exchanges and learning experiences for educators and students alike.

Moreover, our dedication to forging partnerships remains resolute. Collaborations have been instrumental in our achievements, and we intend to fortify existing alliances while actively seeking new affiliations with organizations that share our educational vision.

When it comes to sustainability, it is not merely a buzzword; it is the foundation upon which lasting educational change is built (Means, 2010). The Tech to Teach project is committed to fostering a sustainable ecosystem for technology-driven education, one that ensures the enduring impact of our endeavors. As far as sustainability is concerned, the TTT project complies with the Erasmus+ quality standards concerning the establishment of a sustainable ecosystem for technology-driven education that ensures the enduring impact of the project's main principles and outcomes. Namely, the cultivation of educational institutions' and stakeholders' capacity to sustain and expand the innovative paradigms initiated by the consortium, as well as our active cooperation with stakeholders at various levels, advocating for policies that support and advance technology-enhanced teaching and learning. Additionally, we have committed to continue research in the field and develop activities which ensure that our methods and approaches will continuously evolve to meet the dynamic needs of the educational landscape.

Our sustainability initiatives are grounded in several fundamental principles, as outlined by the European Commission (2020). Foremost among these is the cultivation of educational institutions' and stakeholders' capacity to sustain and expand the transformation initiated by our project. Additionally, we recognize the instrumental role of stakeholders in shaping educational paradigms. In line with this, we pledge to actively engage with stakeholders at various levels, advocating for policies that support and advance technology-enhanced teaching and learning.

Continual innovation is paramount in the digital age (Reeves & Reeves, 1997). Thus, our commitment to research and development activities remains steadfast. We believe that by staying at the forefront of educational innovation, we ensure that our methods and approaches evolve to meet the dynamic needs of the educational landscape.

Lastly, our vibrant community of educators, nurtured by the project, holds a pivotal role in our sustainability efforts. We will continue to foster and expand this community, providing spaces for ongoing collaboration, sharing of insights, and professional growth, thus ensuring that the spirit of innovation and transformation perseveres.

4.8 Conclusion

As we draw the curtains on this comprehensive guidebook, we embark on a reflective journey that encapsulates the collective wisdom and experiences of educators and partners from diverse corners of the world.

Throughout this expedition, we have unearthed invaluable insights, underscoring the pivotal role of technology in the modern educational landscape. Our shared experiences have illuminated the profound impact technology can have when wielded effectively.

To our esteemed transnational partners, we extend our heartfelt gratitude. Your unwavering commitment and dedication have been the wind beneath our wings, propelling our journey to resounding success.

As we conclude this chapter of our global journey, we underscore the paramount importance of continued collaboration. Our shared mission to advance technology-enhanced learning knows no bounds. By forging ahead together, exchanging best practices, and wholeheartedly embracing innovation, we wield the power to shape the future of education on a global scale.

In unity and shared purpose, we illuminate the path to a brighter, more digitally empowered future for education. It is a future where technology knowledge transcends borders, and students worldwide are the ultimate beneficiaries of our collective dedication.

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