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FLED LEARNING DESIGN FOR FLEXIBLE EDUCATION

Scaffolding in Flexible Learning Environments

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1. Executive Summary

In Activity 3 of our EU project UniTN takes the lead in developing and validating a scaffolding system for educational design. This system focuses on specific aspects, including technology, inclusiveness and learning regulation. Our main goal is to assist teachers in shaping their learning scenarios by creating a range of scaffolding models. These models will be developed through a literature review on the current best practices for Flexible Learning Environments (FLEs), feedback among our partners and then assessed by experts in face to face, blended and online learning modes. Also, to ensure the validity of our scaffolding systems we will involve an Advisory Board in the validation process.

These systems will be integrated into the three case studies from Activity 2. We will openly share the scaffolding systems for review and feedback allowing us to consider a wide range of perspectives.

In order to quantitatively assess the progress of Activity 3 we have identified key performance indicators:

1. The development of three types of scaffolding is being pursued: use of scaffolding using technology focused on enhancing students' regulatory skills and for inclusiveness.
2. Adaptability of five guideline checklists that can be adapted to educational settings, including face-to-face, online and blended learning environments.
3. Moreover, a five guideline checklist will be generated for inclusion and to address the diverse learning regulation needs of students. This includes aiming at supporting self-regulated learners, students who lack regulation skills and those who are externally regulated.
4. Additionally a five guideline checklist will be produced as a level of support to address the needs of education students and disadvantaged learners. The aim is to ensure that all students are included in the learning process.

Thus, Activity 3 led by UniTN, is dedicated to establishing an effective scaffolding system that caters to various learning scenarios and regulatory needs. The ultimate goal is to contribute to the success of the project.

2. Introduction

2.1 Scaffolding, Flipped Classroom and Flexible Learning Environments

In the educational field, scaffolding refers to a process where teachers offer support to help students to enhance their understanding and skills that would be "beyond their unassisted efforts". This support is provided temporarily and it is gradually reduced as students become more independent (Wood, Bruner, & Ross, 1976).

Scaffolding should stand on the three following pillars: contingency, intersubjectivity, and transfer of responsibility (Belland, 2017; Pea, 2004).

1. **Contingency** refers to the necessity of continuously assessing students' competencies in specific tasks, enabling the teacher to offer suitable scaffolding activities. It also demands that instructors deliver these scaffolding activities at the right moments.
2. **Intersubjectivity**, a shared understanding among learners, facilitates the exchange of ideas, peer support, knowledge building, and meaning negotiation (Levine & Moreland, 1991). This is often enhanced by explicit displays of shared knowledge through platforms like discussion forums, wikis, and social media (Bonk & Cunningham, 2012). Teams with high intersubjectivity can more effectively identify solutions for successful learning.
3. **Transfer of responsibility,** this concept in scaffolding emphasises that learners should gradually take ownership of their learning from those providing the scaffolding. This means that over time, the support provided through scaffolding should be reduced, enabling learners to perform tasks independently (Doo, Bonk & Heo, 2020).

Scaffolding can be classified into four types (Hannafin, Land and Oliver, 1999):

1. **conceptual scaffolding:** aids learners in identifying key themes and associated knowledge;
2. **metacognitive scaffolding:** assists learners in overseeing and reflecting on the learning process;
3. **strategic scaffolding:** offers alternative methods to approach a task;
4. **procedural scaffolding:** guides learners in utilising resources and tools for learning, such as introducing system functions and features (Doo, Bonk & Heo, 2020).

5. In a flipped classroom (FC) setting the traditional order of lecture and homework is reversed. Students first engage with material outside of class through video lectures or other resources: class time is then used for problem solving activities, discussions or practical applications to reinforce their knowledge (Bergmann & Sams, 2014). The following scaffolding actions are usually implemented to help students to thrive in a FC context:

- It's important to provide students with guidance on what they should focus on before the class begins or while studying outside the classroom.
- It's crucial to offer support during the class sessions. This can include facilitating discussions, answering questions or guiding group work to ensure that students receive the help they need.
- It's beneficial to provide resources or exercises after class for students who require extra practice to reinforce their learning.

In flexible learning environments, students have some control over their learning experience (Müller & Mildenberger, 2021) thus scaffolding can be implemented through different methods, including:

1. **Guided Instructions:** teachers provide step by step guidance and demonstrations to assist students.
2. **Resources:** students are offered resources like cheat sheets, examples or how to guide.
3. **Reflection:** continuous feedback, opportunities for self-assessment and reflections on progress.
4. **Technology Tools:** leveraging technology to provide personalised content and adaptive learning paths.
5. **Peer Collaboration:** encouraging learning and peer teaching.

Throughout the learning process it is important to encourage students to ask questions and reflect on their own progress. Providing feedback is also essential in helping them grow and improve.

Both flexible learning and flipped classrooms emphasise that learners should take a role in their education: scaffolding strategies play a role in guiding and supporting students as they take more responsibility for their learning outcomes.

3. Scaffolding in the Scientific Literature

An exhaustive literature review has been conducted, centred around best practices of scaffolding in flexible learning environments and flipped classrooms. However, the primary users of FLeD comprises higher education and upper secondary education teachers who will interact with a technological tool, which necessitates additional adjustments.

The purpose of this literature review is to inform the development of the FLeD Scaffolding system, both towards the users of the tool and their teaching and learning activities.

The literature search used three scientific databases: ERIC, Scopus, and Web of Science. The search string employed was: *("Flexible Learning" OR "Flipped Classroom") AND "Faculty Development"*. The initial results yielded 394, 690, and 30 papers respectively from the databases. Following the application of inclusion criteria, such as papers not older than five years, educationally based, and describing teacher training and educational development, the number of relevant papers reduced to 60.

Further refinement of the selection involved a full-text search using the keyword *"scaffolding"*, which resulted in 12 papers. Additionally, four more were manually selected due to their critical relevance to the project. The inability to yield any results when "scaffolding" was directly included as a keyword in the search engine across all three databases could potentially suggest a novel research area, thus underscoring the significance of this investigation.

The papers selected through this process are listed in the subsequent table:

Table 1: Papers selected after the process of literature review

N.	Title	Author/s	Year
1	Blended Learning: Moving Beyond the Thread, Quality of Blended Learning and Instructor Experiences	Kastner, J.A.	2019
2	Flipping Perceptions, Engagements and Realities: A Case Study	Inan, N.K., Balakrishnan, K., Refeque, M.	2019
3	Blended learning environments that work: An evidence-based instructional design for the delivery of qualitative management modules	Müller, F.A., Wulf, T.	2021
4	Flexible Teaching During a Pandemic and Beyond: A Reflection on Lessons Learned From the Society for the	Cavazos, J.T., Hakala, C.M., Schiff,	2022

N.	Title	Author/s	Year
	Teaching of Psychology's Pivot Teaching Committee	W.B., White, J.A., Baskin, H.M.	
5	Faculty Members' Experiences with the Implementation of Flipped Classroom Environments in Higher Education	Alebrahim, F., Ku, H.	2019
6	Blended Learning Tools and Practices: A Comprehensive Analysis	Kumar, A., Krishnamurthi, R., Bhatia, S., (...), Nayyar, A., Masud, M.	2021
7	From micro to macro levels of practice: A showcase of a SoTL journey within and beyond classroom experiences	Mohd-Yusof, K., Samah, N.A.	2022
8	Introducing the flip: A mixed method approach to gauge student and staff perceptions on the introduction of flipped pedagogy in pre-clinical medical education	Simmons, M., Colville, D., Bullock, S., (...), Shuttleworth, M., Reser, D.	2020
9	Bridging Distances: Professional Development for Higher Education Faculty through Technology-Facilitated Lesson Study	Soto, M., Gupta, D., Dick, L., Appelgate, M.	2019
10	Online and face-to-face composition in forming the professional competencies of technical teacher candidates with various learning style types	Tambunan, H., Silitonga, M., Sidabutar, U.B.	2021
11	One-on-one technology mentoring for in-service teachers: The experiences of future ICT coordinators	Top, E., Gurer, M.D., Baser, D., Akayoglu, S., Akkus, R.	2021
12	The Perceptions of Faculty Members of Education Regarding the Technology-Based Implementations: Lecture Capturing	Üstünlüoglu, E., Dahlgren, R.	2021
13	Educate to transform: An innovative experience for faculty training	Sanz, N.M., Urías, M.D.V., Salgado, L.N., Benítez, N.V., Martínez, M.C.V.	2022

N.	Title	Author/s	Year
14	Flipped learning in faculty development programs: opportunities for greater faculty engagement, self-learning, collaboration and discussion	Yılmaz, Y., Çalışkan, S.A., Darcan, Ş., Darendeliler, F.	2021
15	Growth of Pedagogical Practice in an Active Multidisciplinary FLC on Flipped Learning	Onodipe, G., Robbins, M., Ayuninjam, G., Howse, T., Cottrell-Yongye, A., Curry-Savage, J.	2020
16	Modeling and Scaffolding the Technology Integration Planning Cycle for Preservice Teachers: A Case Study	Bergeson, K., Beschorner, B.	2020

4. Scaffolding Practices for FLEs

In the first place, within the FLeD Project we shall here distinguish two levels of scaffolding. This document focuses on the scaffolding system that will be embedded in the tool to allow FLeD users to get the most from it. The users of FLeD Tool -mainly teachers- will thus be scaffolded by this system. A second level of scaffolding, which is not the focus of this document, is actually a training of the teachers on “how to use scaffolding” and “how to implement it in FLEs”. It is a meta-scaffolding that has as the object not the teachers (the tool’s users) but their students. Many of the scaffolding practices highlighted in this paper are also transferable to this meta-scaffolding level, together with others which are already present in the patterns: thistask will come later in the project within WP5.

Analysing the selected papers, the following scaffolding practices emerge for the use in Flexible Learning and Flipped contexts:

1. **Scaffolded Learning**: This approach involves providing learners with a structured framework to guide their learning process through **a series of small constant actions**. Complex tasks are broken down into manageable parts, clear instructions are provided, and feedback is offered at each step, facilitating a gradual build-up of skills and understanding (Alebrahim & Ku, 2019; Belland, 2017; Lajoie, 2005; Pea, 2004).
2. **Just-in-Time Teaching (JiTT)**: This pedagogical strategy integrates web-based assignments with in-class activities. Learners complete assignments prior to class, and

their responses inform the tailoring of in-class activities. This method enables immediate feedback and allows for the adjustment of teaching strategies based on learners' understanding.

3. **Peer Instruction**: This technique involves learners teaching each other, fostering a deeper understanding of the material. The use of online platforms is suggested to facilitate this form of instruction.
4. **Active Learning**: This approach emphasises learners' active participation in the learning process, as opposed to passive reception of information. Activities such as discussions, problem-solving exercises, and group projects are employed to promote active learning.
5. **Formative Assessment**: This method involves the use of assessments to provide learners with feedback on their learning and guide their study strategies. Techniques such as quizzes, self-assessments, and reflection activities are used.
6. **Universal Design for Learning (UDL)**: This framework involves the design of learning experiences to be accessible and inclusive for all learners. Multiple means of representation, expression, and engagement are employed to cater to the diverse needs of learners.
7. **Online Learning Communities**: The creation of online learning communities is proposed to support learners' learning. Techniques such as discussion boards, group projects, and social media platforms are used (Doo et al., 2020; Hannafin & Oliver, 1999 Müller, & Mildenberger, 2021; Müller & Wulf, 2021).
8. **Use of Lecture Capture Technology**: Lecture capture technology is identified as a form of scaffolding. This technology allows for the recording of lectures, which can be reviewed by learners at their own pace, particularly beneficial for complex topics (Üstünlüoğlu, & Dahlgren, 2021).
9. **Peer Learning**: Peer learning is identified as a form of scaffolding. This technique involves learners working together in groups to discuss and understand lecture content, promoting deeper understanding and critical thinking.
10. **Use of Additional Resources**: The use of additional resources, such as textbooks, articles, or online resources, is suggested to supplement lecture content. These resources can provide additional information or different perspectives on the topic, enhancing learners' understanding.

11. **AI Scaffolding Support**: AI can be used in the loop with humans and other systems and assume various roles in the scaffolding process. For example, it can be used for several of the aforementioned scaffolding practices, such as Peer Learning, Peer Instructions, Formative Assessment, Just-in-Time Teaching, etc.

The following table shows in which of the four categories of scaffolding these practices can fall:

Table 2: Scaffolding practices and categories (original table)

Scaffolding Practice	Conceptual Scaffolding	Metacognitive Scaffolding	Strategic Scaffolding	Procedural Scaffolding
Scaffolded Learning	✔	✔	✔	✔
Just-in-Time Teaching (JiTT)	✔	✔	✔	✔
Peer Instruction	✔		✔	
Active Learning	✔	✔	✔	
Formative Assessment		✔		✔
Universal Design for Learning (UDL)				✔
Online Learning Communities				✔
Pre-class learning materials	✔			✔
In-class activities	✔		✔	✔
Post-class activities		✔	✔	✔

As for the applicability of the strategy in face-to-face, blended and fully on-line contexts, please refer to the following table (please, note that this is a synthesis of the practices on these papers, and not absolute indications, for example: obviously, one can use formative assessment in face-to-face context, but in the literature review selection it has been mostly used in blended and on-line context due to the possibility to use online resources and tools):

Table 3: Scaffolding Practices and contexts of learning (original table)

Scaffolding Practice	Face-to-Face Learning	Blended Learning	Online Learning
Scaffolded Learning	✔	✔	✔
Just-in-Time Teaching (JiTT)	✔	✔	
Peer Instruction	✔	✔	✔
Active Learning	✔	✔	✔
Formative Assessment		✔	✔
Universal Design for Learning (UDL)	✔	✔	✔
Online Learning Communities		✔	✔
Pre-class learning materials	✔	✔	✔
In-class activities	✔	✔	
Post-class activities		✔	✔

5. Guidelines for Applying Scaffolding

5.1 Guidelines for scaffolding online flexible education Patterns

This guidelines package includes principles specifically connected to actions useful to introduce scaffolding processes in online education settings, giving focused prompts on how to sustain better an efficient design of students' learning experiences, particularly in digital environments.

1. Guarantee prior preparation of the activities and provide recommendations for each learner to manage the flexibility of the online education environment.
2. Improve the ability to work in groups and improve interactions, in order to develop an online learning community, sharing thoughts with the other members of the group (It is important that the majority of group members achieve this goal to work as a team effectively) and offer constant tutoring and facilitation.
3. Give brief but detailed instructions to students before completing the activity and indicate clearly the approximate time needed to complete the activity as well as the timeline and deadlines to complete the work. Associate task activities for students with a concrete activity that should be constantly monitored and reviewed.

4. Offer a gender-sensitive design and policy. Therefore, it is fundamental that the online environment includes gender-sensitive indicators in the curriculum, a new name for transgender people, and considers the plurality of genders.

5.2 Guidelines for scaffolding face-to-face Patterns

Developing guidelines for scaffolding in face-to-face teaching contexts requires a focus on direct interaction, immediate feedback, and leveraging the physical classroom environment. Here are five suggested guidelines:

1. Facilitate Immediate and Personalised Feedback. Utilise the advantage of face-to-face interactions to provide immediate, personalised feedback. This can include verbal comments during activities, written notes on assignments, or one-on-one/group discussions. The immediacy of feedback in a physical setting allows for quicker adjustments and deeper understanding.
2. Leverage Physical Space for Collaborative Learning. Arrange the physical classroom to foster collaboration and interaction among students. This could involve flexible seating arrangements, designated areas for group work, and utilisation of classroom resources like whiteboards for brainstorming and problem-solving.
3. Incorporate Hands-On Activities and Demonstrations. Use the face-to-face environment to include more tactile learning experiences, such as experiments, demonstrations, or role-playing activities. These experiences can make abstract concepts more tangible and understandable.
4. Integrate Real-Time Questioning and Discussions. Encourage an interactive classroom environment where students feel comfortable asking questions and engaging in discussions in real-time. This can be facilitated through open Q&A sessions, class debates, or small group discussions, instant pooling tools, allowing for immediate clarification and deeper exploration of topics.
5. Adapt Teaching Techniques to Individual Learning Styles. In a face-to-face setting, teachers can more easily adapt their teaching styles to accommodate different learning preferences. This might involve a mix of visual aids, oral explanations, and practical exercises to cater to visual, auditory, and kinesthetic learners, respectively.

5.3 Guidelines for scaffolding collaborative blended education Patterns

These guidelines introduce suggestions in order to support scaffolding actions in blended education environments, proposing key points to maximise the overall experience, taking into account the importance, the potential and the power of cooperative, collaborative, discussion and reflections processes among students.

1. Offer students precise information about the time dedicated to the project, including virtual time, in-class time, and tutoring sessions.
2. Define periodical goals so that all students' teams can determine phases to advance in the project and ensure the work is done progressively.
3. Organise groups of 5 people to work in class and try to ensure gender equity and an equal number of people per group (students can be grouped by themselves or by the teacher)
4. Define moments to connect out- and in-class time and to link the content and activities of the course with the project.
5. Devote a face-to-face session to tutoring and group work regularly every four weeks.

5.4 Guidelines for scaffolding Pattern to students with lack of regulation or externally regulated

This set of guidelines proposes useful information for teachers aimed at fostering the implementation of specific actions to support the learning experience of students characterised by lack of regulation or externally regulated, through the integration of dedicated formative activities (structured feedback sessions, group activities, resources).

1. Provide targeted process information and structured content guidelines (following almost 2 of the following items: a. Create video lessons enriched with questions; b. Generate resources with schemas; c. Give instructions to guide the consultation of a resource; d. Create concept maps of the resources consulted).
2. Provide resources with increased scaffolding, summaries, or annotations.
3. Offer diverse sources oriented to different degrees of regulation and in different formats to meet their needs.
4. Support and help these students by proposing tasks to plan their work and goals or offering complementary instructional resources.
5. Provide highly structured feedback to track their progress and re-orient the students' work.
6. Foster group activities and teamwork.

5.5 Guidelines for scaffolding pattern to self-regulated learners

The guidelines package promotes points aimed at fostering teachers in the introduction of specific design processes focused on the improvement of self-regulated learners' formative

experience, through specific strategies (balance students workload and materials, work groups, monitoring students' actions).

1. Support students in organising the study materials, especially during the first phases, and give instructions to self-record their performance.
2. Provide an appropriate workload of materials to all the students of the course, identifying different self-regulation profiles and behaving accordingly.
3. Provide clear instructions about what is expected from the students and the assessment strategies that will be used.
4. Give students the choice to work in pairs or small groups.
5. Provide opportunities to monitor the students' learning by using cognitive, metacognitive, motivational, behavioural, and emotional strategies and provide instruments for self-assessment in the self-reflection phase (e.g., peer or co-assessment instruments or completing a quiz).

5.6 Guidelines for scaffolding Pattern to special needs

The guidelines' set underlines particular and crucial points for teachers in order to design teaching, learning and assessment practices focused on underpinning students with special needs. The focus then is to promote a specific overview of strategies to be introduced and practical examples aimed at fostering specific formative processes.

1. Provide students with the necessary adaptations to resources and course instructions to ensure equal access to education.
2. Adapt materials and technologies according to the students' needs.Convert materials in other modalities (e.g., from verbal to written) so that the material can be used for different needs.
3. Adapt essential technological facilities according to the students' needs.
4. Provide feedback in multiple ways and multiple modalities, such as video, audio, or written text-based feedback,.as well as through interactive modes tailored to students' specific needs.
5. Create a learning environment open and accessible with different sources (audio, video, maps, etc) taking into deep consideration the specificities and needs of all students.

5.7 Guidelines for scaffolding Pattern to disadvantaged students

These pointers are particularly sharpened in scaffolding formative actions aimed at sustaining learning needs connected to disadvantaged students and useful to create adequate and

complex learning environments, comprehending specific resources and focused teaching and assessment approaches, in particular, considering the socio-economic situation and multilingual contexts

1. Support students in the organisation of the study materials during all tasks.
2. Provide an appropriate workload of materials that considers the students' disadvantaged elements.
3. Provide clear and structured instructions about what is expected from the students.
4. Create clear and simple models of assessment.
5. Convert materials in other modalities (e.g., from verbal to written or digital, provide lexical prompts in advance or image/ text link) so that they can be used for different tasks.

7. CONCLUSIONS

The Scaffolding tool was designed through the development of specific guidelines for educational planning that implement the pedagogical-educational principles of technology, inclusiveness and learning regulation in an interdisciplinary way. Using this tool teachers have the possibility to model different learning scenarios by creating a wide range of scaffolding models in face-to-face, blended and online flexible learning environments (FLE). Three types of scaffolding have been developed in which technology focuses on improving inclusiveness skills: the guidelines are structured into checklists adaptable to different educational contexts with the aim of supporting less self-regulated or externally regulated students, students with specific educational needs and also students who live particular socio-economic situations (disadvantaged) and students in multilingual contexts.The ultimate objective of this scaffolding tool and its guidelines is to guarantee the principles of equity and inclusiveness of the learning process within flexible learning environments.

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** at the beginning of a reference indicates that it is part of the literature review.*

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