NOVIGADO

ACTIVE LEARNING AND INNOVATIVE TEACHING IN FLEXIBLE LEARNING SPACES

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O2 - ACTIVE LEARNING REFERENCE FRAMEWORK

FOR INNOVATIVE TEACHING IN FLEXIBLE LEARNING SPACES

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1 Introduction

The overall objective of the Novigado project is to **support schools and related stakeholders in the transition from a conventional and teacher-centred classroom**, where the transmission model is prevalent, into teaching practices that promote **active learning with the support of flexible, innovative learning environments and the use of relevant ICT**. Additionally, with the perspective of continued distance education due to the COVID-19 pandemic, active learning methods supported by ICT can be helpful in developing a sustainable model of education in which the physical space of brick-and-mortar classrooms is blended with or, should such a need arise, completely replaced with online activities. The Novigado project's meta objective is to **stimulate the development of key competences and transversal skills** among students as crucial for their society's well-being and for their functioning in the pandemic-affected environment and the post-COVID-19 world. For that purpose, this **Active Learning Reference Framework** defines the key elements, techniques and criteria for active learning in flexible learning spaces, and it will form the conceptual framework of the Novigado project.

Within the scope of the project, this framework was constructed based on a rigorous **desk research and literature review** on various definitions of active learning, active learning techniques, flexible learning environments, and teachers' and students' roles, including critique of and obstacles to the implementation of active learning methods.

This document supports the subsequent phases of the Novigado project: creating the Capacity-Building Programme for pilot schools, defining Guidelines for schools in Learning-Space Innovation, organising the Pilot Evaluation Scheme for the school pilot implementation, and designing the Active Learning Scaleup Instrument and the Online Scenario Tool.

2 Active Learning

There are several theories that explain active learning. Nowadays, educational researchers generally define active learning as follows:

Naithani (2008) notes that the roots of active learning can be traced back to Confucius (551-479 BC), who stated, "I hear and I forget. I see and I remember. I do and I understand." It is also commonly thought that people remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say, 90% of what they do, according to the so-called 'cone of experience' (based on the works of Edgar Dale).

Therefore, they need to share their learning experiences, make links with their background knowledge and new information, and apply it to their daily lives. Active learning arises from social

constructivism, a theory generally attributed to the Swiss psychologist Jean Piaget and the Russian psychologist Lev Vygotsky (Sparks, 2013).

Cherney (2015) states that active learning is a process of creating meaning. New knowledge is built when students combine new information with their existing concepts, knowledge or experience through the reflection process (Bell and Kahrhoff, 2006). Any new information that is not consistent with the past experiences is rejected as incorrect or incorporated into the new knowledge. To create meaning in active learning, students have to produce active effort. In other words, active learning requires students to do something (read, discuss, write) that needs higher-order thinking skills. Consequently, those students participate in the construction of the facts, ideas and skills through the completion of tasks and activities directed by the instructor actively (Bell and Kahrhoff, 2006).

According to Gilliot (2017), active learning within an active pedagogy framework must be student-centred. Gilliot explains that students learn through emerging and persistent problems in an individual and interpersonal way that allows them to process information actively and deeply. Weimer (2002) identified five key changes to practice that need to be implemented in the student-centred learning approach:

1. **The balance of power:** for the student-centred approach to work, power needs to be re-distributed from teachers to the students. As students should be in the centre of the learning process, they need to start being in charge of the learning process, having the ability to influence what and how they are learning.
2. **The function of content:** following the constructivist approach where learners actively construct their knowledge by constructing the meaning and relating it to the previously acquired knowledge.
3. **The role of the teacher:** involving students in the process of acquiring knowledge and being active in the learning. Teachers are not the only source of expertise, and students should not wait for them in order to learn.
4. **The responsibility for learning:** students should be responsible for their own learning; they should be taught how to learn and become autonomous, self-regulating learners.
5. **Evaluation purpose and processes:** teachers need to implement assessment for learning and assessment as learning – both being formative assessment strategies to support students as learners.

According to Lebrun (2007), the framework of active learning pedagogy is composed of 13 elements: learning as a personal process; previous knowledge as catalyser; the motivation factors; the importance of available resources; the role of context, the learning environment and concrete experiences; the high-level abilities to be implemented; the research and questioning processes within learning; the conceptual change (awareness, imbalance and reformulation); the need for feedback in activities; the cooperative and interactive aspect of learning; the connection between personal, professional and life projects; and the importance of manufacturing, creating; the reflection role of active learning.

According to University of Cambridge Local Examinations Syndicate (UCLES, 2019), active learning is based on some theories such as constructivism, social constructivism, schemas or schemata, scaffolding, Bloom's Taxonomy, child-centred approach, inquiry-based, problem-based or discovery learning, and experiential learning.

- Constructivism has its roots in the cognitive theories of Piaget, and learners construct their own understanding individually.
- According to Lev Vygotsky (1896-1934), learning happens primarily through social interaction in social constructivism.
- Jerome Bruner (1915-2016) describes scaffolding as supporting a student, or group of students, in their learning of new language or skills.
- The revised Bloom's Taxonomy offers a classification of affective and cognitive skills. Active learning approaches will help students develop at every stage of Bloom's Taxonomy (creating, evaluating, analysing, applying, understanding, remembering).
- Maria Montessori (1870-1952) advocates a child-centred approach. Students play an active role in their learning while teachers are activators of learning in student-centred, or learner-centred learning.
- Inquiry-based, problem-based or discovery learning, where learners learn by addressing and posing questions, analysing evidence, connecting such evidence to pre-existing knowledge, drawing conclusions and reflecting upon their findings.
- Experiential learning describes someone learning from direct experience.

According to UCLES (2019), the benefits of active learning can be listed as the following:

- Active learning builds both knowledge and understanding which students can then apply to new contexts and problems.
- Active learning fosters students' learning and their autonomy, gives them skills of lifelong learning, and allows them to develop their metacognitive thinking.
- Active learning approaches help learners to develop higher-order thinking skills to achieve high grades in high-quality examinations.
- Active learning activities involve collaboration.

Naithani (2008) explains two types of active learning: cooperative and problem-based active learning. In cooperative active learning, students' involvement is crucial for the successful active learning environment. It aims at developing a network of students to achieve higher levels of learning (Naithani, 2008). Learning is a team effort which depends on positive interdependence, individual accountability, continuous interaction, teamwork, and collaboration and cooperation amongst students. On the other hand, problem-based learning is a self-directed effort of a student towards understanding the solution of a problem. It begins with a challenge of presenting a real-life problem, the answer to which they have to find individually and/or collectively. In this process, students identify what they know and what they need to know to solve the problem.

3 Active Learning Elements

Active learning elements are means by which students gain knowledge and understanding. Active learning elements are identified and listed from different authors' active learning definitions stated in previous sections. There are some basic activities through which all students learn. These elements of active learning are reading, watching, writing, talking, listening, collaborating, discussing, investigating, practising and producing. Specific active learning strategies use one or more of these active learning elements.

- **Reading, watching, listening:** Students learn through active reading, watching and listening. Active reading involves a summary of readings that helps students process what they have learned. When students read, listen or watch, they learn actively if they relate what they hear or see with what they already know. Writing or talking of what is read, listened to or watched provides a means for students to process new information actively. When students talk about a topic they have read, listened to or watched, they organise and reinforce what they have learned actively.
- **Collaborating:** Students in collaboration learn new things actively from one another. Students can collaborate to solve a given problem. When a question is posed in a collaboration group, students may have different answers. Students communicate with one another to hear different opinions. Allowing students to pause for thought, to use their new knowledge, to teach one another, or to answer questions on the day's topics is one of the simplest ways to increase active learning.
- **Discussing:** A well-planned discussion activity can encourage and stimulate student learning. Discussion helps students to process information actively. The goal of discussion is to get students to practise thinking about course materials. They should be able to think, to connect what they have just learned with what they already know, or to use the knowledge they have gained in any way.
- **Investigating:** Investigation activities create open-ended problems that require students to explore, manipulate and investigate to solve them. Investigative learning is student-centred and places importance upon the learner having a greater responsibility for their own learning. While students are investigating, exploring and discovering the world around them, they are involved in problem-solving and learning actively.
- **Practising:** Practising speeds up active learning. Practising is the act of rehearsing a behaviour again and again for the purpose of improving and mastering it. Students should practise or apply what they have learned in order to master it.
- **Producing:** While producing, students internalise ideas and express information creatively in ways that inspire others. Creative application of core content is a teacher's most powerful tool in building students' understanding. For students to understand the content, students must think creatively about the content itself. If teachers help students use content in creative ways, it will help students learn actively.
- **Reflecting:** While being actively engaged, students also reflect about their own learning. Active learners learn by doing and thinking about what they are doing.

4 Key Competences and Transversal Skills

Active learning elements may directly support the development of key competences and transversal skills. The key competences determined by the European Commission (2018) can be summarised as the following:

- **Communication:** Articulating thoughts and ideas effectively using oral, written and non-verbal communication skills in a variety of forms and contexts. Listening effectively to decode meanings. Using communication for multiple purposes to inform, instruct, motivate and persuade.

- **Mathematical Competence and Basic Competences in Science and Technology:** Demonstrating ability to reason with numbers and other mathematical concepts. Demonstrating the ability to evaluate scientific and numerical information on the basis of its sources and the methods used to generate it. Demonstrating the capacity to evaluate scientific arguments based on evidence and to apply conclusions from such arguments in an appropriate manner.
- **Digital Competence:** Applying technology effectively as a tool to research, organise, evaluate and communicate information. Using digital technologies, communication networking tools and social media appropriately to access, manage, integrate, evaluate and create information to function successfully in a given environment.
- **Learning to Learn:** Demonstrating commitment to learning as a lifelong process. Being a self-directed learner by going beyond basic mastery of skills to explore and expand your own learning and opportunities to gain expertise. Demonstrating initiative to advance skill levels towards a professional level.
- **Social and Civic Competences:** Interacting effectively with others: knowing when it is appropriate to listen and when to speak. Collaborating with other people: being able to work effectively and respectfully with diverse teams, being flexible and willing to help make necessary compromises to accomplish a common goal. Sharing responsibility in collaborative work, and valuing the individual contributions made by each team member.
- **Cultural Awareness and Expression:** Working effectively in a multinational team. Respecting and being aware of cultural differences, and working effectively with people from a range of social and cultural backgrounds.
- **Entrepreneurship:** Working effectively in a multinational team. Making use of social and cultural differences to create new ideas and increase both innovation and quality of work. Ability to turn ideas into action. Ability to have creativity/innovation.

According to UNESCO (2013), transversal skills are competences that are transferable between jobs. The UNESCO Framework for transversal competences can be summarised as follows:

- **Critical and Innovative Thinking:** This includes creativity, entrepreneurship, resourcefulness, application skills, reflective thinking and reasoned decision-making.
- **Interpersonal Skills:** They include communication skills, organisational skills, teamwork, collaboration, sociability, collegiality, empathy and compassion.
- **Intrapersonal Skills:** They include self-discipline, ability to learn independently, flexibility and adaptability, self-awareness, perseverance, self-motivation, compassion, integrity, risk-taking and self-respect.
- **Global Citizenship:** It includes awareness, tolerance, openness, responsibility, respect for diversity, ethical understanding, intercultural understanding, ability to resolve conflicts, democratic participation, respect for the environment, national identity and sense of belonging.
- **Media and Information Literacy:** It includes the ability to locate and access information through ICT, media, libraries and archives, to express and communicate ideas through ICT, to use media and ICT to participate in democratic processes, the ability to analyse and evaluate media content.

5 Practical Techniques of Active Learning

Bell and Kahrhoff (2006) define any type of activity that involves students in the learning process as Active Learning Activity. Brame (2018) specifies it as instructional activity that involves students in doing things and thinking about what they are doing. Gilliot (2017) emphasises that active learning activities must make sense to students because they involve their efforts to build their knowledge actively. Active learning activities can vary from very simple (for example, to pause a conference to allow students to clarify and organise their ideas by discussing with neighbours) to complex ones (for example, to use case studies as a focal point for taking decisions). They can be exemplified as working with other students on projects during class, making a presentation, asking questions or contributing to discussions, participating in a project as part of a course, working with other students out of class on homework, discussing ideas of a course with others outside of class, and peer tutoring (Brame, 2018).

Techniques or activities help active learners create meaning and learn actively. According to Brame (2018), active learning techniques that are mostly used in classrooms can be summarised by the following:

- **The pause procedure:** The teacher pauses instruction every 12 to 18 minutes, encourages students to discuss and review the notes in pairs. The teacher has students write down everything that they can remember from the previous class segment.
- **Demonstrations:** The teacher asks students to predict the outcome of a demonstration. Students briefly discuss their expected outcome in groups. After the demonstration, the teacher asks them to discuss the observed result and how it may have differed from their prediction.
- **Think-pair-share:** The teacher asks students a question that requires higher-order thinking skills (for example, levels of application, analysis or evaluation, within Bloom's taxonomy). The teacher asks students to think or write about an answer, then discuss their answers in groups. Then, the teacher asks the groups to share their answers, and follows up with his or her explanation of the solution.
- **Concept maps:** These are visual representations of the relationships between concepts. Concepts are placed in nodes (often, circles), and the relationships between them are indicated by labelled arrows that connect the concepts. The teacher has students create a concept map, identifying the key concepts for mapping in small groups or as a complete class. The teacher asks students to determine the general relationship between the concepts and organise them two by two, drawing arrows between the related concepts and labelling with a short phrase to describe the relationship.
- **Team-based learning (TBL):** This is a structured form of small group learning that emphasises student preparation outside of the class and application of knowledge in the class. Students are strategically organised into various teams of 5-7 students working together.
- **Problem-based learning (PBL):** The teacher asks students to address complex and challenging problems and work collaboratively to solve them. PBL is about connecting disciplinary knowledge with real-world problems. A student actively guides his or her own learning, individually or in a group. The selected problem should reflect real-life circumstances and be contemporary to facilitate the process of learning and doing (Naithani, 2008). Some other techniques include project-based learning with its

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modification known as the Genius Hour, which is based on the practices of huge companies known as Passion Projects or 20% projects.

According to Cherney (2015), class discussion is also among the common activities that promote active learning. Gonzalez (2015) presents 17 class discussion strategies which aim to engage all students in the lesson. They are opposed to a technique she calls Fisheye Teaching where only a couple of the most courageous students take part in the discussion. She divides the strategies into three groups: high-prep, which require more teacher preparation, low-prep, which can be used at any time without special preparation, and ongoing strategies, which can be integrated into the instruction.

High-prep strategies:

- **Gallery Walk:** firstly, students work in small groups on a certain topic assigned by a teacher. Then, they are divided into new groups and rotate between the stations, teaching one another about the content they were working on.
- **Philosophical Chairs:** this is a form of a debate. The debatable statement is read aloud and students divide into positions based on whether they agree or disagree with the statement. It may also take the form of a continuum. Standing in a half-circle, students take turns to defend their position.
- **Pinwheel discussion:** students are divided into four groups – three of them represent a certain standpoint whereas the fourth one plays a role of a devil's advocate and keeps the discussion going. Each group has an assigned time to prepare. The name comes from the way they are seated. Students take turns in speaking for their group.
- **Socratic seminar:** for this discussion activity, students need to be prepared beforehand by reading a text or a couple of texts related to the topic and annotating them. The discussion starts with a leader who asks an open-ended question like "What do you think this text means?" The discussion follows naturally with the aim of gaining a deeper understanding of the text presented. Socratic seminars can take the form of a Fishbowl activity, where only a couple of students discuss the topic and the others act as observers.
- **Thoughts, Questions and Epiphanies (TQE):** This is a discussion technique that is split into four stages. Before the class, students get ready for the activity by reading an assigned text. During the class, they are split into groups where they first discuss their TQE for 15 minutes. Stage 3 is choosing up to 2 TQEs that will be written down and shared with other students on the board. The last stage is a whole-class discussion of the chosen TQEs.

Low-prep strategies:

- **Affinity Mapping:** first, students brainstorm answers to a very broad question, like "What are the implications of World War II?" which they write down on post-its. After lots of ideas are gathered, they start to arrange them in groups.
- **Concentric Circles (Speed dating, Onion):** Each student in the outer circle is paired with a student in the inner circle. The teacher asks a question which they need to discuss. After that, they rotate and a new discussion question is asked.
- **Cover-stations:** students are split into groups of 4-6. They are assigned a question to discuss. After that, two students from each group are asked to move to another group

where they share the key ideas related to questions from the previous discussion and the whole group is asked another.

- **Fishbowl Discussion:** all students sit in a circle but two of them facing each other sit in the centre of the circle. The students who sit in the centre discuss the topic and the others observe, and make notes. The variation of this activity is that a student from the circle can switch with a student from the centre and continue the discussion.
- **Hot Seat:** one student sits in a "hot seat" where he or she impersonates a character from a novel, a historical figure or a concept. The other students ask questions to which the person in the hot seat needs to respond, staying in the role.
- **Snowball Discussion:** students start by discussing the topic in pairs, they are joined in fours, eights and so on, until reaching whole-class discussion.

Ongoing strategies:

- **Asynchronous Voice:** this is an asynchronous discussion technique with the use of technology (like Voxer or Flipgrid) where students can discuss topics by sending each other voice messages.
- **Backchannel Discussion:** this is a type of discussion that may accompany another activity, like watching a film or lecture. Students have a separate channel (e.g. Using Socrative or Mentimeter) to discuss the topics or note down the most important statements without interrupting the flow of the presentation.
- **Talk Moves:** these are the beginning of sentences that students can use, made to model the discussion (e.g. "I agree with what you said… because…").
- **Teach-OK:** this technique allows students to explain the concepts to one another after the teacher has given a whole-class presentation related to the topic.
- **Think-Pair-Share:** This is a thinking routine where students firstly reflect on the question asked by themselves, then talk about it in the pair, and then share it with the whole class.
- **Ongoing Conversations:** this strategy involves keeping track of all the conversations among students. A student is given a tracker sheet that he or she needs to fill out and meet the goal set by the teacher. This simple technique works as a supplement to other techniques, as well.

6 Active Learning Environments

According to Naithani (2008), active learning involves designing, implementing, maintaining and promoting, within and outside the classroom, an environment for learning through creating opportunities for active engagement with the subject matter.

Snape and Johnston (2019) remark that the idea of flexible learning spaces (FLS) has two sides: one is the choice of furniture and equipment, the other is giving students choice and ownership and self-direction in finding spaces and places that work best for them to help them learn and get the most out of their learning.

European Schoolnet (EUN) (2020) proposes a model that articulates six active learning zones: Interact, Exchange, Investigate, Create, Present and Develop. All learning zones combined make the Future Classroom Lab. The zones are defined as the following:

- **Interact Zone:** The teacher can use technology to enhance interactivity and student participation in traditional learning spaces. One challenge of the traditional classroom setting is getting all students actively involved; technology enables each and every pupil to contribute. Solutions vary from individual devices like tablets and smartphones, to interactive whiteboards and interactive learning content. In the Interact zone, learning involves both teachers' and students' active engagement.

- **Exchange Zone:** In this learning zone, learning places much importance on the ability to collaborate with others. The teamwork takes place while investigating, creating and presenting. The quality of collaboration is composed of ownership, shared responsibility and decision-making process within groups. ICT can help to create a richer way of communication and collaboration. Collaboration in the 21st-century classroom is not limited to face-to-face and synchronous communication, but can take place online and asynchronously.

- **Develop Zone:** The Develop zone is a space for informal learning and self-reflection. Students can carry out school work independently at their own pace, but they can also learn informally while concentrating on their own interests outside of the formal classroom settings both at school and at home. By providing ways to foster self-directed learning, the school supports learners' self-reflection and metacognition skills. The school encourages its students towards true lifelong learning by acknowledging and validating informal learning.

- **Investigate Zone:** In the Future Classroom, students are encouraged to discover for themselves; they are given the opportunity to be active participants rather than passive listeners. In the Investigate zone, teachers can promote inquiry- and project-based learning to enhance students' critical thinking skills. The flexible furniture supports this concept, and the physical zone can be reconfigured quickly to enable work in groups, in pairs or individually. New technology gives an added value to the research by providing rich, versatile and real-life data, and also by providing tools to examine and to analyse.

- **Create Zone:** The Future Classroom allows the students to plan, design and produce their own work – for example, a multimedia production or a presentation. In the create zone, simple repetition of information is not enough: students work with real knowledge-building activities. Interpretation, analysis, teamwork and evaluation are important parts of the creative process.

- **Present Zone:** Students of the Future Classroom will need a different set of tools and skills to present, deliver and obtain feedback on their work. The presentation and delivery of the pupils' work have to be factored into the planning of lessons, allowing students to add a communicative dimension to their work. Presentations of students can be supported by a dedicated area with its design and layout, encouraging interaction and feedback. Online publication and sharing are also encouraged, allowing the students to become accustomed to using online resources and familiarising themselves with the principles of eSafety.

The layout of the classroom is just as important as planning the programme and units of work because if the classroom is not set up in a way that is conducive to learning, it will be a hindrance. Moreover, it is important to explain to students the purpose of each zone, the routines and procedures that help the space function in an efficient way, and to set clear expectations in order to increase the chances of success during the implementation of FLS (Snape and Johnston, 2019). Students should be told about the invisible boundaries which exist between different zones

in the classroom, as well as about being considerate to other people as there is more than one class in one room at a time.

According to the OECD (2017), the principles of designing innovative learning environments (ILE) should:

- strengthen the learners' active engagement in learning;
- encourage well-organised cooperative/collaborative learning;
- be in harmony with the learners' emotions and motivations;
- be sensitive to individuals' differences and needs and their backgrounds;
- arrange programmes demanding hard work without overload;
- use broad assessments and formative feedback to support learning; and
- promote "horizontal connectedness".

7 Redesigning Classrooms for Active Learning

Redesigning classrooms for active learning has aroused great interest among different educational researchers. They are interested in redesigning classrooms to develop active learning. Theoretical and empirical studies on redesigning classrooms for active learning constitute meaningful evidence for us. This section is devoted to such studies as are available.

Dillon, Gilpin, Juliani and Klein (2016) advocate classroom redesign as the transformation of learning spaces from factory model schemes to modern educational ecosystems and argue for it by stating that the world outside of the school walls "continues to innovate and advance at an increasing pace." They focus on the practical aspects of classroom redesign. The three qualities conducive to creating the optimal classroom experience are that it should be "learner-centred, engaged, and dynamic." It should be warm and welcoming, and should offer flexibility, but, at the same time, the learning space should not be overloaded with stimulating decorations. They also examine how technological devices are integrated by the teacher, rather than what types of technology are used. Three key factors in this case include strong wireless access, charging stations for devices, and having enough power outlets to maintain classroom flexibility.

According to Gordy, Zhang, Sullivan, Haynie, Richards-Moore and Bailey (2018), many institutions are making conscious efforts to incorporate technology into classrooms by transforming traditional classrooms into active learning classrooms rich in technology, hoping to have a positive impact on student learning. Research studies have shown that interactive learning environments improve students' problem-solving skills, attitude development and class attendance rates, and reduce failure rates. Active learning spaces have a significant and positive impact on student learning.

Neill and Etheridge (2008) investigated a transformation of a university classroom to see whether it had an effect on the students' engagement, collaboration and learning styles. Members of the faculty and technical staff collaborated to develop a flexible learning space suitable for their needs. The classroom is changed by taking into consideration its pedagogical use (transition to a more student-centred approach), physical design (easy to adjust the setting), and decentralised use of information technology. The room is equipped with movable tables able to seat 6-7 students each (54 in general), PCs along the sides, whiteboards and projectors. Multiple and differentiated

classes were assigned to learn in the space (13 in total where some teachers are assigned to the classroom and some request it) and compared with a control group of 18 classes in a traditional setting. Data were gathered through surveys (N=180 students, n=8 faculty) and interviews. The results show that teachers use multiple student-centred teaching approaches (e.g. discussions or group activities) in both traditional and flexible classrooms; however, the flexibility of the room was correlated with increased student engagement, more collaborative learning, greater variety of use, and enhanced teaching/learning styles of participants. When comparing the classes led by the same instructor in a traditional vs flexible setting, the researchers conclude that the flexible classroom does not change the approaches to teaching but it changes the perception of the environment, making it more positive for both students and teachers. The researchers also noticed that some of the barriers in implementing the flexible classroom were the fixed placement of the instructor's PC, and making sure teachers and students felt comfortable with moving the tables and chairs to suit the instruction style of the lesson (Neill and Etheridge, 2008).

A FabLab is a place to play, to create, and to invent: a place for learning and innovation. FabLabs provide access to the environment, skills, materials and advanced technology to allow students to make (almost) anything. Lehmans and Capelle (2019) investigate how the reconfiguration of space and time in a FabLab can modify how students relate to learning, to others and to schooling. This study also analysed the use of space by teachers, mediators and youngsters in FabLabs. For two years, Lehmans and Capelle (2019) carried out an ethnographic study through the observation of four groups of K-12 students' school projects in two different FabLabs. Students were also interviewed for the study. Results show that students move around differently in FabLabs from traditional classrooms. A student's possibility of movement represents their own role mobility during the learning process. Space flexibility is used by students as an energy liberation instrument that fosters concentration, mutual aid and stress release. The peripheral place assigned to machines in FabLabs fosters human interactions. Moreover, the results emphasise the importance of student's self-perception of autonomy during the learning process. As a matter of fact, autonomy in FabLabs is related to a social dimension that requires skills of assertiveness and teamwork. A student's posture in a FabLab is different: in a traditional class, a students' role is to listen and write; in a FabLab, their role is to understand, illustrate and explain to others. Therefore, pedagogical relations between students and teachers are modified in these spaces. However, for students who do not have the digital skills required, FabLabs have more constraints and they can become escape and isolation spaces.

8 Teachers' Role in Active Learning

Sparks (2013) states that in the traditional view, teaching is the transmission of information. A traditional teacher is like a radio transmitter transmitting data to be received by any student whose receiver is tuned to the correct frequency. In active learning, on the other hand, teaching requires both a change in philosophy and in practice. An active teacher stops asking the question, "How can I explain this to my students?" and starts asking, "How can I get my students to discover this?" Only students can learn, and only when they get involved with the material can they learn. Only students can change their own knowledge as a means to integrate new knowledge. Teachers can only support students while they are exploring the new educational content actively. Teachers' pedagogical mission is to design and implement activities that motivate students' discovery, to provide support, and to evaluate their achievements (Sparks, 2013).

According to Naithani (2008), there are three major components of an active learning environment and they are students, instructors, and institute/management. An active learning environment demands behaviour modification on the part of students, instructors and institute/management. There is a need for a paradigm shift from the usual approach of "How I like to teach" to "How the learner wants to learn and how the learner will learn better." Active learning would start with teachers who can upgrade their knowledge and skills in the time of need. Then, they have to identify the needs of the students with reference to changes expected in the learning environment. After that, they have to balance the students' needs with what they think is best for the learning environment. Finally, this would lead to preliminary preparations in collaboration with the learners, and would be followed by gradual, step-by-step implementation of the new methods and tools (Naithani, 2008).

According to Cherney (2015), teachers strive to optimise learning through multiple aspects of the student-centred approach in an active learning paradigm. Classes focus on student learning, not on teacher instruction. Teachers become facilitators of learning by transferring learning responsibility to the students, who in turn must participate in the learning process actively with their instructors and peers.

According to Dillon et al. (2016), redesigning learning spaces to maximise learning is primarily a shift in culture and mindset. Teachers who want to change their learning spaces should understand that this decision is "a commitment to student-centred learning including a shift in the locus of control." It is also noted that, for the change to be successful, teachers need to "see their roles in a multi-faceted way," as "facilitators of deeper, quality learning, learners and positive risk-takers for kids, and as empowered change agents in the area of learning-space design."

According to Gilliot (2017), teachers' role in active pedagogy is to focus on a students' learning, and to guide and facilitate their learning by giving them feedback. It is also important to show that teachers are still learners.

For Lebrun (2007), on the one hand, an ideal teacher must have knowledge and gain expertise. He should create "enigma" among students and guide them during the learning process. On the other hand, students should develop their own knowledge instead of reproducing others'.

According to Sparks (2013), active teachers see the double importance of collaboration between students and the guiding role of the teacher. The effective collaboration of students depends on the ability of group members to recognise and adopt various roles. Students should be able to recognise behaviour that may be impeding the group. They should also be able to adopt roles that help the group with their task, as well as those that promote harmony among the members.

According to UCLES (2019), teachers can make the best use of active learning as listed below:

- Teachers should review and activate students' previous information and help them to make links with new knowledge. In addition, they should continually elicit feedback on all students' learning through use of effective questioning and corresponding design plans for future teaching.
- New knowledge should be presented in small steps with opportunities for well-scaffolded practice and review.
- Learners need adequate time to process new information.

- Teachers should encourage learners to be conscious and strategic to develop skills of planning, monitoring and evaluating their learning.
- Teachers should enable learners to build knowledge through speaking, listening, reading and writing. The use of focused and high-quality dialogue, paired discussion and group work is important in processing new learning and fostering understanding.

9 Students' Role in Active Learning

There is a growing trend to stimulate students to take a more active role in their own learning. In traditional learning, students expect to be taught and drift through a lecture passively. However, students should have the right to control their own learning. According to Goldberg (2012), the more active that students are in the classroom, the more engaged they are in the learning process, and the more they remember. Learning how to learn is closely associated with this.

UCLES (2019) also states that learners take part in their own learning process actively by making links with existing knowledge and new information. Active learning requires students to think hard and creatively, and to practise using new knowledge and skills in order to develop long-term recall and a deeper understanding.

Active learning not only fosters students' learning and autonomy, but is also successful in engaging students and improving their skills like lifelong learning (Banavara, 2017). Active learning makes students capable of analysing and evaluating on their own, thinking independently and solving their problems more creatively. This will guide them toward becoming thinkers and lifetime self-instructors.

According to Sparks (2013), active students experience a deeper and lasting understanding because they are cognitively involved with what they are studying: they learn by doing and thinking about what they are doing. Active students try to apply, analyse, evaluate and create by moving to the highest levels of Bloom's taxonomy.

10 Obstacles to the Practical Implementation of Active Learning

According to Aye (2018), the main reason for the criticism of active learning is teachers who do not like taking risks. If students do not participate in classroom activities actively and use higher-order thinking, teachers are criticised for teaching in unconventional ways. Other specific obstacles include the following: limited class time, heavy curriculum, impracticability of active learning in large classes, lack of materials, equipment or resources, and students reluctant to engage in active learning methods.

According to Aksit and Niemi (2016), who polled a group of students involved in teacher education in Turkey, the main problem reported by students was related to the attitude and lack of skills among the educators who tried to employ active learning. Teachers may be resentful about losing control over the class as they fear that having less control is synonymous with ineffective class management. Another obstacle is overcrowded classrooms, as it is much harder to manage

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discussions and to put students into groups if one teaches in a class which has more than 30 students. Insufficient time and time pressure related to covering subsequent items of the curriculum were also found to be major barriers which could discourage teachers from employing active learning methods, as "the use of active learning increased the required amount of time" (Aksit and Niemi, 2016, p. 100). Students also pointed to the lack of the necessary equipment required for laboratory exercises or computer-based classes. Lack of resources for active learning resulted in an increased workload for teachers who needed to prepare them on their own. Inflexibility of the existing classrooms was also cited as one of the obstacles, as students realised that in order to effectively engage in autonomous learning, they need a comfortable working environment. Another problem was students' own passivity, lack of motivation and lack of self-confidence. Listening to a lecture seems easier than active participation in the class. Students also pointed out that they "were raised with a tradition of behavioural training model [...], so it is easy to continue this tradition [...]" (Aksit and Niemi, 2016, p. 101). Presenting their own material in front of their peers requires more self-confidence than just passive participation in the back seat. The final barrier mentioned by the students was the system of standardised examinations, as "getting a high score in these tests generally requires memorised information. [...] Teachers mentioned that when they started their career as teachers, they did not believe they would use these innovative methods in their class because of the examination system and students' and parents' expectations" (Aksit and Niemi, 2016, p. 101).

11 Critique of Active Learning

In their critical study of constructivist, discovery, problem-based, experiential and inquiry-based teaching, and especially aspects related to the amount of guidance that students receive, Kirschner, Sweller and Clark (2006) compare the effectiveness of these pedagogical approaches with direct instructional guidance. According to those authors, the new methods, which are associated with unguided or minimally guided learning environments, in the light of recent advances in human cognitive architecture, might be less effective in comparison with methods offering direct instructional guidance. This effect seems to be most easily visible among novice to intermediate learners and in cases where learners were not offered any scaffolding. Considering those findings, learner-centred methods should be chosen less frequently when dealing with students who are only starting to learn a given subject area. This is because novice learners have no experience in integrating the new information with their prior knowledge. "Controlled experiments most uniformly indicate that when dealing with novel information, learners should be explicitly shown what to do and how to do it" (Kirschner et al., 2006, p. 79). For "a student, as opposed to a scientist, is still learning about the subject area in question and, therefore, possesses neither the theoretical sophistication nor the wealth of experience of the scientist. Also, the student is learning science – as opposed to doing science – and should be aided in her/his learning through the application of an effective pedagogy and good instructional design" (Kirschner, 2009, p. 149).

Special importance should also be placed on providing additional scaffolding and more guidance in order to avoid situations where students become lost or frustrated and could "acquire misconceptions or incomplete or disorganised knowledge" (Kirschner et al., 2006, p. 84). This scaffolding proved effective when used by teachers when their students had problems with making progress with minimal guidance. The four stages of the scaffolding process include: (a)

demonstrating to students how to identify and self-check important information; (b) showing students how to reduce and paraphrase the information they receive; (c) asking students to make notes which would be useful in developing collaborations and routines; and (d) recommending that students collaborate with one another and have discussions when solving problems.

12 Conclusion

Having thoroughly analysed various studies and research sources related to active learning and flexible learning environments, we can state that these topics are widely covered and have been thoroughly examined by researchers. The main findings of this Active Learning Reference Framework in the field of active learning pedagogy, key competences and transversal skills, practical techniques of active learning, active learning environments, active roles of the students and teachers, obstacles to and critique of active learning, can be summarised as the following:

Active learning is a process of creating meaning during which students participate actively in the construction of the understanding of concepts and skills by discovering, processing and applying information through the completion of active learning activities. The active learning pedagogy stems from the constructivist theory generally attributed to the Swiss psychologist Jean Piaget and the Russian psychologist Lev Vygotsky. Active learners learn by doing and thinking about what they are doing. They actively take part in their own learning process by making links with their existing knowledge and new information. Any type of learning activity that involves students in the learning process is called an Active Learning Activity. Active Learning Activities should include development of communication competences, teamwork and creativity. They involve the efforts of students to build their knowledge actively.

When the information about active learning is compared with the data related to key competences and transversal skills, one can observe that active learning pedagogy goes hand in hand with the goals set by the European Commission and UNESCO. The European Commission (2018) lists the following key competences: communication, mathematical competence and basic competences in science and technology, digital competence, learning to learn, social and civic competences, cultural awareness and expression, and entrepreneurship. According to UNESCO (2013), transversal competences like innovative thinking, interpersonal skills, intrapersonal skills, global citizenship, media and information literacy are critical for students in preparation for their life in the 21st-century world.

One of the institutions which aims at promoting active learning pedagogy is the Future Classroom Lab (2020) of European Schoolnet, which features the following active learning zones: Interact, Exchange, Develop, Investigate, Create and Present. Each of those spaces represents both a physical type of space and a stage of learning within the active learning pedagogy, where students can engage in such activities as reading, watching, writing, talking, listening, collaborating, discussing, investigating, practising and producing.

According to the OECD (2017), active learning environments should be designed to strengthen the learners' active engagement in learning and to encourage well-organised cooperative and collaborative learning. Active learning spaces should give students choice and self-direction in finding spaces that work best for them to help them during learning. Research studies show that interactive learning environments improve students' problem-solving skills, attitude development

and class attendance rates, and reduce failure rates. Active learning spaces have a significant and positive impact on student learning.

Teachers who want to change their learning spaces should understand that this decision is a commitment to student-centred learning. In order to increase the chances of success during implementation of flexible learning spaces, it is important to explain to students the purpose of each active learning space and the procedures that provide the learning space function for active learning. Classroom redesign for active learning should be learner-centred, engaged and dynamic. A flexible classroom should be warm and welcoming. Students should feel comfortable with moving tables and chairs to suit an Active Learning Activity in the classroom. Flexibility of classroom correlates with increased student engagement, more collaborative learning, and great variety of use of enhanced active learning.

When a teacher in an active learning classroom uses technology, in tandem with effective pedagogy, he or she can have a positive impact on student learning. Interactive learning spaces with technology support can also have a significant and positive impact on student learning. Active learning classrooms can be designed by transitioning to a more student-centred approach, easy-to-adjust physical design and decentralised use of information technologies in classrooms.

Active teachers are able to design and implement activities which motivate their students to discover, provide support and scaffolding for the students to achieve the adequate level of both expertise and skills, and serve to evaluate students' achievements. Teachers become facilitators of learning by transferring learning responsibility to their students. In practical terms, teachers should be able to select the types of active learning strategies that match their learning styles, the course objectives, and their students' characteristics.

Active students are capable of analysing and evaluating on their own, thinking independently, and solving their problems more creatively. They take part in their own learning process actively by making links with existing knowledge and new information. These skills are particularly useful in a time when distance learning is becoming more and more common, especially due to the COVID-19 pandemic. The more independent the students are and the less control and teacher assistance they require, the easier it is for them to function in the world of remote schooling, with some lessons taught in a synchronous, and some in an asynchronous manner.

Some obstacles to active learning which have been identified during the desk research process and which need to be addressed in subsequent stages of the Novigado project include lack of skills related to the practical implementation of active learning and teaching methods, limited class time, heavy curriculum, impracticability of active learning in large classes, the lack of materials, equipment or resources, and the negative attitude of students who were not accustomed to active learning methods.

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14 About Novigado

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