CONTESSA
Contemporary Teaching Skills for South Asia

Co-funded by the Erasmus+ Programme of the European Union

MODULE 5
DIGITAL TEACHING AND LEARNING

5.1 E-PEDAGOGY AND DIGITALLY ENHANCED LEARNING ENVIRONMENTS

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Digital Teaching and Learning. E-Pedagogy and Digitally Enhanced Learning Environments.

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Introduction

What is the CONTESSA course?

The CONTESSA course is one of the results of the "Contemporary Teaching Skills for South Asia" project co-funded by the Erasmus+ Program of the European Union. Its aim is to be a contribution to establishing successful teacher education programs for primary teachers, particularly in Cambodia and Sri Lanka, which will create a long-lasting positive impact on the overall educational systems.

It is increasingly important for successful educators to stay up-to-date with contemporary skills and methods to use inside and outside of the classroom. The CONTESSA course therefore offers five carefully selected modules, each of which contain three focuses aimed at the development of contemporary teaching skills. The modules and their focuses are as follows:

Module 1. Building Blocks of Primary Education
1. Twenty-First Century Teaching and Learning
2. Lesson Planning and Methodological Skills: Concepts, Tools and Application
3. Designing Learning Environments

Module 2. Excellence in Teaching: Profession-Specific Competences of Primary School Teachers
1. Teaching Comprehension: Roles, Tasks and Functions
2. Assessing Learning Results
3. Pedagogical Professionalization

Module 3: Learner-Centered Primary Education: Enhancing Co-Created Learning Processes
1. Individual Development and Problem-Solving Skills
2. Lifeworld-References and Future Prospect
3. Self-Determination, Empowerment and Self-Efficacy

Module 4: Embracing the Differences: Pedagogic Approaches to Diversity, Heterogeneity, Special Needs
1. Inclusive Pedagogy: Approaches and Strategies
2. Teaching and Learning in Diversity: Preparation, Realization, Assessment
3. Diversity-Sensitive Classroom Management

Module 5: Digital Teaching and Learning
1. E-Pedagogy and Digitally Enhanced Learning Environments
2. Digital Media and Technology: Tools and Formats for Educational Purposes
3. Online-Based Lesson Preparation and Conduction

Upon completion of this course, participants will be able to implement newly acquired contemporary teaching skills, engage all students in classroom activities and learn new ways to help students reach their full potential.

Who is the CONTESSA course for?

The "Contemporary Teaching Skills for South Asia" project aims at promoting contemporary teaching skills for pre-service and in-service teachers working in primary schools. The following document is specifically adapted for pre-service teachers.

Furthermore, the CONTESSA course is available for anyone interested in staying up-to-date with contemporary teaching skills.

This is the English version of the CONTESSA course. Material is also available in Khmer, Sinhala and Tamil.

What is the structure of the CONTESSA course?

As mentioned before, the CONTESSA course consists of five modules, each worth the equivalent of 3 ECTS. Ideally, the modules are all used together since individual modules refer to other modules, but they are also designed in a way that each one can be used on its own.

Each module contains three thematic focuses and documents are available for each focus. This makes a total of 15 documents available in the CONTESSA course. Each document contains a theoretical introduction to the focus, followed by practice exercises based on the theory. **STEP 1 – THEORY –** is meant as a revision of what has been read in the theoretical introduction. Practice exercises check the comprehension of the text to make sure that the underlying theory has been understood. **STEP 2 – EXPERIENCE –** offers examples of real teachers and how they practically implement the theory explained in the theoretical introduction. These examples are again connected to practice exercises which are meant to allow for the application of the previously learned theoretical knowledge. **STEP 3 – (SELF-)REFLECTION –** includes reflection questions based on each focus. **STEP 4 – PRACTICE –** is the final STEP where a teaching project is created based on what has been seen before in STEPs 1 and 2.

The practice exercises in STEPs 1 and 2 can be directly completed in this document. STEPs 3 and 4 are part of a separate portfolio document which has to be created by each individual. A template for this portfolio is available as a separate document.

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1 DIGITAL ENHANCEMENT AND E-PEDAGOGY

Information and communication technologies (ICTs) have seen a tremendous increase of importance due to the rise of "cell phones, Internet, [and] communication software" (Baldiņš, 2016, p. 251) since the 1990s. They have transformed the way people communicate and interact with each other. Today's children grow up with this kind of communication. Education should therefore consider the extended (methodical) possibilities ICTs can offer for acquiring content, working on assignments, or developing competences (Karunanayaka, 2006), especially since ICTs have allowed the transformation from "a teacher-centred, lecture-based instruction to student-centred, interactive learning environments" (UNESCO, 2002, p. 3). Teaching in the 21st century calls for more student-centered approaches that engage students in co-construction of knowledge and active participation in the learning process. While a teacher-centered pedagogy would emphasize the delivery of learning content, student-centered learning focuses on creating opportunities for the construction of knowledge by the learners.

See also Module 1, Focus 3 "Designing Learning Environments"

Digitally-enhanced technologies in the educational context thus comprises the use of technologies for teaching and learning, regardless of their use in an in-person or online setting. Historically they have been comprised of technologies such as over-head projectors, instructional films, radio, and television, "but in the current day, technology-enhanced learning pertains more to the use of computer-based technologies, including smartphones and other smart devices" (Sen & Leong, 2020, online). Over the past few decades, computer-based or **digital technology**, such as tablets, smartphones, and interactive white boards have either joined traditional classroom equipment, such as blackboards (i.e. **analog technology**), or even replaced it in the physical learning environment of schools. Consequently, classrooms with an increased use of digital technologies have experienced a transformation of teaching "from 'blackboard &

Digital technology in this context refers to "the combination of some computer-based hardware, such as a smartphone, robot, smart watch, smart glasses, smart board and computer, and some dedicated software that provides the concrete functionality for the learning process" (Koper, 2014, p. 3).

Analog technology in this context refers to devices generating, processing, transmitting, or displaying

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chalk' mode to the 'computer & projection' mode" (Yang, Pan, Zhou, & Huang, 2018, p. 2). However, the simple transformation from 'blackboard & chalk' to 'computer & projection' is not enough to support and improve the teaching/learning process. Teachers also have to have a pedagogical understanding of these devices and their possible application to offer successful teaching, regardless of the degree of digital technologies present in the classroom. **E-pedagogy**, a branch within pedagogy, therefore "studies and develops learning technologies and improves […] [educational] approaches to a successful technology application" (Baldiņš, 2016, p. 252).

While digitally enhanced teaching and learning describes physical learning environments which are enhanced with technology, online learning or distance education describes learning which, to a varying degree, takes place online. In the fully online mode, students learn remotely, from home, at online access centers or public libraries, and they only interact with the teacher and other students through learning management systems (LMS) or video conferencing tools. Communication and interaction thus take place **synchronously** (via conferencing tools such as Zoom or Skype) or **asynchronously** (via e-mail or forums). However, there are also hybrid forms, which combine learning in an online and a physical learning environment. In the flipped/inverted mode, for example, students receive learning material and assignments to do remotely while the time in the physical classroom is reserved for discussing the results. Whereas in the flex mode, the teacher is available in the physical classroom for those students who need face-to-face support while the other students work remotely. (Thomas, 2017) These online learning formats have become increasingly important during the COVID-19 pandemic but are less common in regular elementary teaching. The following will thus be mainly focused on digitally enhanced teaching and learning.

While introducing digitally enhanced teaching and learning has a variety of benefits for the teaching/learning process, not all schools are equipped

information which are not computer dependent, e.g., blackboards or books.

E-pedagogy, as used in this document, comprises digitally enhanced practices in relation to learning as well as teaching.

Synchronous learning is instruction and collaboration in "real time" via the Internet. It typically involves tools, such as live chat, audio and video conferencing, data and application sharing, shared whiteboard, virtual "hand raising", joint viewing of multimedia presentations and online slide shows. (Poe & Stassen, n.d., p. 6)

Asynchronous learning methods use the time-delayed capabilities of the Internet. It typically involves

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with the same infrastructure necessary to do so. For example, **Global South** countries, especially in areas with more rurally located schools, lack basic technological equipment. This is mainly due to financial constraints: Schools might not even be able to provide the initial equipment let alone pay for recurring costs. Instable electrical power supply or Internet connection further complicate the introduction of digitally enhanced teaching and learning, even though the growing number of "mobile devices with cellular data network among teachers and students" (Lim, Ra, Chin, & Wang, 2020, p. 2450) partly counterbalances this problem. Additionally, teachers are untrained to use the digital technology per se and lack sufficient knowledge of the pedagogical purposes of said tools. (Lim et al., 2020) This text has been written with awareness of the abovementioned constraints a lot of teachers face when it comes to introducing digitally enhanced teaching and learning into their classrooms. It is meant as a guide presenting the theoretical basis and at the same time showing examples of how to use technology in a pedagogically sound way. We are aware that it illustrates a certain ideal classroom, but we try, at the same time, to offer alternatives for classrooms with little or minimal equipment.

tools, such as e-mail, threaded discussion, newsgroups and bulletin boards, file attachments. (Poe & Stassen, n.d., p. 6)

Global South: A term used by the World Bank that refers to low and middle income countries in Asia, Africa, Latin America and Caribbean. (Lim et al., 2020, p. 2448)

1.1 The Situation in Cambodia

Already in 2004, the Cambodian Ministry of Education, Youth and Sports (MoEYS) announced the following vision:

> The long-term vision of Education for All in Cambodia is to ensure equal access to basic education for all citizens and to prepare its citizens to play an active role in reconstructing the country as well as integrating Cambodia into the knowledge-based global community. The Ministry of Education, Youth and Sports (MoEYS) is introducing various initiatives to facilitate greater integration of information and communication technology (ICT) to improve the effectiveness of

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> education at all levels and to produce the technologically literate, productive and critically thinking workforce for the country. (p. 4)

However, the funding of these initiatives has caused a main problem in reaching the envisioned goals (Corrado, Flinn, & Tungjan, 2019). At the same time, Cambodian's Internet penetration rate (around 50% at 2018) is high enough to assume that a large enough amount of trainee teachers possesses the necessary digital knowledge that they can pass it on "to young students in schools affected by the lack of resources" (Corrado et al., 2019, p. 6).

1.2 The Situation in Sri Lanka

Recognizing the need to develop [teacher's] leadership in […] [digital education], several policy level decisions have been made within the Sri Lankan context (Ministry of Education, Sri Lanka, 2011). While various e-learning initiatives have taken place in Sri Lanka in recent history, there is a need to bridge the internal digital and social gap that exists (Mozelius, Hewagamage, & Hanson, 2011). Also, to reduce the complexity of e-learning as perceived by actual and potential users of e-learning facilities in Sri Lanka, development of more user-friendly techniques and e-learning environments, where potential benefits are clearly visible, are needed (Yatigammana, Johar, & Gunawardena, 2013). […] Numerous initiatives have been launched to expand the facilities needed to enhance digital learning within the Sri Lankan school system. As a result, many schools are equipped with computer laboratories, Internet and Wi-Fi facilities, software packages and e-learning resources. The subject Information Technology has been introduced to schools to enhance digital literacy among learners (Ministry of Education, Sri Lanka, 2011). Further, the importance and need of training teachers in digital education has been identified (Ministry of Education, Sri Lanka, 2012). The C-DELTA project implemented by the OUSL, *for example*, focused on developing

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capacity among secondary school teachers to become digital education leaders in their own school communities.[1]

While "Sri Lanka is still at the emerging stage of using ICT in education" (Lim et al., 2020, p. 2452), the Sri Lankan government is in the process of finalizing an ICT education master plan, which is meant "to provide direction and promote the use if ICT" (Lim et al., 2020, p. 2453). Most recently, the Minister of Education has announced that even schools in remote areas of the Northern, Sabaragamuwa, Uva and Central Provinces are to be equipped with technology-enhanced equipment (The Sunday Morning Sri Lanka, 2020). Necessary equipment has been introduced to schools and there is a plan to further equip schools with the needed technology; however the main focus thus far has been on providing hardware, while the accompanying support on how this hardware can be applied to offer meaningful learning experiences has been neglected. (Lim et al., 2020) Digital technology is thus still mainly used to substitute analog technology in a teacher-centered approach to teaching and learning. These technologies are used by the teachers for lecture slides or drilling exercises instead of adopting them to offer meaningful learning experiences for the learners. (Lim et al., 2020) However, as explained before, the simple substitution of analog technology with digital technology is not enough to support and improve the teaching/learning process. Teachers have to have the necessary pedagogical understanding of these devices and their possible application to offer successful teaching.

2 DIGITALLY ENHANCED LEARNING ENVIRONMENTS

As seen in Module 2, Focus 2, a "learning environment refers to the diverse physical locations, contexts, and cultures in which students

[1] Taken from Karunanayaka & Weerakoon (2020, p. 63). CC BY-SA 4.0. Changes made to all CC BY texts used in this document are indicated in italics or square brackets.

learn" (The Glossary of Education Reform, 2013, online). It comprises the physical setting, interactions between fellow students and interactions between students and teachers. As part of the teacher's pedagogical concept, the learning environment is carefully designed based on theoretical considerations on effective teaching and learning. In the context of digitally enhanced learning environments, the digital aspect also has to be considered. Learning environments can thus "be defined as the set of physical and digital locations, contexts and cultures in which students learn" (Koper, 2014, p. 3). Again, it is not simply about taking technology and using it in the classroom, but it is about pedagogical reflection on how these technologies can be used to meet one's objectives and support the students' learning process (Spector, 2014).

Koper (2014) distinguishes between different cases of learning environments with regards to their degree of technological enhancement (p. 3):

- The digital case: when the physical environment includes digital learning devices, but does not provide relevant non-digital stimuli to the user. For instance in a quiet study room when using a simulation program. The representation of the learning environment can dominantly be influenced by the digital device(s), e.g. by presenting a virtual reality world, a serious game, a virtual classroom or a (digital) book. The cognitive representations that are stimulated by the digital device can result in learning processes. In this case there is a digital stimulated representation of the learning environment.
- The embedded case: the physical environment provides relevant stimuli to the user and the digital devices are adding, augmenting information to enrich the cognitive representation. In this case there is a combined, partly digital, partly physical stimulated representation of the learning environment.
- The side-by-side case: the digital devices are added to a physical environment to support additional learning functions such as

information, support, tests and feedback, but the digital devices are ignorant of the actual physical environment. All information about the physical environment should be added to the device by the user. For example when students are presented with tasks to execute in their physical environment, but they need to input the results to the digital device themselves. In this case the user's representation of the learning environment is fragmented: the physical parts and the digital parts.

- The classical case: the physical environment provides relevant stimuli, and there are no additional digital relevant signals. This is 'old school' situation where humans are interacting and learning without the help of any digital device. In this case there is a representation of the learning environment by the user that is stimulated by the physical environment.

In the context of digitally enhanced learning environments and e-pedagogy, only the embedded and the side-by-side cases are relevant. The classical case has no digitally enhanced connection at all, while the digital case is digitally enhanced but does not consider the teaching aspect in the teaching/learning process.

2.1 Smart Learning Environments (SLE) and Smart Classrooms

The idea of smart learning environments fits in the tradition of adding the adjective 'smart' to various existing phenomena, such as smart phones, smart tv's, smart boards, smart lights and smart cities in order to identify a next step in its development or a new generation. So, from this perspective smart learning environments could be seen as learning environments that are considerably improved to promote better and faster learning. So what type of improvements makes a learning environment smart? […] [T]he […] set of requirements for SLEs are the following. [A]n SLE is a learning environment in which:

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- one or more digital devices are added to the physical locations of the learner;
- the digital devices are aware of the learner[']s location, context and culture;
- the digital devices add learning functions to the locations, context and culture, such as the provision of (augmented) information, assessments, remote collaboration, feedforward, feedback, etc.;
- […] digital devices are monitoring the progress of learners and [provide] appropriate information to relevant stakeholders.[2]

The following three interrelated dimensions are characteristics for a smart learning environment: characteristics related to the educational technology, characteristics related to the conditions of the physical environment, and characteristics related to the performed processes in the smart learning environment. (Palau & Mogas, 2019) The three dimensions with their characteristics are illustrated in figure 1:

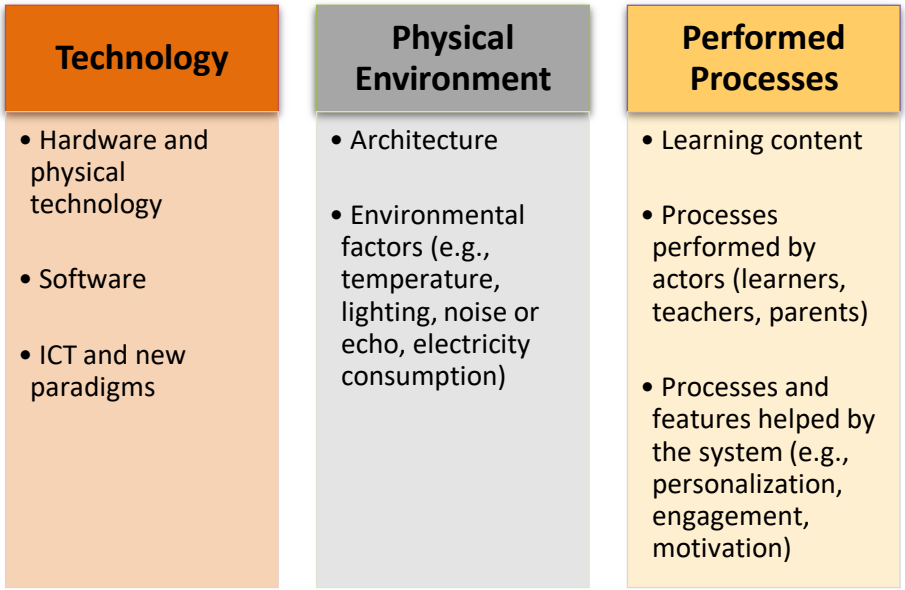

Figure 1: Dimensions of Smart Learning Environments[3]

While Koper (2014) and Palau & Mogas (2019) have detailed characteristics of a smart learning environment, Spector (2014) points out

[2] Taken from Koper (2014, p. 4). CC BY 4.0.
[3] Adapted from Palau & Mogas (2019, p. 60).

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three essential foundation areas for the design, development and deployment of smart learning environments: the epistemological, the psychological and the technological one. The **epistemological** perspective shows that people develop knowledge and expertise through the creation of mental models, which are different for each individual. Prior experience and knowledge influence this development, which has to be considered when creating the learning environment to maximally support the learning process. The epistemological perspective also highlights how language and discourse are socially influenced, which in turn

> contributes to how knowledge is developed. […] Taken together, these two tenets provide a general description of how people come to know and understand their worlds – namely by a process of creating internal mental representations and then sharing ideas formed on the basis of those representations with others through appropriate languages and media. (Spector, 2014, p. 4)

The psychological perspective considers behaviorism ➥, an approach which understands and predicts human behavior by observing and measuring it, as a valuable contribution in understanding smart learning environments. Whereas cognitivism ➥, which wants to understand the mental processes underlying human behavior, can contribute to the planning and implementation of smart learning environments: "The contributions of cognitive scientists have continued to expand how computers can be used to model and support human learning in the form of intelligent tutoring systems and pedagogical agents." (Spector, 2014, p. 5) Social psychology and how people are influenced by their surroundings is another aspect of the psychological perspective: "People do not live and learn in isolation from others. A smart learning environment will take this fact into account explicitly and in meaningful ways." (Spector, 2014, p. 5) While the so far mentioned aspects have been cognitive in their nature, non-cognitive elements, such as emotions and habits, also have to be

Epistemology is the study or a theory of the nature and grounds of knowledge especially with references to its limits and validity. (Merriam-Webster, n.d., online)

➥ See also Module 1, Focus 2, "Lesson Planning and Methodological Skills: Concepts, Tools and Application"

considered in the design, development and deployment of smart learning environments.

Finally, the third foundation area concerns technology. Modern information and communications technologies provide a significant challenge for the design, development, and deployment of learning environments, instructional systems and performance technologies. Which technologies should be used to support which goals and objectives for different learners in a variety of situations? Which ones are likely to be effective and sustainable? Finally, which ones will contribute to the development of smart learning environments? […] A smart educational technology is one that accomplishes its purpose effectively and efficiently. This often requires an innovative use of a technology in an engaging and flexible manner. As it happens, the word 'smart' is now attached to a number of educational technologies that do not have very many (or any) of those characteristics. One finds the phrase 'smart phone' and 'smart board' in widespread use in educational technology. Whiles [sic] these can be considered innovative technologies, their use in education is typically not very innovative, and they fail to have many other characteristics of smartness. They do have the potential to become smarter, however. For example, smart phones can already track a person's location and keep a history of that person's purchases. When that person is in a store, a smart phone could conceivably send a message to the person noting that a particular item of likely interest is on sale in that store. Such an action would represent a flexible and engaging application – albeit not particularly educational. A smart board could capture a child's picture or fingerprint; it could also have a database of the pictures or fingerprints of the children in the class along with a history of the performance and problems each child has exhibited. Then, after a child attempts to solve a complex or challenging problem, the smart board could offer a suggestion to guide the child to a correct solution; or the smart board could simply ask the child to respond to a question that is likely to cause a revision in

the child's response. Such a smart board could then be genuinely considered smart.

However, it always has to be considered that the technology itself is limited in the sense that it needs human input or interaction. Therefore, there is a risk that the individual constitution of meaning is hindered by technology-based automatisms. Consequently, teachers are necessary to minimize this risk by adding the necessary pedagogical considerations for guaranteeing an effective learning process in the smart learning environment. A naturalistic approach to epistemology that focuses on a description of how people actually develop knowledge concludes that there is no single or simple way to characterize knowledge development. People create internal representations and then talk about those representations with others along various paths to understanding. People are smart in different ways, at different times, and in different circumstances. However, it is clear that the ability to engage in meaningful discourse with others facilitates the development of knowledge.

Various psychology approaches to human thought and action provide descriptions of a variety of processes and factors that affect thought and action. The varieties of learning experiences are many, even for one person or for a specific group of people. However, it is again clear that providing personalized feedback and supporting collaboration with others can result in desired outcomes, while ignoring social and affective factors can inhibit learning.

The lessons learned from educational technology are many and varied. Simply using a new technology to replace prior practice may not be an effective use of an innovative technology. Because a technology is innovative does not mean that its use to support learning and instruction will be innovative or effective. What we can take from prior educational technology applications is that early successes in small and privileged settings can be misleading; taking an educational technology to scale involves significant planning, policy (re-)development, training, support and leadership that are all too often lacking in educational systems.

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What do these perspectives provide with regard to a framework for smart learning environments? Perhaps there are a few characteristics from these foundational perspectives that can be extracted and used as a preliminary set of indicators of the smartness of a learning environment. In any case, here is a preliminary and partial set of characteristics for a smart learning environment, divided into three categories. [4]

The categories represent those characteristics which are absolutely necessary for a smart learning environment and those which are not decisive but additionally beneficial. Also, the shown characteristics in table 1 and the framework model in figure 2 are suggestions for smart learning environments and can be adjusted to other learning environments by applying a side-by-side approach of technology and physical environment for their specific needs. It is also important to note that the presented characteristics refer to an ideal type of a smart learning environment.

Table 1: Characteristics of Smart Learning Environments[5]

I – Necessary	II – Highly desirable	III – Likely
Effectiveness - the learning environment results in generally acceptable or desirable learning outcomes, preferably better than a corresponding non-smart learning environment with similar learners.	**Engaging -** the learning environment is capable of motivating and sustaining continuing interest and participation of a variety of learners, preferably more so than in a corresponding non-smart learning environment.	**Conversational -** the learning environment can engage the learner in a dialogue or facilitate a group dialogue on a relevant topic or problem.
Efficiency - the learning environment is cost effective, preferably not costing significantly more in	**Flexible -** the learning environment can adjust to changes, such as new learners joining the course, different	**Reflective -** the learning environment can generate a self-assessment based on student progress and

[4] Taken from Spector (2014, p. 4ff.). CC BY 4.0.
[5] Adapted from Spector (2014, p. 7f.) CC BY 4.0

initial capital expenditure, support and maintenance over a five-year period than a non-smart learning environment with a similar number of learners.	resources being introduced, or additional goals or objectives being added.	performance, preferably suggesting activities and attributes in the learning environment that can be adjusted to improve overall effectiveness.
Scalable - the learning environment has been demonstrated to be effective and efficient on a large scale that extends well beyond one case or a small number of limited and restricted tryouts.	**Adaptive -** the learning environment can adjust to specific learner needs by recognizing learners' competences, learning styles, and interests.	**Innovative -** the learning environment makes use of new and emerging technologies, and uses innovative technologies in innovative ways to support learning and instruction.
Autonomous - the learning environment can react appropriately and autonomously to different learning situations and circumstances, as would a human teacher or tutor; this includes the ability to help learners become more organized and aware of their own learning goals, processes and outcomes.	**Personalized -** the learning environment can provide personalized assignments and/or formative feedback when needed to help struggling learners as well as those progressing rapidly.	**Self-organizing -** the learning environment can rearrange resources and control mechanisms to improve its performance over time based on data that are automatically collected and used to refine how the environment interacts with learners in various circumstances.

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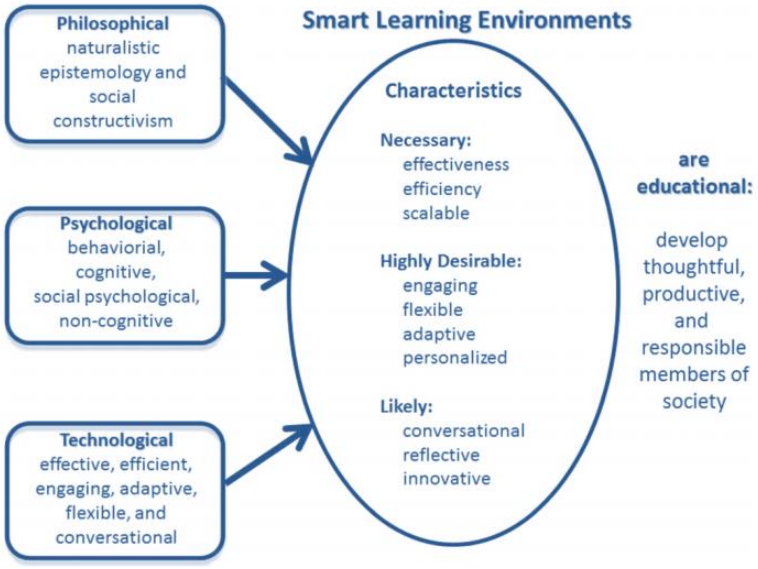

Figure 2: Preliminary Framework for Smart Learning Environments[6]

A smart learning environment is not automatically smart by simply using technology in the teaching/learning process. It needs the right components, including human beings, and the correct arrangement of digital and other tools to achieve the desired outcome for the students. Therefore, the learning environment has to be designed in a way to reach

> effectiveness (an ability to achieve recognized goals and objectives), efficiency (the ability to be effective without tremendous costs and effort), engagement (the willingness to collaborate with and learn from others), flexibility (the willingness to try new things), adaptivity (the ability to adjust to different situations and make appropriate adjustments), and reflectiveness (the ability to recognize successes and failures and learn from mistakes) (Spector, 2014, p. 9).

While the term 'smart learning environment' is an umbrella term, the term 'smart classroom' is narrower and considers the digitally enhanced physical learning environment (Palau & Mogas, 2019). Initially, it was used to describe classrooms equipped with interactive whiteboards to distinguish them from the 'computer classroom'. However, with the constant development of digital technology, a smart classroom, also

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described as intelligent classroom or classroom in the future, is nowadays characterized by a high degree of technological devices, such as wireless Internet connections, smartboards, mobile devices (i.e., tablets and smartphones) and virtual learning platforms (Li, Kong, & Chen, 2015). These devices allow for "rich and immersive teaching and learning experiences" (Li et al., 2015, p. 1), which would not be possible without their use. As described before, the decisive characteristic of a smart classroom is the fact that these technologies and devices are smart in the sense that they can react to students' needs and offer custom-made solutions.

Li et al. (2015, p. 3f.) therefore summarized the following characteristics of an ideal type of a smart classroom:

- The smart classroom is a technology-rich, physical and virtual combined learning environment which has the ability of context awareness and can adjust their environmental parameters like light and temperature automatically.
- The smart classroom could provide the learning contents, interaction support, and constructive learning tools for all type of the teaching and learning activities, including personalized learning, group learning, inquiry learning, collaborative learning, mobile learning, and virtual learning. The smart classroom conducive to learner-centered learning gives students the adaptive learning support for active learning and constructive learning activities.
- The smart classroom has the ability to store, collect, compute, and analyze the massive data of learners to do the optimized pedagogical decisions.
- The smart classroom is an open learning environment to bring the students to an authentic learning context. It can stimulate

[6] Taken from Spector (2014, p. 8). CC BY 4.0.

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students' learning motivation, engage students' creation, and give students hands-on learning experience effectively.

These possibilities can represent an optimization of the teaching and learning situation but can never replace the teacher's work of integrating pedagogical considerations into the teaching/learning process to enable meaningful and individualized learning.

2.2 Strategies for Digitally Enhanced Learning Environments

There are multiple possible settings of digitally enhanced learning environments. The way teaching and learning with technology works always depends on the given technological infrastructure and the technological know-how of students and teachers. However, the following learning/teaching strategies should always be considered when designing a digitally enhanced learning environment:

- Putting the student in the center of the teaching/learning experience;
- Activating and integrating students' prior experiences and knowledge;
- Making appropriate adjustments to what a learner knows, has already mastered and wants to learn next;
- Being flexible and adapting to changes as they occur;
- Offering and supporting collaborative learning;
- Engaging learners in meaningful discourse with others;
- Providing personalized feedback to develop confidence and satisfaction;
- Identifying and supporting struggling students;
- Motivating students; and
- Taking the time and making efforts to gain attention and show relevance.

(Spector, 2014, p. 2ff.)

While these considerations are relevant for every 21st century classroom, in the context of digitally enhanced learning (embedded cases as well as

side-by-side cases), they have to be put in relation to the following questions:

- Which technologies should be used to support which goals and objectives for different learners in a variety of situations?
- Which ones are likely to be effective and sustainable?

(Spector, 2014, p. 5)

The difference between the embedded case and the side-by-side case is that in the latter case, the technology is still dependent on the user – the learner as well as the teacher - whereas in the first case, the technology is able to automatically react to the user's - the learner's - needs, making it, to a limited extent based on algorithms, more personalized.

Teachers might not always have all the necessary technology available to turn their classroom into a smart learning environment. However, they also have to keep in mind that technologies are not without limitations and unintended consequences. While advantages of digitally enhanced teaching and learning include the possibility for learner-centered education (since its variety can appeal to a broad range of learning styles), access to global and free resources (Poe & Stassen, n.d.), and in the elementary context, the enabling of "very young children to engage in technology-aided instruction" (Jacob, 2016, online) through the invention of easily manageable touch-screen technology, disadvantages also exist. Teachers and students have to become familiar with the new tools technology can offer (Poe & Stassen, n.d.). There is always the risk that the technology stops working or does not even work to begin with. Additionally, technologies can only be complements to the learning/teaching experience in the sense that they will always need a skilled teacher who decides which tools are appropriate for the development of certain competences. Finally, different students respond differently to digitally enhanced learning. It might support some in their learning process, others might not be influenced at all, and for others it might even have a negative impact on their learning. (Jacob, 2016)

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It is thus important to critically select the tools which will most likely facilitate learning and use the existing infrastructure to make the learning environment as smart as possible. It always has to be kept in mind that it is not the technology as such which makes a learning environment smart, but it is "the configuration of its parts – human and others – and their interactions" (Dron, 2018, p. 2).

3 KEY POINTS

- ✓ Information and communication technologies (ICTs) allow for student-centered, interactive learning environments by creating opportunities for the construction of knowledge by the learners themselves.
- ✓ When integrating technology into the classroom, teachers need the pedagogical understanding of the use of these devices and their possible application to offer a successful teaching/learning experience.
- ✓ Digitally enhanced learning environments can either be settings where digital devices are added to the physical environment to support the teaching/learning process (side-by-side case), or they are settings where the digital devices interact with the physical environment to support the teaching/learning process (embedded case).
- ✓ A smart learning environment (SLE) or smart classroom is an example of an embedded case, where the physical environment is characterized by a high degree of digital devices which are capable of reacting to students' needs and offering custom-made solutions.
- ✓ While SLEs can optimize teaching and learning, their effective functioning is still dependent on teachers' pedagogical considerations when establishing such learning environments.
- ✓ When teaching in a digitally enhanced learning environment, teachers have to respect 21st century teaching principles enriched with considerations such as which technologies support the

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teaching/learning process and reach the set learning objectives or which technologies are most effective.

- ✓ Advantages of a digitally enhanced learning environment include: possibility for learner-centered education, the access to global and free resources and easily manageable touch-screen technology.
- ✓ Disadvantages of a digitally enhanced learning environment include: teachers and students have to become familiar with the new tools technology can offer, the technology might not work, and different students respond differently to technology-enhanced learning.
- ✓ It is not the technology as such which makes a learning environment smart, but all involved parts– human and non-human – and how they interact.

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STEP 1 PRACTICE EXERCISES

A Indicate if the following statements are true or false:

1. Teaching in the 21st century calls for more teacher-centered approaches. T/F
2. The use of ICTs in the classroom allows for a student-centered, interactive learning environment. T/F
3. Currently, digitally enhanced learning is mainly achieved through the use of instructional films, radio and television. T/F
4. When using technology in the classroom, teachers do not need any additional pedagogical understanding. T/F
5. An effective use of innovative technology in the classroom can be achieved by simply replacing previously used practices with new technology without further considerations. T/F
6. Taking an educational technology to scale involves significant planning, policy (re-) development, training, support and leadership that are all too often lacking in educational systems. T/F

B Drag and drop the following examples into the appropriate category in the chart below:

Zoom[1] – Skype[2] – E-mail[3] – Discussion forum[4] – Face-to-face teaching in physical learning environment[5] – Live chat[6] – Shared smartboard[7] – Virtual hand raising[8] – Joint viewing of multimedia content[9] – File attachments[10] – Newsgroups[11] – Phone call[12] – Instructional videos[13]

Synchronous Communication	Asynchronous Communication

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C Indicate if the following statements describe the Digital Case, Embedded Case, Side-By-Side Case or Classical Case of a digitally enhanced learning environment:

	The physical environment provides relevant stimuli, and there are no additional digital relevant signals. This is 'old school' situation where humans are interacting and learning without the help of any digital device. In this case there is a representation of the learning environment by the user that is stimulated by the physical environment.
	The digital devices are added to a physical environment to support additional learning functions such as information, support, tests and feedback, but the digital devices are ignorant of the actual physical environment. All information about the physical environment should be added to the device by the user. For example when students are presented with tasks to execute in their physical environment, but they need to input the results to the digital device themselves. In this case the user's representation of the learning environment is fragmented: the physical parts and the digital parts.
	When the physical environment includes digital learning devices, but does not provide relevant non-digital stimuli to the user. For instance in a quiet study room when using a simulation program. The representation of the learning environment can dominantly be influenced by the digital device(s), e.g. by presenting a virtual reality world, a serious game, a virtual classroom or a (digital) book. The cognitive representations that are stimulated by the digital device can result in learning processes. In this case there is a digital stimulated representation of the learning environment.
	The physical environment provides relevant stimuli to the user and the digital devices are adding, augmenting information to enrich the cognitive representation. In this case there is a combined, partly digital, partly physical stimulated representation of the learning environment.

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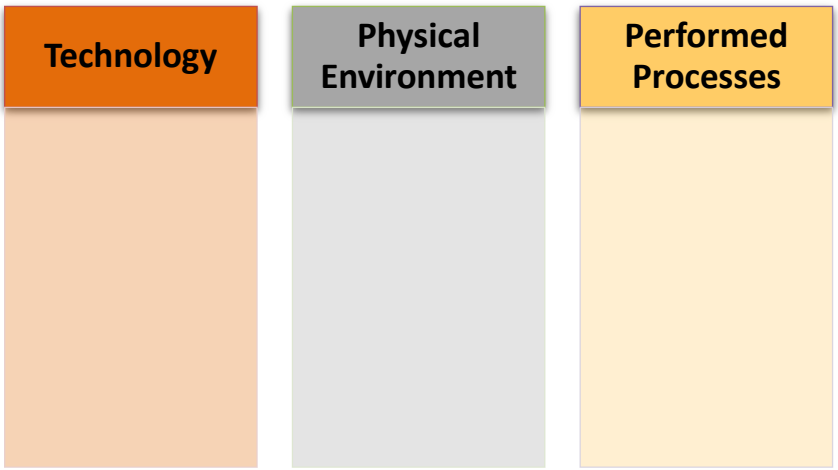
D Drag and drop the following characteristics into the appropriate category of the graph below displaying the dimensions of smart learning environments:

Processes performed by actors – Hardware and physical technology – Environmental factors – Architecture – Processes and features helped by the system – ICT and new paradigms – Learning content– Software



E Fill in the blanks with suitable words from the box:

learners	motivation	noise or echo	teachers	personalization
electricity consumption		temperature	parents	
	lighting	engagement		

1. Examples of environmental factors in a smart learning environment are_____, _____, _____, and _____.
2. Actors performing processes in a smart learning environment are_____, _____, and_____.
3. Processes and features which are encouraged by a smart learning environment are_____ _____, _____, and_____, among others.

F Choose the appropriate characteristics describing an ideal General Digitally Enhanced Learning Environment (side-by-side case) and a Smart Learning Environment/Smart Classroom (embedded case) from the list below. Characteristics can be assigned to MULTIPLE categories:

Technology enriched learning environment added to the physical environment[1] – Technology-rich, physical and virtual combined learning environment[2] – Can adjust light and temperature automatically[3] – Supports active learning[4] – Creates an authentic learning context[5] – Gives students hands-on learning experiences[6] – Technology interacts directly with learner[7] – Can react appropriately and autonomously to different learning situations and circumstances[8] – Student-centered[9] – Offers and supports collaborative learning[10] – Engages learners in meaningful discourse with others[11] – Motivates students[12] – The learner/teacher controls the technology[13]

General Digitally Enhanced Learning Environment	Smart Learning Environment/Smart Classroom

STEP 1 PRACTICE EXERCISES - SOLUTIONS

A Indicate if the following statements are true or false:

1. Teaching in the 21st century calls for more teacher-centered approaches. T/F (Correct Answer: Teaching in the 21st century calls for more student-centered approaches that engage students in co-construction of knowledge and active participation in the learning process.)

2. The use of ICTs in the classroom allows for a student-centered, interactive learning environment. T/F

3. Currently, digitally enhanced learning is mainly achieved through the use of instructional films, radio and television. T/F (Correct Answer: Currently, digitally enhanced learning pertains more to the use of computer-based technologies, including smartphones and other smart devices.)

4. When using technology in the classroom, teachers do not need any additional pedagogical understanding. T/F (Correct Answer: Teachers have to have a pedagogical understanding of technology used in the classroom and their possible application to offer successful teaching, regardless of the degree of digital technologies present in the classroom.)

5. An effective use of innovative technology in the classroom can be achieved by simply replacing previously used practices with new technology without further considerations. T/F (Correct Answer: Simply using a new technology to replace prior practice may not be an effective use of an innovative technology; only because a technology is innovative does not mean that its use to support learning and instruction will be innovative or effective.)

6. Taking an educational technology to scale involves significant planning, policy (re-) development, training, support and leadership that are all too often lacking in educational systems. T/F

B Drag and drop the following examples into the appropriate category in the chart below:

Zoom[1] – Skype[2] – E-mail[3] – Discussion forum[4] – Face-to-face teaching in physical learning environment[5] – Live chat[6] – Shared smartboard[7] – Virtual hand raising[8] – Joint viewing of multimedia content[9] – File attachments[10] – Newsgroups[11] – Phone call[12] – Instructional videos[13]

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Synchronous Communication	Asynchronous Communication
1	**3**
2	**4**
5	**10**
6	**11**
7	**13**
8	
9	
12	

C Indicate if the following statements describe the Digital Case, Embedded Case, Side-By-Side Case or Classical Case of a digitally enhanced learning environment:

Classical Case	The physical environment provides relevant stimuli, and there are no additional digital relevant signals. This is 'old school' situation where humans are interacting and learning without the help of any digital device. In this case there is a representation of the learning environment by the user that is stimulated by the physical environment.
Side-by-Side Case	The digital devices are added to a physical environment to support additional learning functions such as information, support, tests and feedback, but the digital devices are ignorant of the actual physical environment. All information about the physical environment should be added to the device by the user. For example when students are presented with tasks to execute in their physical environment, but they need to input the results to the digital device themselves. In this case the user's representation of the learning environment is fragmented: the physical parts and the digital parts.
Digital Case	When the physical environment includes digital learning devices, but does not provide relevant non-digital stimuli to the user. For instance in a quiet study room when using a simulation program. The representation of the learning environment can dominantly be influenced by the digital device(s), e.g. by presenting a virtual reality world, a serious game, a virtual classroom or a (digital) book. The cognitive representations that are stimulated by the digital device can result in learning processes. In this case there is a digital stimulated representation of the learning environment.
Embedded Case	The physical environment provides relevant stimuli to the user and the digital devices are adding, augmenting information to enrich the cognitive representation. In this case there is a combined, partly digital, partly physical stimulated representation of the learning environment.

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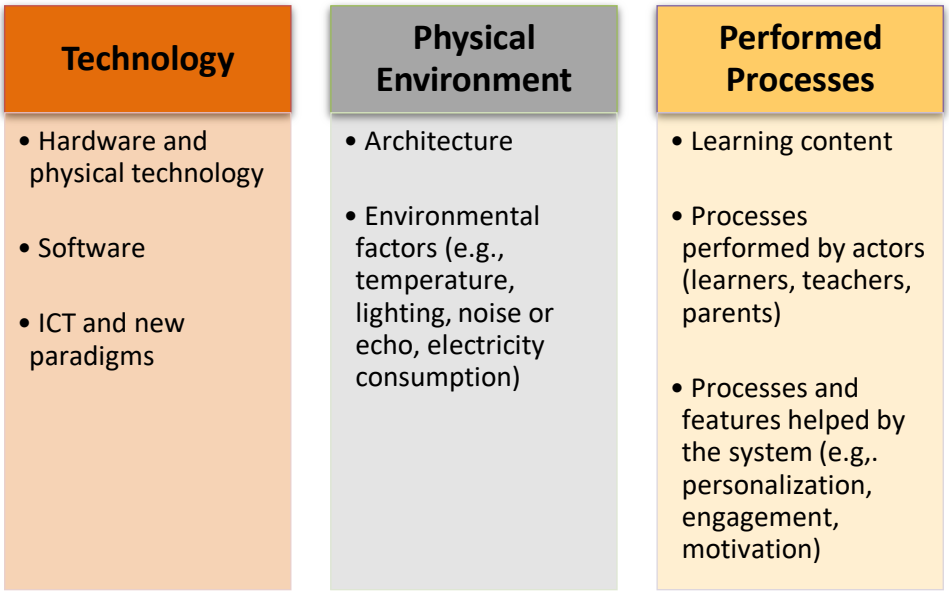
D Drag and drop the following characteristics into the appropriate category of the graph below displaying the dimensions of smart learning environments:

Processes performed by actors – Hardware and physical technology – Environmental factors – Architecture – Processes and features helped by the system – ICT and new paradigms – Learning content– Software



E Fill in the blanks with suitable words from the box:

learners	motivation	noise or echo	teachers	personalization
electricity consumption		temperature	parents	
	lighting	engagement		

1. Examples of environmental factors in a smart learning environment are temperature, lighting, noise or echo, and electricity consumption.
2. Actors performing processes in a smart learning environment are learners, teachers, and parents.
3. Processes and features which are encouraged by a smart learning environment are personalization, engagement, and motivation, among others.

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F Choose the appropriate characteristics describing an ideal General Digitally Enhanced Learning Environment (side-by-side case) and a Smart Learning Environment/Smart Classroom (embedded case) from the list below. Characteristics can be assigned to MULTIPLE categories:

Technology enriched learning environment added to the physical environment[1] – Technology-rich, physical and virtual combined learning environment[2] – Can adjust light and temperature automatically[3] – Supports active learning[4] – Creates an authentic learning context[5] – Gives students hands-on learning experiences[6] – Technology interacts directly with learner[7] – Can react appropriately and autonomously to different learning situations and circumstances[8] – Student-centered[9] – Offers and supports collaborative learning[10] – Engages learners in meaningful discourse with others[11] – Motivates students[12] – The learner/teacher controls the technology[13]

General Digitally Enhanced Learning Environment	Smart Learning Environment/Smart Classroom
1	**2**
4	**3**
5	**4**
6	**5**
9	**6**
10	**7**
11	**8**
12	**9**
13	**10**
	11
	12

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STEP 2 PRACTICE EXERCISES

A Listen to this teacher talk about teaching with technology (Audio File 5.1.1; audio transcription can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. Which advantages does she mention?
   a) Access to various educational platforms
   b) It allows for inclusive education
   c) Lesson becomes interesting
   d) Less teacher talk

2. Which disadvantages does she mention?
   a) It is very expensive
   b) Teacher has no control if students are engaged
   c) They can get easily distracted
   d) Screens are bad for children's eyes and posture

3. What is the teacher's solution to the problem that too much screen time is bad for children?
   a) Children should not spend any time online
   b) There should be a restriction on the time children spend online
   c) She has no solution

B Listen to this teacher talk about online learning (Audio File 5.1.2; audio transcription can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. Which advantages does he mention?
   a) Lesson becomes interesting
   b) Access to various educational platforms
   c) Students can participate in lessons whenever and wherever
   d) It allows for inclusive education

2. Which challenges does he mention?
   a) Not all children participate in the lessons

b) Parents are not very supportive
c) Students are not able to go to school and see their teacher and peers
d) Due to data problems children turn off their cameras in Zoom calls so it is in fact only a lecture given by the teacher

3. How did the teacher deal with the fact that students and parents were not very involved in learning?
   a) He called the parents and asked them to be more involved
   b) He asked the students to talk to their parents
   c) He did not do anything

4. How did the teacher deal with the fact that students felt isolated because they did not see their teacher?
   a) He used his school's LMS chat option for group conversations
   b) He organized Zoom calls/Zoom classes/video calls where students could see their teacher and each other
   c) He did not do anything

C Watch this teacher talk about teaching in an online setting. (Video File 5.1.1; audio transcriptions can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. What kind of strategies does this teacher use to help students want to learn in an online setting?
   a) Motivation methods
   b) Good timing
   c) Encouraging further study
   d) Making the students understand that they can learn everywhere

2. The teacher keeps contact with the parents to find solutions how they can help their children.
   a) True
   b) False

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STEP 2 PRACTICE EXERCISES - SOLUTIONS

A Listen to this teacher talk about teaching with technology (Audio File 5.1.1; audio transcription can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. Which advantages does she mention?
   a) Access to various educational platforms
   b) It allows for inclusive education
   c) Lesson becomes interesting
   d) Less teacher talk

2. Which disadvantages does she mention?
   a) It is very expensive
   b) Teacher has no control if students are engaged
   c) They can get easily distracted
   d) Screens are bad for children's eyes and posture

3. What is the teacher's solution to the problem that too much screen time is bad for children?
   a) Children should not spend any time online
   b) There should be a restriction on the time children spend online
   c) She has no solution

B Listen to this teacher talk about online learning (Audio File 5.1.2; audio transcription can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. Which advantages does he mention?
   a) Lesson becomes interesting
   b) Access to various educational platforms
   c) Students can participate in lessons whenever and wherever
   d) It allows for inclusive education.

2. Which challenges does he mention?
   a) Not all children participate in the lessons

b) Parents are not very supportive
c) Students are not able to go to school and see their teacher and peers
d) Due to data problems children turn off their cameras in Zoom calls so it is in fact only a lecture given by the teacher

3. How did the teacher deal with the fact that students and parents were not very involved in learning?
   a) He called the parents and asked them to be more involved
   b) He asked the students to talk to their parents
   c) He did not do anything

4. How did the teacher deal with the fact that students felt isolated because they did not see their teacher?
   a) He used his school's LMS chat option for group conversations
   b) He organized Zoom calls/Zoom classes/video calls where students could see their teacher and each other
   c) He did not do anything

C Watch this teacher talk about teaching in an online setting. (Video File 5.1.1; audio transcriptions can be found in the appendix of this document). Answer the following multiple-choice questions. There can be MULTIPLE correct answers:

1. What kind of strategies does this teacher use to help students want to learn in an online setting?
   a) Motivation methods
   b) Good timing
   c) Encouraging further study
   d) Making the students understand that they can learn everywhere

2. The teacher keeps contact with the parents to find solutions how they can help their children.
   a) True
   b) False

STEP 3 PORTFOLIO TASK – SELF-REFLECTION QUESTIONS

Write essay answers to each of the following self-reflection questions. Each essay answer should be approximately 300-500 words long and answered in a coherent text with full sentences. THESE ESSAY ANSWERS GO INTO YOUR PERSONAL PORTFOLIO!

1. Which arguments would you give for using technology in the classroom? What are, from your point of view, the challenges or risks that have to be considered?

2. Which arguments would you give for teaching in a smart learning environment/smart classroom?

STEP 4 PORTFOLIO TASK – TEACHING PROJECT

Create your own personal teaching project. Use the description of your learning environment from Module 2.3 and add possible technical equipment and how it can be used in your lesson planning to enhance students- and target-orientation. This portfolio task should be approximately 800-1000 words long. THE TEACHING PROJECT GOES INTO YOUR PERSONAL PORTFOLIO!

APPENDIX

Transcript: Audio File 5.1.1

Teacher: Because I'm completely against the talk and talk system, Sir. And we live in the 21st century and we have, I mean our country is a little, I feel, still a little backwards when it comes to all these contemporary methods you see in education. So I feel we need to go forward, as smart class allows us to do a lot of things, have access to various educational platforms and the lesson becomes really interesting because these children are children of the 21st century. So talk and talk no longer works. That is useful for educational purposes. It can have a negative impact on students also health wise and psychologically. Like how do you know that the children are engaged, right, behind the screen? They must be doing something else, right. So students can be easily distracted. The screens are bad for their eyes, bad for their posture. So there are a lot of health issues and psychological issues related to this online teaching system. So student wise there are some disadvantages also as I told you.

Interviewer: Ok. That means you prefer working with online tools, yes?

Teacher: I don't prefer but we have to have some system to make sure that the students are engaged, that the time they are engaged is less. Online time should be, actually there should be restrictions. So, I think now in my school specifically we don't have online lessons all five days of the week. We have like given them two days, even though student time is limited, but some schools from 8 am to 2 o'clock they have online lessons. So that is really bad for the students, being exposed to digital. I prefer online teaching it is very helpful at a time like this, but you have to have a proper systemized method to make sure the students are not negatively affected.

Transcript: Audio File 5.1.2

Teacher: Our system the system that we used was good because the students did not have to be all at the same time in the same place for us to organize those classes. Just make lessons and students can go and take those lessons and participate in them whenever they have time, at night or in the morning, whenever they have data. That was an advantage of our lessons, smart classes, but the challenge again was not all students were participating in them. Even parents, they were not very supportive in that regard. We had to call them, we had to ask them to be more active in the smart classes. Another challenge was that even though with these organized classes students didn't really get to see their teachers, they didn't get to talk and meet their friends, I guess being more distant from school, not being in the mood of learning, that was another challenge. And teachers had to do something about it. What we did about it, I guess how we overcame that challenge was combining both Zoom or other video, I guess, apps to have classes all at the same time simultaneously so students can actually see each other. We had some Zoom classes to facilitate that. It helped a little bit because students, they got to see their faces, faces of each other. It helped at first but then later they turned the video off because video uses a lot of data and they preferred using audio only. And it turned out to be only a lecture. Teachers turned on their audio, they turned off their video and they just listened to the teacher talk.

Transcript: Video File 5.1.1

Interviewer: Because of Covid-19 all schools were closed. Most schools decided to switch to online teaching. What are the methods to help students to still want to learn?

Teacher A: Motivating methods, timing, encouraging further study and making them understand that they can learn everywhere. I keep a good contact with students and parents to find solutions to help them with their learning.

The digital age has provided a wealth of new educational tools for the classroom and successful educators understand the importance of incorporating them into their teaching. In this module, you will see how to effectively use information and communications technology (ICT) so that it aligns with learning objectives, subject matter and assessment in the classroom. Through concrete applications of technology, the opportunities provided by digital media will be shown to support and enrich the design and implementation of teaching and learning processes and a set of key digital skills will be developed so that you can better use digital media in pedagogical contexts

Enjoy!