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Evaluation of the "FERTILE" design methodology

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Executive Summary

In this report, the "FERTILE" consortium presents the evaluation process and results of the initial version of the Fertile Design Methodology (FDM) and the refined FDM that emerged from the initial FDM's evaluation. The FDM is a comprehensive methodology aiming to support educators in designing blended learning projects that cultivate learners' Computational Thinking (CT) skills through the seamless integration of Educational Robotics (ER) and Arts, hereafter called Artful ER projects.

The section "Towards releasing the FERTILE Design Methodology" elaborates on the methodology, detailing the FDM steps and activities incorporated in those steps. Feedback from educators highlighted the need for improving Initial FDM's communication and representation (as reported in Section 3.1 The findings regarding the initial FDM), rather than changes to its conceptual basis. To address these challenges, the consortium developed comprehensive training materials and integrated the FDM into a community platform. These enhancements aimed to simplify the project design process, provide explicit guidance, and better support the integration of face-to-face and remote learning activities.

The promising results from the initial evaluation allowed the consortium to move forward to the final step of the last phase, where the FDM is re-evaluated. Thus, the final section of this report, "Evaluating the FERTILE Design Methodology in pilot studies", details the evaluation of the "FERTILE" Design Methodology. The findings underscore the FDM's effectiveness in fostering interdisciplinary collaboration and enhancing CT skills among learners. However, they also point to the necessity of additional support for educators in applying the methodology. The findings in the section "Refinement of the FERTILE Design Methodology" led to suggestions for improvements regarding the clarity of steps, integration of activities, and support for blended learning.

ACRONYMS

List of abbreviations

FDM	FERTILE Design Methodology
F2F	Face To Face
CCPS	Creative Computational Problem Solving
CT	Computational Thinking
FCP	FERTILE Community Platform
ER	Educational Robotics
DBR	Design Based Research
MEQ	Methodology Evaluation Questionnaire
UniWA	University of West Attica, Greece (project coordinator)
URJC	Universidad Rey Juan Carlos, Spain (project partner)
CUB	Comenius University Bratislava, Slovakia (project partner)
CUP	Univerzita Karlova, Czech Republic (project partner)
UVa	Universidad de Valladolid, Spain (project partner)

1. INTRODUCTION

This report marks achieving the FERTILE project's fourth milestone, focusing on the release and evaluation of the FERTILE Design Methodology (FDM). This milestone is integral to the ongoing development of the FERTILE Design Methodology, which aims to support educators in developing blended learning projects that cultivate learners' Computational Thinking (CT) skills through the integration of Educational Robotics (ER) and Arts, collectively referred to as Artful ER projects.

Following the project's plan, researchers from all partner teams contributed to this report and its associated research activities. The workload was distributed according to the planned allocation, with the UniWA and URJC teams taking on a significant portion of the tasks due to their leading roles in the associated results. The report has undergone an internal review process, where researchers from participating organizations provided feedback through internal review forms and direct comments on the report, ensuring its refinement and accuracy.

After this introduction, the second section, "Development Process of the FDM," elaborates on the methodology's development using a Design-Based Research (DBR) approach, structured in four phases: (1) Problem identification and needs analysis, (2) Conceptualization, (3) Iterative formulation cycles, and (4) Evaluation and refinement towards the final FDM. This report focuses on the fourth phase, detailing the release of the FDM and its subsequent evaluation.

The third section presents the findings from the evaluation of the initial version of the FDM that led to the release of the "FERTILE" Design Methodology. It includes detailed feedback from educators on the methodology's usability and effectiveness, highlighting its strengths and areas requiring improvement. Key aspects such as the structured approach, logical sequencing, and interdisciplinary collaboration are discussed alongside challenges related to complexity and the integration of blended learning.

It also addresses the solutions implemented to support the FDM, including the development of comprehensive training materials and the integration of the FDM into a community platform. These enhancements aim to simplify the project design process, provide clearer guidance, and better support the integration of face-to-face and remote learning activities.

The fourth section evaluates the FDM's application in training pilots, summarizing the effectiveness and identifying necessary refinements.

In the fifth section, the findings from this evaluation inform the suggestions for improvement, particularly regarding the clarity, integration of activities, and support for blended learning.

These insights pave the way for the FERTILE consortium to advance to the final DBR phase and produce the project's final result: The handbook of the "FERTILE" Design Methodology.

2. Development Process of the FERTILE Design Methodology

As presented in the "M1.3 "An initial version of the FERTILE design methodology" report, the FERTILE consortium followed a Design-Based Research (DBR) approach (Amiel & Reeves; 2008) to develop the FDM. Figure 1 depicts the four phases included in this DBR approach.

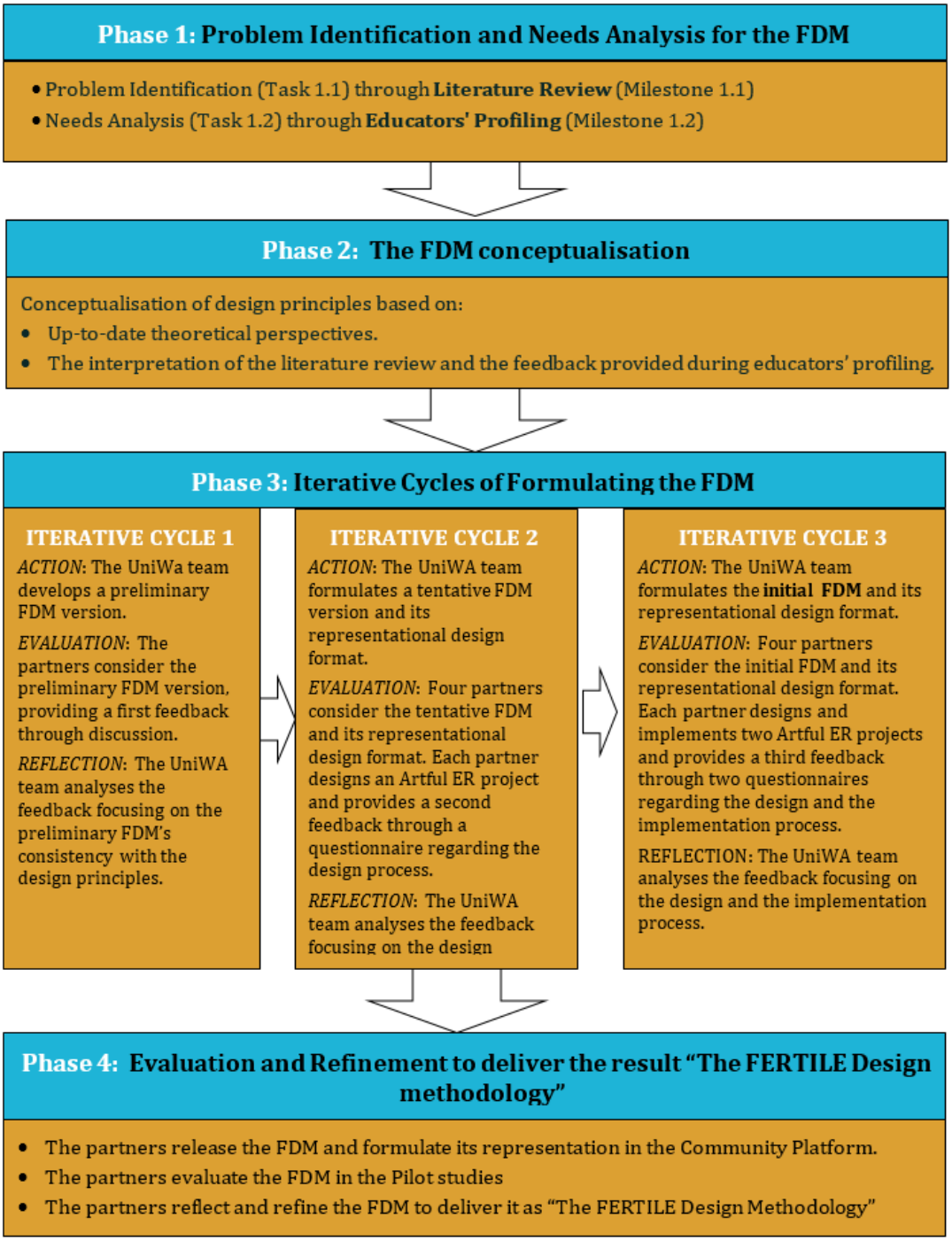

Figure 1. The FDM Development Process as a Design-Based Research approach

This report elaborates on the fourth phase, which includes the following steps regarding the FDM:

1. **Release:** The partners utilised the preliminary feedback for the initial FDM derived during the third cycle of the third DBR phase to release the FDM (Iterative cycle 3 of phase 3 in Fig. 1).. This release involved considering (i) the FDM per se (https://fertile-project.eu/fertile-methodology/), (ii) the FDM's adequate presentation as a "FERTILE" training material (https://fertile-project.eu/trainingmaterial/) , and (iii) the FDM's representation as an authoring functionality of the "FERTILE" community platform (M2.1 "FERTILE Community Platform Design Requirements").
   The Initial FDM is designed to help educators create interdisciplinary projects that integrate arts and educational robotics to enhance computational thinking (CT) skills. It consists of sequential steps and detailed activities that facilitate blended learning.
2. **Evaluation in pilot studies:** The partners reflected on the research design applied in the iterative cycles during the third DBR phase and the findings regarding the initial FDM to formulate the FDM evaluation. The partners developed adequate instruments to collect comprehensive feedback from trainers and trainees during pilot studies in educational settings.
3. **Refinement**. The feedback collected during the pilot studies is analysed to evaluate the FDM's usefulness and effectiveness and identify any refinement needed.

In what follows, we structure the report based on these steps.

3. Towards releasing The FERTILE Design Methodology

This section starts with the 3.1 subsection presenting the findings regarding the initial FDM which derived during the third cycle of the third DBR phase. In the subsequent subsections, we discuss the findings' implications and release the FDM in three forms: the FDM per se as a conceptual methodology (3.2 subsection), the FDM's presentation as a "FERTILE" training material (3.3 subsection), and the FDM's representation in an authoring learning design tool, i.e., as a functionality of the "FERTILE" community platform.

3.1 The evaluation data regarding the initial FDM

The research objective is to evaluate the initial version of the FDM in real educational settings. To achieve this, the UniWA, URJC, CUB, and CUP teams coordinated their efforts to recruit Art and ER educators from collaborating partners or other appropriate affiliations. The 15 educators then took on designing and implementing two Artful ER pilot projects based on the initial FDM version (see the Report 'An initial version of the "FERTILE" Design Methodology'). Please refer to Table 1 for the demographics of the 15 educators involved in the study. The table includes information such as country of origin, discipline and the pilot artful ER project they designed and implemented.

Table 1: The educators' demographics

ID	Country of Origin	Discipline	Pilot Artful Er project
GR1	Greece (organised by UniWA)	ER	The Art of Anticipation
GR2		Arts	
GR3		Arts	
GR4		ER	RoboTerrorizing the playground
GR5		Arts	
SP1	Spain (organised by URJC)	ER & Arts	Languages of Children
SP2		ER & Arts	Project smartwatch
CZ1	the Czech Republic (organised by CUP)	ER	One-stroke-drawing
CZ2		Arts	
CZ3		ER	Folk Songs
CZ4		Arts	
SL1	Slovakia (organised by CUB)	ER	Charlie and the Chocolate Factory
SL2		Arts	
SL3		ER	Little Red Riding Hood
SL4		Arts	

- Data collection process

The partners organised the collection of extensive feedback from participating educators through two online questionnaires. While the first questionnaire (Initial FDM Design Questionnaire) addresses

their views on the design process (https://forms.gle/A48vz9fguuQLfFoj6), the other focuses on their views on the implementation process (https://forms.gle/Y7UVnbchu9zaPnGA9) of the Artful ER pilot projects (Initial FDM Implementation Questionnaire). The implementation process involves putting the designed project into practice, and it focuses on how educators execute the designed activities in real classroom settings,

Initial FDM Design Questionnaire

After this experience, they completed the online "Initial FDM Design Questionnaire" to reflect on their design experience. This questionnaire included two parts, a quantitative and a qualitative one. The 1st part included 9 Likert-like scale questions as statements. The quantitative data collected was intended to reveal the participants' trends on the usefulness of three issues. The first two issues involved the two basic elements of the FDM: (i) the FDM steps and (ii) the FDM activities. The last issue involved overviewing the FDM Dimensions of (i) blended learning, (ii) interdisciplinarity of ER and Arts and (iii) CT skills.

The 2nd part of the "Initial FDM Design Questionnaire" included two open-ended questions asking educators to comment on the difficulties they faced while designing and the perceived usefulness of designing based on the initial FDM. This qualitative data was intended to provide a more profound consideration of the educator's experience and enrich the "Initial FDM Questionnaire" with evaluation criteria.

Initial FDM Implementation Questionnaire

The Initial FDM Implementation Questionnaire used in this study aimed to evaluate the implementation of the pilot Artful ER Project in relation to its design and according to the instructions provided by the FERTILE Design Methodology (FDM). It consisted of two sections: Evaluation of the Pilot Artful ER Project's implementation in relation to its original design, and Evaluation of the Pilot Artful ER Project's implementation according to the FDM instructions for each step.

The first section comprised eight Likert-like questions assessing various aspects of the project implementation, such as the sequence and completeness of implementing FDM steps, the integration of activities within each step, adherence to the allocated time for activities, collaboration between educators, and the implementation of both face-to-face and remote activities as per the original design. The second section consisted of six Likert-like questions, each corresponding to a specific FDM step.

Additionally, the questionnaire included two open-ended questions to gather qualitative feedback from participants. The first open-ended question asked, "What changes have you applied to the original Artful ER project designed during its implementation so that students can complete the project?" The second open-ended question inquired, "What would you change in the Artful ER project design after the implementation experience?"

As presented in the report "M1.3 "An initial version of the FERTILE design methodology" and overviewed in Figure 1 depicting the FDM's Development Process, the FERTILE consortium collected quantitative and qualitative data regarding the initial FDM. These data involved designing and implementing pilot Artful ER projects based on the initial FDM.

Educators' insights on the design process

Tables 2 and 3 present the findings of designing pilot Artful ER projects based on the initial FDM. We collected educators' perceptions through 9 close-ended questions addressing the Initial FDM's core elements: (i) steps, (ii) activities, (iii) the dimensions of interdisciplinarity, CT skills and blended learning. Then we applied descriptive analysis to determine the trends shown in Table 2. In the same line, we collected educators' perceptions in three open-ended questions. Table 3 presents representative quotes of the inductive content analysis around the perceived usefulness and effectiveness of the FDM's core elements. Tables 5 and 4 present the educators' perceptions of implementing the pilot Artful ER projects, which were designed based on the initial FDM.

Regarding the quantitative research findings of designing pilot Artful ER projects based on the initial FDM (see Table 2), the mean scores for questions related to the steps, activities, and dimensions of the FDM consistently fall within the range of 4.2 to 4.7 (out of 5), suggesting that participants found these aspects to be highly beneficial in facilitating project design and interdisciplinary collaboration. However, question 8 stands out with a slightly lower mean score of 3.6. This question specifically addresses the educators' perception of how well the FDM supported them in determining the activities' modality (in a face-to-face, online or blended learning context). The higher standard deviation of 1.1 for this question indicates more variability in responses compared to other questions, suggesting that opinions were more divided on this aspect. Despite this variability, it's important to note that the mean score of 3.6 still falls within a moderately positive range, indicating that while some educators may have felt less supported in making decisions about blended learning implementation, overall, there was still a level of perceived support from the FDM in this regard.

Table 2. Evaluation data regarding the Artful ER projects' design based on the initial FDM - Descriptive analysis of quantitative data (n=15)

Close-ended question as Likert scaled statement (1:Strongly Disagree-5:Strongly Agree)	Mean	St.Dev
FDM Steps		
Q1. I found the sequence of the steps helpful in designing the project (usefulness of the sequence of steps)	4.3	0.6
Q2. I found the scope of every step helpful towards designing the project gradually (usefulness of the various steps)	4.2	0.9
FDM Activities		
Q3. Breaking down each step into individual activities helped design students' involvement in the project	4.4	0.7
Q4.The features describing each activity (Activity Type, Duration, Modality, Class Orchestration, CT competencies, etc.) helped promote ideas generation in both disciplines (Arts, ER)	4.6	0.5
Q5.The features describing each activity (Activity Type, Duration, Modality, Class Orchestration, CT competencies, etc.) helped represent and communicate ideas among the disciplines (Arts, ER)	4.6	0.6
FDM Dimensions		
Q6. The FDM supported me in collaborating with the teacher-co-designer to set goals from both disciplines.	4.7	0.5

Q7.Designing together activities for cultivating particular CT competencies promoted mutual understanding of the disciplines involved.	4.5	0.9
Q8.The FDM supported me in deciding which activities will be better implemented f2f in the classroom or remotely from home (blended learning).	3.6	1.1
Q9.The FDM supported me in understanding how to cultivate CT skills through the project.	4.4	0.8

The qualitative research findings of designing pilot Artful ER projects based on the initial FDM align with the quantitative ones (see Table 3). On the positive side, the educators highlighted the FDM's structured approach, noting its effectiveness in culminating and organizing design ideas (e.g., CZ3, GR4), thereby aiding educators in project synthesis and understanding the scope of each step (e.g., GR1). The educators also emphasized the FDM's support for designing activities, reporting that it facilitated task specification and alignment with learning objectives (e.g., SL1). Such findings suggest that the FDM can scaffold educators while designing Artful ER projects. However, the findings also shed light on several challenges. The educators noted issues related to FDM comprehension, reporting that they found specific steps unclear and incomprehensible (CZ2). The time-consuming nature of applying the FDM steps emerged as a concern (SL2), potentially impeding educators to design efficiently. Furthermore, some educators noted the complexity of breaking down FDM steps into activities (GR1), indicating potential difficulties. Ambiguity in CT skill cultivation (GR4) and perceived suppression of creativity (CZ3) are among these challenges, suggesting that while the FDM provides a structured framework, it is important to communicate it adequately and enhance its usability.

Table 3. Two-level coding of educators' evaluation on the Artful ER projects' design based on the initial FDM - (n=15)

Open-ended questions: *"Q1: What difficulties did you face in a) following the steps' sequencing, b) understanding the scope of each step?", "Q2: How did you find useful designing the project by a) following the particular steps' sequencing, and b) designing activities for each step?"* and *"Q3: Since the FDM aims to cultivate CT through the interdisciplinarity of Art and ER in a blended learning context, suggest changes/improvements in this direction".*		
FDM steps		
Theme	Topic	Quotes
Usefulness	The FDM steps sequencing supports the culmination of an educator's design ideas	*… the steps helped us to classify thoughts and ideas* (CZ3)
	The FDM steps sequencing supports organizing an Artful ER project	*I find that following the steps helped me to organise better the lesson* (GR4)
Effectiveness … Difficulties	The FDM steps are well-founded for synthesising an Artful ER project	*I had no problem understanding the scope of each step* (GR1)
	Applying the FDM steps is straightforward	*I have not encountered any difficulties in step sequencing* (SP2)
	The FDM steps are incomprehensible	*…the very characteristics of those individual steps were sometimes unclear and incomprehensible...* (CZ2)
	The FDM steps are not all	*A succession of steps seemed to me too detailed*

	essential for synthesising an Artful ER project	(CZ4)
	Applying the FDM steps is time-consuming	*We tried to follow exactly the proposed steps, but we needed more time for the project.* (SL2)
FDM Activities		
Topic	Code	Quotes
Usefulness	The FDM activity features trigger an educator's design ideas	*… helped us to design the activity better, to think through and specify its tasks.* (SL1)
	The FDM activity features support synthesizing an Artful ER project	*By thoroughly detailing the specific characteristics and attributes of each activity, I ensured a comprehensive understanding of the project requirements.* (GR1)
	The FDM activity features support its adequate description	*…thanks to the proposal we were able to look at the activity in a systemic way.* (SL3)
	The FDM activity features support aligning its contents with a project's learning objectives	*…it also guided us in the objectives we set for our activity.* (SL1)
Effectiveness… Difficulties	Breaking down the FDM steps in FDM activities is complicated	*Breaking down the steps into individual activities proved to be a complex task, as there were interdependencies and overlapping aspects between the steps, making it difficult to delineate clear boundaries for each activity.* (GR1)
	Matching the FDM activity to specific CT skill(s) is not straightforward.	*Sometimes, it was difficult to choose the CT skill that was cultivated.* (GR4)
	Selecting the type of an FDM activity is not straightforward.	*Sometimes, it was difficult to choose the type of activity as in many activities, there was more than one option* (GR4)
FDM Dimensions		
Topic	Code	Quotes
Usefulness	The FDM provides a structured approach supporting interdisciplinarity between ER and Arts	*…helped me to find the connection between an animation creative process and computer thinking principles.* (GR2)
	The FDM provides a structured approach supporting CT skills' cultivation	*…we were unsure of the assignment of the activity to the CT skill.* (SL1)
	The FDM provides a structured approach suppressing creativity	*This kind of logical thinking, when everything has to follow each other logically, goes against my beliefs about creativity in music.* (CZ3)

Educators' insights on the implementation process

Similar to the Initial FDM Design Questionnaire, quantitative analysis of the Likert-scale questions involved calculating the mean and standard deviation for each question in both sections of the questionnaire. Mean scores were computed to assess various aspects of the project implementation, such as adherence to the original design, integration of activities, collaboration between educators, and implementation of FDM steps. Standard deviations were examined to understand the variability in participants' perceptions across different aspects of project implementation. The open-ended questions in the questionnaire were subjected to content analysis to extract meaningful insights and feedback from the educators. The responses were analysed to identify any changes applied to the original project design during implementation and to determine educators' suggestions for improving the Artful ER project design based on their implementation experience. Content analysis enabled the identification of common themes, challenges, and recommendations for future project design and implementation.

Overall, the combination of quantitative and qualitative analyses provided a comprehensive understanding of educators' perspectives on both the design and implementation of the FDM within the context of the Artful ER pilot projects.

The quantitative research findings of implementing pilot Artful ER projects designed based on the initial FDM (see Table 4) indicate the educators' generally positive perceptions while operationalising the FDM. The mean scores for questions assessing the sequencing applied through the FDM steps, and the effectiveness of collaborating with teacher-co-designers all scored above 4, reflecting the educators' valuing of the FDM. Additionally, the educators reporting the FDM steps' implementation to their students' enacting an Artful ER project was highly rated, with mean scores ranging from 4.3 to 4.8. The findings of students' ability to clarify concepts, generate ideas, formulate interdisciplinary solutions, and create Artful ER artefacts suggest that the FDM triggered project implementation and facilitated the project goals' achievement.

On the other hand, there was slightly lower agreement regarding the combination of classroom (f2f) and remote activities being implemented as originally designed (Table 4, mean 3.9, St.dev. 1.2). For instance (see Table 5), UniWA noted modifications in online programming activities to better suit students' familiarity levels ("In response to the students' familiarity, the programming activities that were held online through the simulator were modified to focus more on programming back-and-forth movements of the robots rather than emphasising motor speed control."). These adjustments could have impacted the seamless integration of classroom and remote activities.

There was slight agreement regarding the integration of activities within each step (Table 4, mean 3.9, St.dev. 1.0). The CUB mentioned (Table 5) needing "more time" for implementation, suggesting that time constraints impacted the smooth integration of activities ("Especially more time."). Additionally, UniWA noted that student-driven topic changes sometimes required adjustments to activities and subsequent steps ("The fact that the topic was quite based on the students' choices sometimes changed the application of the activity and the next steps had to be adjusted based on the changes."). These factors likely contributed to challenges in consistently integrating activities within each step.

Lastly, there was lower agreement on the estimated duration of activities (see Table 4, mean 3.3, St.dev. 1.0). Indeed, the need for more time was a recurrent theme (see Table 5, CUB). CUB pointed out the necessity for additional time ("Especially more time."), and CUP suggested dedicating more time to the entire project and individual steps after gaining implementation experience ("After experience with the project, I would dedicate more time to it, so that there would be more time for the entire project, as

well as for the individual steps."). These comments indicate that the initial time estimates needed to be more sufficient, aligning with the quantitative finding regarding activity duration.

Table 4. Evaluation data regarding the Artful ER projects' implementation based on the initial FDM - Descriptive analysis of quantitative data (n=15)

Close-ended question as Likert scaled statement (1:Strongly Disagree-5:Strongly Agree)	Mean	St.Dev
Evaluation of the Pilot Artful ER Project's implementation in relation to its original design		
Q1. I implemented the FDM steps in the sequence they were originally designed	4.5	0.9
Q2. I implemented all the FDM steps without skipping any of those originally designed.	4.4	0.9
Q3. I found all the activities well integrated within each step.	3.9	1.0
Q4. The activities lasted as long as originally designed.	3.3	1.0
Q5. Splitting teaching hours between the disciplines was implemented as originally designed.	4.4	0.6
Q6. I collaborated effectively with the teacher-co-designer in applying every step.	4.7	0.6
Q7. The combination of ER and Arts activities was implemented as originally designed.	4.5	0.8
Q8. The combination of classroom (f2f) and remote activities was implemented as originally designed.	3.9	1.2
Evaluation of the Pilot Artful ER Project's implementation according to the FDM instructions for each step		
Q9. In the "Understanding the challenge" step, the students managed to clarify the concepts required to understand the challenge they had to face.	4.5	0.9
Q10. In the "Generating ideas" step, the students suggested one or more ideas that potentially satisfied the conditions given in the challenge.	4.7	0.5
Q11. Regarding the ER discipline. in the "Formulating the solution" step, the students managed to formulate an algorithm for the robot behaviour (in natural language), considering the requirements of the challenge, before proceeding to program the robot at the next step "Creating the Solution".	4.3	0.7
Q12. Regarding the Art discipline, in the "Formulating the solution" step, the students managed to formulate the art part of the solution, considering the requirements of the challenge, before proceeding to its construction at the next step "Creating the Solution".	4.4	0.6
Q13. The students' final artefact created at the "Creating the solution" step met the challenge's requirements set at the "Understanding the challenge" step.	4.8	0.4
Q14. In the "Evaluating the solution" step, the students managed to evaluate the artefact's adequacy and its correspondence to the requirements of the challenge given in the "Understanding the challenge" step.	4.8	0.4

Table 5. One-level coding of educators' evaluation on the implementation of the Artful ER projects based on the initial FDM

Open-ended questions: *"Q1: What changes have you applied to the original Artful ER project designed during its implementation for the students to manage completing the project?"*		
Themes	**Frequency (n=15)**	**Representative Quotes**
Adjust due to students' background and needs	9	*"In response to the students' familiarity, the programming activities that were held online through the simulator, were modified to focus more on programming back-and-forth movements of the robots rather than emphasizing motor speed control. "* (GR1) *"The fact that the topic was quite based on the students' choices sometimes changed the application of the activity and the next steps had to be adjusted based on the changes."* (GR3)
Organizational changes	4	*"Especially more time."* (SL1)
No changes	2	*"I have not applied changes to the original design."* (SP2)
Open-ended questions: *"Q2: What would you change in the Artful ER project design after the implementation experience?"*		
Themes	Frequency (n=14)	Representative Quotes
Use a more effective representation	1	*"I would try to make the forms that we have to complete more friendly to the user "* (GR2)
Changes of the project design	5	*"Maybe connect it a bit more, so that the robotics is present throughout the whole theatre, not just in one part, so that it is "more alive" also from the robots' side."* (SL2)
Time adjustments	5	*"After experience with the project, I would dedicate more time to it, so that there would be more time for the entire project, as well as for the individual steps."* (CZ2)
No changes	3	*"I would probably leave it as it is,…"*(CZ4)

The qualitative data sheds light on potential areas where the structured framework of the methodology may benefit from additional support to enhance usability. The educator's adjustments due to students' backgrounds and needs, organizational changes to allocate more time, and adaptations based on students' choices suggest that **while the methodology offers a structured framework, external factors may independently influence the implementation of the project.**

3.2 Overview of the evaluation findings

3.2.1 The FDM as a conceptual methodology

The findings from the evaluation suggest that the FDM is indeed a structured approach developed to guide educators in the design and implementation of interdisciplinary Artful ER projects. This methodology is rooted in a series of carefully sequenced steps and detailed activities designed to

promote collaboration between disciplines, particularly arts and robotics, while cultivating computational thinking (CT) skills among students.

FDM Steps

The FDM comprises several steps, each contributing to a project's gradual and comprehensive design. These steps are sequentially arranged to ensure educators can systematically build upon previous activities. As indicated by the evaluation in Table 2, the sequence of steps was highly regarded for its usefulness in project design (Table 2, Q1: mean 4.3, St.dev. 0.6). The educators noted that following these steps helped them organize their thoughts and ideas more effectively, ultimately aiding in the synthesis of a cohesive project. For instance (see Table 3), the structure provided by the FDM helped educators classify and refine their ideas (CZ3) and organize their lessons better (GR4).

FDM Activities

Each step in the FDM is broken down into specific activities that outline detailed characteristics such as activity type, duration, modality (face-to-face or remote), class orchestration, and targeted CT skills. These characteristics are designed to trigger educators' creativity and assist in comprehensively planning student involvement in the project. According to Table 2, the activities' breakdown was found to be highly beneficial (Q3: mean 4.4, St.dev. 0.7), and the descriptive characteristics of each activity were praised for promoting idea generation and interdisciplinary communication (Q4 and Q5: mean 4.6, St.dev. 0.5 and 0.6, respectively).

Educators highlighted (see Table 3) that these activity characteristics helped them design better, more specific tasks and align these tasks with the learning objectives of their projects (SL1). By detailing the specific characteristics of each activity, the FDM supports educators in creating well-rounded and educationally robust project plans (GR1).

FDM Dimensions

The dimensions of the FDM encompass the broader educational goals of blended learning, interdisciplinary collaboration and CT skill cultivation. These dimensions are crucial for ensuring that the designed activities meet the learning objectives and foster a deeper understanding and integration of computational thinking within the context of art and robotics. The support provided by the FDM in setting objectives from both disciplines was highly rated (Table 2, Q6: mean 4.7, St.dev. 0.5), and the process of designing activities to cultivate specific CT skills promoted mutual understanding among educators from different disciplines (Table 2, Q7: mean 4.5, St.dev. 0.9).

Educators found that (Table 3) the FDM provided a structured approach that facilitated the connection between creative processes in the arts and computational thinking principles in robotics (GR2). This structured approach was crucial in helping educators understand and navigate the interdisciplinary nature of their projects.

Overall Effectiveness

Overall, the FDM was positively received by educators for its ability to guide project design and implementation. Table 4 shows high levels of agreement among participants regarding the

implementation of FDM steps in sequence (Q1: mean 4.5, St.dev. 0.9) and without skipping any steps (Q2: mean 4.4, St.dev. 0.9). Effective collaboration with teacher-co-designers (Q6: mean 4.7, St.dev. 0.6) further underscores the FDM's strength in fostering collaborative project development.

Additionally, students' abilities to clarify concepts, generate ideas, and formulate solutions were highly rated (Table 4), indicating that the FDM successfully facilitated the achievement of educational objectives (Q9 to Q14: means ranging from 4.3 to 4.8).

Conclusions

In summary, according to the analysis and interpretation of the evaluation data gathered from the educators, the initial version of the FDM provides a comprehensive and structured framework that effectively supports educators in designing and implementing interdisciplinary Artful ER projects. The high mean scores and positive qualitative feedback reflect its utility in organizing project design, promoting interdisciplinary collaboration, and achieving educational goals. However, additional support through training materials and a community platform is recommended to further enhance its usability, as discussed in subsequent sections.

Therefore, the initial FDM presented in the report "M1.3 "An initial version of the FERTILE design methodology" stands as the "FERTILE" Design Methodology. Figure 2 depicts the core elements of the FDM.

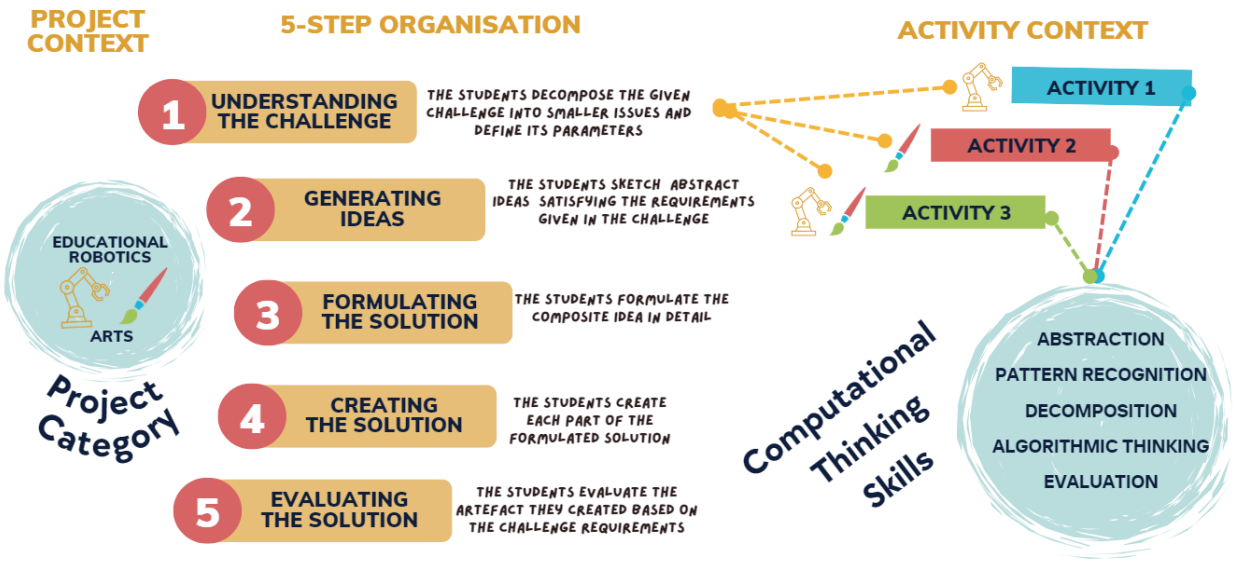

Figure 2. The "FERTILE" Design Methodology

3.2.2 The FDM's communication through the training materials

While the FDM has proven to be an effective framework for designing and implementing interdisciplinary Artful ER projects, the data indicates that additional support is necessary to enhance its usability, particularly in the context of blended learning. The evaluation data primarily highlighted

challenges related to blended learning, thus requiring targeted training materials to help educators navigate this aspect more effectively.

Specifically, the need for **support in blended learning** is highlighted by the quantitative findings in Table 4, where the mean score for the combination of classroom (f2f) and remote activities being implemented as originally designed was 3.9, with a higher standard deviation of 1.2. This variability indicates that while some educators felt supported, others struggled with this aspect. The qualitative data supports this, with UniWA noting the need to modify online programming activities to suit students' familiarity levels better ("In response to the students' familiarity, the programming activities that were held online through the simulator were modified to focus more on programming back-and-forth movements of the robots rather than emphasizing motor speed control." - Table 5). This adjustment underscores the complexity of integrating f2f and remote activities and highlights the need for specific training materials to address these challenges.

Thus, while the FDM provides a structured approach, additional guidance is needed to help educators make informed decisions about which activities are best suited for face-to-face or remote settings.

Therefore, to support the FDM we propose two training materials (https://fertile-project.eu/trainingmaterial/) :

Presentation 3.1, titled "Learning Design Ideas for Educational Robotics in a Blended Learning Context," showcases educators' design ideas and experiences with Educational Robotics (ER) in online and blended learning environments. The objectives are to identify effective design practices for integrating ER in these contexts and highlight ER simulators' benefits and applications. The presentation aims to provide insights into how educators can effectively apply ER in online and blended learning settings, demonstrating the value of using simulators to enhance the learning experience.

The training materials consist of videos aiming to identify the technological features and programming capabilities of widely used ER simulators. The goal is to offer insights into how these simulators can be effectively utilized in educational settings, emphasizing their integration with artistic activities. The video playlist, available on the "FERTILE" project YouTube channel, includes tutorials on UniBotics, EV3 Makecode, Beebot, Tinkercad, Arduino, and Micro:bit Makecode, with subtitles in all national languages through YouTube captions.

3.2.3 The FDM's representation as the authoring functionality of the "FERTILE" community platform

The FERTILE community platform (FCP) offers a user-friendly interface and enhanced functionality, making it easier for educators to design, collaborate on, and submit Artful ER projects. The FCP utilizes a set of web-based "design forms" that guide users in providing the necessary information to define each step prescribed by the FDM. By moving to this platform, the usability of these design forms will be significantly improved, simplifying the project design process for educators. Additionally, it addresses issues of ambiguity and lack of clarity identified in the qualitative findings, further justifying the need for a community platform as an authoring tool.

The qualitative data reveals several areas where educators experienced ambiguity and lack of clarity, which the FERTILE platform can mitigate:

Clarity and Comprehension of FDM Steps: Some educators found certain steps of the FDM unclear and incomprehensible. For instance, CZ2 stated, "The very characteristics of those individual steps were sometimes unclear and incomprehensible" (Table 3). The FERTILE platform can provide detailed explanations for each step, enhancing understanding and reducing confusion.

Complexity in Breaking Down Steps into Activities: GR1 highlighted the complexity involved in breaking down steps into individual activities: "Breaking down the steps into individual activities proved to be a complex task, as there were interdependencies and overlapping aspects between the steps, making it difficult to delineate clear boundaries for each activity" (Table 3). The platform offers templates and predefined structures to simplify this process, making it more intuitive for educators.

Time-Consuming Process of Applying FDM Steps: The qualitative feedback also pointed to the time-consuming process of applying the FDM steps. SL2 mentioned, "We tried to follow exactly the proposed steps, but we needed more time for the project" (Table 3). The FERTILE platform's interface and automated features can help reduce the time required to design projects, allowing educators to focus more on the content and less on the process.

Difficulty in Matching Activities to CT Skills: Educators faced challenges in matching specific activities to computational thinking (CT) skills. GR4 noted, "Sometimes, it was difficult to choose the CT skill that was cultivated" (Table 3). The platform can include built-in guidance and recommendations for aligning activities with CT skills, ensuring a more coherent and targeted approach.

Perceived Suppression of Creativity: CZ3 expressed concerns that the structured nature of the FDM might suppress creativity: "This kind of logical thinking, when everything has to follow each other logically, goes against my beliefs about creativity in music" (Table 3). The platform can offer flexibility and customization options, allowing educators to tailor the design process to fit their creative needs while still adhering to the FDM framework.

In conclusion, the FERTILE platform addresses the issues of ambiguity, lack of clarity, complexity, time consumption, difficulty in skill matching, and perceived suppression of creativity identified in the qualitative findings. By providing a user-friendly, structured, and flexible authoring tool, the platform enhances the overall usability of the FDM, hopefully making the design and implementation of Artful ER projects more efficient and effective for educators.

4. Evaluating the FERTILE Design Methodology in pilot studies

Building on the previous section, which evaluated the initial version of the FERTILE Design Methodology (FDM) with feedback from educators who designed and implemented Artful ER projects, and confirmed it, this section focuses on the comprehensive evaluation of the FDM that we resulted. The FDM discussed here is the result of the iterative refinement process informed by the evaluation of its initial version. This section starts with the 4.1 subsection presenting the methods applied in the pilot studies organized to evaluate the FDM. Subsection 4.1.1 provides the context, participants, and research scope, detailing the pilot study setup across four partner countries and the involvement of trainees and trainers. Subsection 4.1.2 outlines the materials used in the study, including the evaluation questionnaires designed for trainees and trainers. Then, the 4.2 subsection includes the findings from these evaluations. Subsection 4.2.1 presents the quantitative findings from the trainees' evaluations, followed by the qualitative findings in Subsection 4.2.2, which analyze the feedback on the FDM's steps, activities, and dimensions. Subsection 4.2.3 discusses the trainers' evaluations, combining both quantitative and qualitative data to provide a comprehensive analysis of the strengths and areas for improvement identified by the participants.

4.1 Methodology

4.1.1 Context, participants and research scope

The "FERTILE" consortium conducted pilot studies taking place in each partner country. In Greece the study was organised by UNIWA, in Spain by URJC and UVa, in Czech Republic by CUP, and in Slovakia by CUB.

The pilot studies' context and participants are presented in the report FERTILE_R4_T4.1_Report_Pilot_Studies. Notably, those studies shared the same threefold research scope. To evaluate the initial versions of (i) the FDM, (ii) the "FERTILE" Community Platform, and (iii) the "FERTILE" training materials towards their refinement. In this report we focus on the FDM's evaluation.

In this line, we briefly note that the participants undertook two roles, either trainers or trainees. There were 53 trainees in total: 9 Greek, 13 Czech, 19 Slovak, and 12 Spanish. The trainees, comprising 38 females and 15 males, spanned various age groups with the majority being between 20-30 years old. Specifically, the Greek trainees were predominantly female (8 out of 9) and younger (most aged 20-30), while the Spanish group had a broader age distribution with participants ranging from 20 to over 55 years. The Czech and Slovak groups also included a mix of younger and older participants, with notable numbers in the 20-30 and 40-55 age ranges.

The trainees' disciplines were split between educational robotics and arts, reflecting the project's interdisciplinary nature. For example, in Greece, most trainees focused on educational robotics, whereas the Czech and Slovak groups had a balanced interest in both educational robotics and arts.

Regarding teaching experience, the majority of trainees were novices with 0-3 years of experience, especially in Greece and Spain. In contrast, the Slovak group included a significant number of experts with over 5 years of teaching experience. Expertise levels varied, with many trainees in Greece and Spain having low to moderate expertise, whereas the Czech and Slovak trainees exhibited a broader range of expertise from low to high.

Throughout the pilot study, trainees engaged in various activities to co-design artful ER projects using the FDM, under the guidance and support of the trainers. In the end, both trainers and trainees provided feedback regarding their experience, contributing valuable insights into the application of the FDM.

The following research questions addressed the study's objective regarding the FDM:

Research Question 1: How did the trainees evaluate the FDM regarding the usefulness and the effectiveness of the FDM steps, activities and dimensions?

Research Question 2: How did the trainers evaluate the FDM in terms of comprehensibility, interdisciplinary collaboration, computational thinking skill development, and blended learning integration?

RQ1 aims to understand how the trainees perceive the methodology's practical application and its impact on their project design process. On the other hand, through RQ2, the trainers provide a more informed evaluation, considering their deeper understanding of the FDM's theoretical background and its application across various educational contexts. By addressing both RQ1 and RQ2, we obtain a comprehensive evaluation of the FDM from both novice users (trainees) and experienced educators (trainers), highlighting areas for improvement from different viewpoints.

4.1.2 Materials

After each pilot study, participants (trainees and trainers) completed evaluation questionnaires to reflect on their experience from their perspective.

To address research question 1, we developed the "FDM Evaluation Questionnaire for trainees" (MEQ-trainee) (see Appendix A) based on the content analysis of the educators' responses to the "Initial FDM Questionnaire" (see Table 3). To collect participants' perceptions, the MEQ-trainee included 27 close-ended questions expressed as Likert-scaled statements (5:Strongly agree - 1:Strongly Disagree). There were also 5 open-ended questions prompting participants to elaborate on their perceptions and provide qualitative insights.

To address research question 2, we formulated the "FDM Evaluation Questionnaire for trainers" (MEQ-trainer) (see Appendix B). in alignment with the quality indicators set by the consortium in the "FERTILE" project's quality plan. Notably, these indicators were intented for trainers who were expected to know extensively the FDM's theoretical background, i.e., its dimensions (blended learning, interdisciplinary collaboration and CT skill cultivation), and the fact that it follows a step sequencing process based on the Creative Computational Problem Solving (CCPS) model (Chevalier et al., 2020). Apart from being fully aware of the FDM to be able to communicate it to trainees, there was an underluing assumption that trainers were also highly qualified in learning sciences and aware of

contemporary educational models. We expressed these indicators as 7 close-ended using Likert-scaled statements (5:Strongly agree - 1: Strongly Disagree). The participants rated these indicators on a scale of 1 to 5 to evaluate the methodology's (i) theoretical up-to-dateness, (ii) comprehensibility for educators, (iii) flexibility across educational contexts, (iv) support for interdisciplinary collaboration, (v) support for designing interdisciplinary projects, (vi) promotion of computational thinking skills' cultivation, and (vii) support for applying blended-learning. Additionally, there was one open-ended question aimed at explaining the quantitative results obtained from the close-ended questions.

4.2 Findings

The evaluation of the FDM is presented by integrating both qualitative and quantitative data collected through the MEQ-trainee and MEQ-trainer questionnaires.

For the quantitative data, we calculated the mean and standard deviation to illustrate:

a) The trainees' perceived usefulness and effectiveness of the FDM steps, activities, and dimensions, as shown in Figures 3, 4, and 5 for RQ1.

b) The trainers' evaluations of the FDM, as depicted in Figure 6 for RQ2.

In the qualitative analysis process, each participant's response (trainer or trainee) was examined for multiple expressed opinions. If a participant repeated an opinion or provided more than one answer to a question, each unique opinion was counted only once per trainee. This method ensures that the frequency of responses accurately reflects the number of participants who expressed a particular viewpoint, rather than the number of times an opinion was repeated. Consequently, the total number of responses represents distinct viewpoints, providing a clearer understanding of the feedback.

For RQ1, the quantitative data from Figures 3, 4, and 5 are synthesized with the qualitative insights from Tables 6, 7, 8, and 9.

For RQ2, the quantitative data from Figure 6 is synthesized with the qualitative insights from Table 10.

This integrated approach ensures that the quantitative scores are contextualized with relevant qualitative feedback, allowing an in-depth understanding of the data. This structure is important as it allows the reader to see a direct correlation between the quantitative data and qualitative insights, making the findings more robust and comprehensive. By presenting the data in an integrated manner, we provide a cohesive narrative that highlights how trainees' and trainers' perceptions align or diverge across different aspects of the FDM.

4.2.1 Research Question 1. FDM Evaluation by trainees (MEQ-trainee)

This section presents the findings of the FERTILE Design Methodology (FDM) evaluation by trainees through the MEQ-trainee questionnaire. The evaluation covers three main areas: the usefulness and effectiveness of the FDM steps and sequencing, the FDM activities, and the FDM dimensions.

The results are presented in three parts. Part 1 focuses on the FDM steps and sequencing, Part 2 examines the FDM activities, and Part 3 discusses the FDM dimensions. Each part includes both quantitative data from the MEQ-trainee questionnaire and qualitative data from the open-ended responses.

Figures 2, 3, and 4 visually represent the quantitative findings, illustrating the trainees' perceptions of the usefulness and effectiveness of the FDM steps and sequencing, activities, and dimensions, respectively. Additionally, qualitative data, summarized in Table 6, offers more profound insights into the trainees' experiences and perceptions, highlighting both strengths and challenges.

This structure allows for a comprehensive analysis by triangulating quantitative data with qualitative feedback, thereby providing an in-depth understanding of the trainees' FDM evaluation. Presenting the quantitative and qualitative data together within each part helps to contextualize the findings, making it easier to understand how specific elements of the FDM are perceived and where improvements are needed.

4.2.1.1 Part 1: The usefulness and effectiveness of the FDM Steps & Sequencing

The mean scores and standard deviations from the MEQ-trainee responses and the content analysis of the MEQ trainee responses at the open-ended questions indicate that while trainees appreciate the structure and support provided by the FDM, there are areas that require improvement to enhance its clarity and efficiency. The quantitative data shows generally positive evaluations of the FDM steps, with high mean scores indicating their usefulness. For instance, trainees found the FDM steps supportive in culminating design ideas (mean = 3.9, st.dev. = 1.0) and organizing Artful ER projects (mean = 3.7, st.dev. = 1.0) (see Figure 3). However, the standard deviations suggest some variability in trainee perceptions, pointing to differences in how effectively the FDM steps are understood and applied.
The qualitative data further elucidates these challenges. Trainees highlighted the structured nature of the FDM as a key strength, supporting the positive quantitative evaluations. Specifically, 12.5% of trainees praised the FDM for its well-structured methodology (GR5) (see Table 6). Yet, specific issues like ambiguity in differentiating between certain steps (12.5%) (SL5) (see Table 6) underscore the need for clearer explanations and better guidance of the steps within the methodology. This differentiation in the qualitative feedback may explain the variability indicated by the standard deviations in the quantitative data.
Overall, while trainees generally perceive the FDM steps as useful and effective, the presence of both positive and negative qualitative feedback reflects the mixed levels of agreement among trainees, as indicated by the standard deviations.

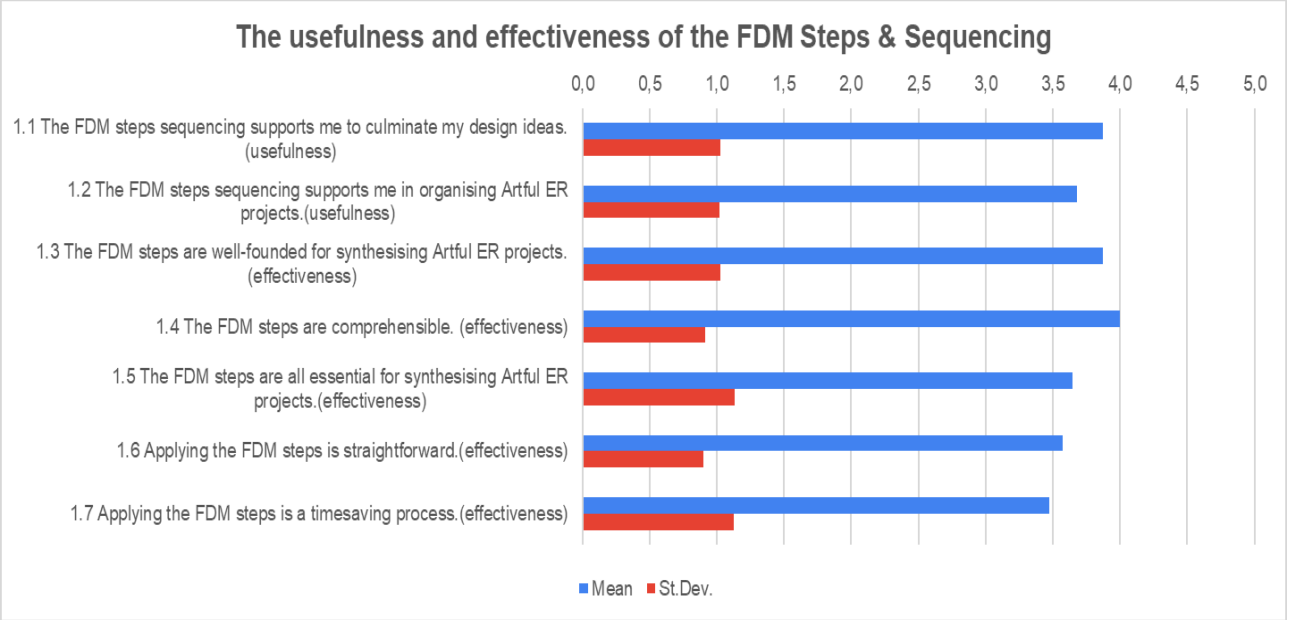

Figure 3. The trainee's responses on the MEQ-trainee regarding the usefulness and effectiveness of the FDM Steps and Sequencing

4.2.1.2 Part 2: The usefulness and effectiveness of the FDM Activities

The trainees rated the usefulness of FDM activity features positively (see Figure 4), with mean scores ranging from 3.7 to 3.9 out of 5, indicating moderate to high satisfaction. While trainees found that FDM activity features triggered their design ideas (mean = 3.9, st.dev. = 0.9) and supported the synthesis of Artful ER projects (mean = 3.7, st.dev. = 1.0), some faced difficulties in differentiating and integrating activities in a project, with 12.5% of trainees mentioning this challenge (CZ6) (see Table 6). The activities' alignment with project learning objectives (mean = 3.8, st.dev. = 1.0) was generally seen as positive, but there was ambiguity in integrating activities into steps, as highlighted by trainees (12.5%) (CZ6) (see Table 6). The standard deviations, which reflect some variability in responses, suggest differing levels of agreement among trainees. This variability can be interpreted through the qualitative data. For instance, while many trainees appreciated the structure and support of the FDM activities, some found specific challenges such as the ambiguity in integrating activities into steps, which created differing perceptions of the methodology's clarity and efficiency. This indicates that while the overall framework is beneficial, individual experiences with the implementation of the steps can vary, leading to the observed variability in quantitative responses.

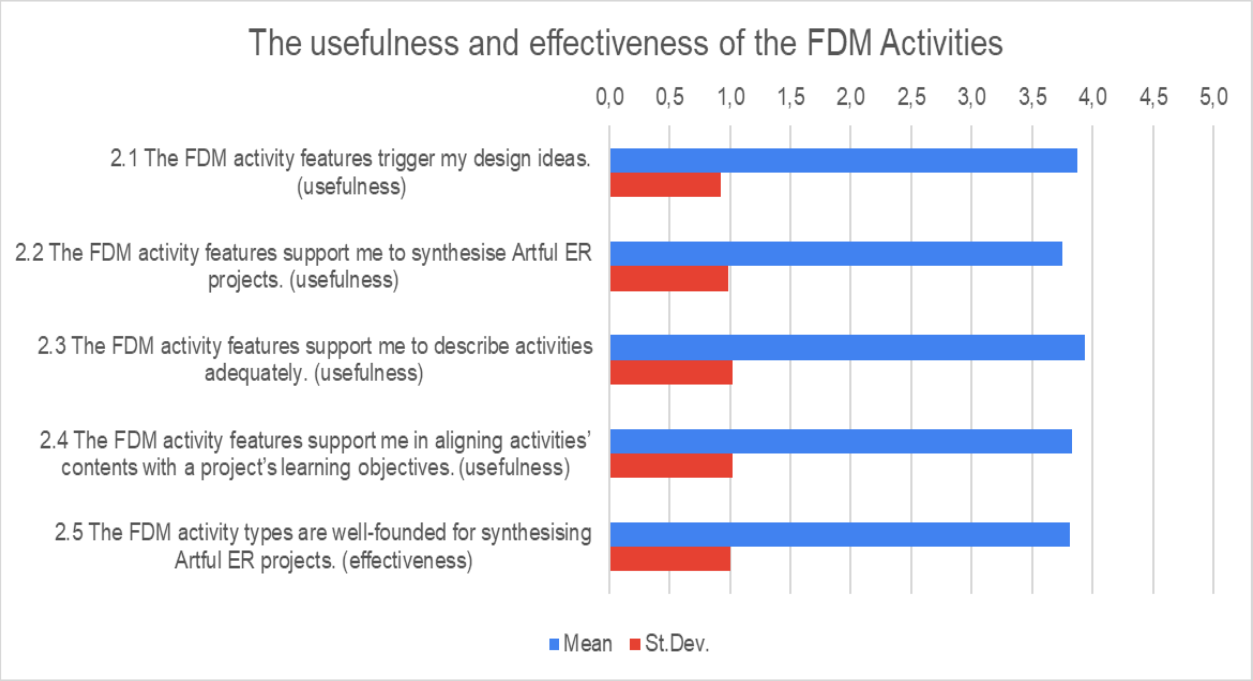

Figure 4. The trainee's responses to the MEQ-trainee regarding the usefulness and effectiveness of the FDM Activities

4.2.1.3 Part 3: The usefulness and effectiveness of the FDM Dimensions

The MEQ-trainee questionnaire responses regarding the FDM dimensions indicate a generally positive perception among educators (see Figure 5), with mean scores ranging from 3.7 to 4.5. The trainees rated the FDM highly for supporting interdisciplinarity between ER and Arts (mean = 4.1, st.dev. = 0.9), fostering creativity (mean = 4.3, st.dev. = 1.0), and promoting mutual understanding through collaborative activity design (mean = 4.5, st.dev. = 0.9). These quantitative findings align with qualitative feedback, where 8 trainees (25%) of trainees mentioned explicitly the clarity of the FDM dimensions including the interdisciplinary approach (see Table 6). There were also slightly lower scores for triggering the use of ER simulators (mean = 3.7, st.dev. = 1.1) and applying blended learning (mean = 3.9, st.dev. = 1.0), with 12.5% (4 trainees) mentioning explicitly that focusing on distance learning is challenging (CUB) (see Table 6). The standard deviations suggest some variability in responses, indicating differing levels of agreement among trainees.

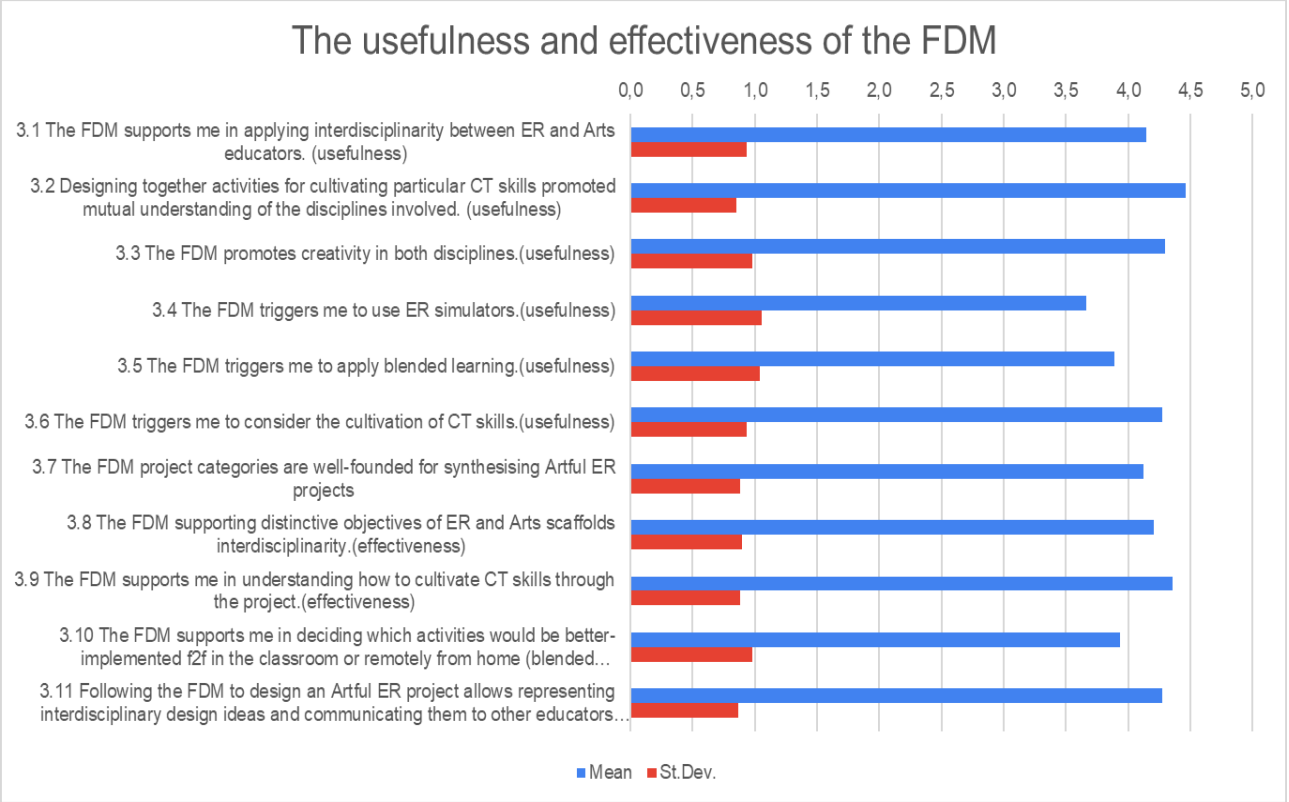

Figure 5. The trainees' responses on the MEQ-trainee regarding the usefulness and effectiveness of the FDM Dimensions

4.2.1.4 Qualitative data analysis regarding the usefulness and effectiveness of the FDM

The content analysis of the open-ended question responses revealed that trainees' feedback encompassed several areas: the FDM conceptualization (Table 6), the community platform (Table 7), the communication of the FDM through training materials (Table 8), and the communication of the FDM during the pilot training (Table 9). For each of these aspects, trainees' feedback was categorized into challenges, strengths, and suggestions for improvement.

In the qualitative analysis process, each trainee's response was examined for multiple expressed opinions. If a trainee repeated an opinion or provided more than one answer to a question, each unique opinion was counted only once per trainee. This method ensures that the frequency of responses accurately reflects the number of trainees who expressed a particular viewpoint, rather than the number of times an opinion was repeated. Consequently, the total number of responses represents distinct viewpoints, providing a clearer understanding of the feedback.

Table 6. Two-Level Coding of Trainees' Perceptions on Designing Artful ER Projects Using the FDM (responses = 32)

Theme	Topic	Frequency of responses (n=32)	Representative Quotes
Challenges	Ambiguity in Steps	4 (12.5%)	"I have trouble differentiating between the steps 'Formulating' and 'Creating'." (SL5)
	Ambiguity in integrating Activities	4 (12.5%)	"I missed the possibility of connecting individual steps and activities in the project and organizing them into a slightly clearer structure in individual steps." (CZ6),
	Time Consuming	5 (15.6%)	"One disadvantage of the methodology as a whole is that it is very time consuming to break the project down into activities." (SL5),
	Integrating ER with Art	2 (6.3%)	"In some interdisciplinary relationships, the intersection of the two disciplines is harder to find. "(SL18)
	Integrating CT	1 (3.1%)	"I have trouble assigning computational thinking skills." (SL5)
	Complexity for Shorter Projects	1 (3.1%)	"The methodology is more suitable for larger and longer projects." (CZ10)
	Stifling Creativity	2 (6.3%)	"The large number of steps and little support in thinking about goals and the whole rather limit creativity for me." (CZ7)
Strengths	Clarity of FDM Dimensions	8 (25%)	"The dimensions of the design methodology are analytical and descriptive. " (GR9)
	FDM Structure	5 (15.6%)	"I think the FDM methodology is well-structured and helpful." (GR5)

Table 7. Two-level coding of trainees' perceptions of the FERTILE Community Platform during Artful ER project design using the FDM (responses = 10)

Theme	Topic	Frequency of responses (n=10)	Representative Quotes
Challenges	Technical Issues	3 (30%)	"As I was working on the parts, it happened repeatedly that despite pressing the 'save' button, it didn't save the things I created." (SL6),
	Translation Issues	2 (20%)	"It is sometimes difficult to understand what the selection items represent - the English translation is important." (CZ12)
Strengths	Collaboration Support	3 (30%)	"FDM was suitable for my work because we could collaborate on the project through the platform with a colleague and complement each other's work." (SL6),
	Authoring environment	1 (10%)	"The form was quite comprehensible and helpful" (GR8)
Suggestions for Improvement	Community environment	1 (10%)	I would prefer to display projects only from those I follow (GR6)

Table 8. Two-Level Coding of Trainees' Perceptions on the FDM's Communication through Training Materials (responses = 10)

Theme	Topic	Frequency of responses (n=10)	Representative Quotes
Challenges	Lack of Clarity in Videos	1 (10%)	"The steps weren't clear enough in the videos." (SL14)
	Need for Correct CT Skills Support	1 (10%)	"I have trouble assigning computational thinking skills." (SL5)
Suggestions for Improvement	Adding Training Videos	2 (20%)	"We would like to have more information about simulators" (SP12)
	Need for project	4 (40%)	"Sample scenarios on different themes" (GR3),

	examples and guidance		
Strengths	Helpful	2 (20%)	"The material was very helpful" (GR4)

Table 9. Two-Level Coding of Trainees' Perceptions on the FDM's Communication through Training Events (responses = 12)

Theme	Topic	Frequency of responses (n=12)	Representative Quotes
Challenges	Limited Time to Understand Topics	1 (8.3%)	"a note about the previous questions: there was relatively little time for a better understanding of the topic" (SL15)
Suggestions for Improvement	More Thorough Training	2 (16.6%)	"Give more attention and depth to the formulating and generating steps which are more difficult and confusing" (GR7)
	Extension of Sessions to Include Practical Exercises	5 (41.7%)	With more time allocation, a discussion between students of different disciplines could be beneficial (CZ1), "More sessions are needed in order to fully implement the projects" (SP6)
	Need for More F2F Sessions	2 (16.6%)	"I consider it necessary to provide more face-to-face sessions to guide the development of the projects and thus better understand and apply the FERTILE design methodology." (SP6),
	Need for Scaffolding	2 (16.6%)	"the number of steps means more confusion at first. With routine/more frequent use, designing will be easier." (CZ11),

Overall, the FDM conceptualization is well-regarded by trainees. The methodology's structure was particularly appreciated as with 5 responses showed (see GR5's comment). Additionally, the clarity of the FDM dimensions was noted in 8 responses, indicating that the FDM provides a solid foundation for project design (GR9) (see Table 6).

However, the majority of trainees identified three main challenges regarding the FDM conceptualization. These included ambiguity in steps, with 4 responses having trouble differentiating between steps like 'Formulating' and 'Creating' (SL5) (see Table 6). There was also ambiguity in integrating activities into the project, with 4 responses highlighting the struggle to connect individual

steps and activities (CZ6) (see Table 6). Also, the methodology was seen as time-consuming by only 5 trainees (SL5) (see Table 6).

Minor concerns were also noted. Integrating educational robotics (ER) with art posed difficulties for 6.25% of trainees (SL18) (see Table 6). Additionally, one trainee found it challenging to assign computational thinking skills (SL5) (see Table 6), and the methodology seemed more suitable for larger projects rather than shorter ones for one trainee (CZ10) (see Table 6). Two trainees also noted concerns about stifling creativity due to the structured nature of the steps (CZ7) (see Table 6).

To address these challenges, trainees suggested improvements focusing not on changing the FDM's conceptualization, but on enhancing its communication through training materials and training events, as well as on its representation through the community platform.

Regarding training materials, trainees emphasized the need for more detailed content, with 1 response highlighting the lack of clarity in videos (SL14), and 4 responses calling for more project examples and guidance to aid understanding (40%) (GR3) (see Table 8). Additionally, there is a call for more resources on simulators, recommended by 2 responses (20%) (SP12) (see Table 8).

In addition to the evaluations of the FDM, it is important to acknowledge the technical issues reported on the community platform (FCP). Addressing technical issues is crucial, as indicated by 3 responses (30%) mentioning difficulties in saving work (SL6), and 2 responses (20%) pointing out the need for improved translations (CZ12) (see Table 7). Additionally, 1 response (10%) suggested improvements in the community environment, such as displaying projects only from the users they follow (GR6) (see Table 7).

These technical and usability challenges on the FCP are detailed in another report specifically devoted to these issues. It is essential to consider that such technical difficulties could potentially have a negative impact on the overall perception of the FDM. Trainers and trainees might associate their frustrations with the platform with the methodology itself, thereby influencing their evaluations. Addressing these technical issues is crucial to ensure that the FCP supports, rather than detracts from, the effective implementation and perception of the FDM.

In terms of training events (Table 9), the primary suggestion was to extend sessions to include more practical exercises and hands-on experience, as indicated by 5 responses (41.7%) (CZ1, SP6). Trainees also requested more face-to-face sessions to enhance direct guidance, noted by 2 responses (16.6%) (SP6), and more thorough training on challenging steps like formulating and generating, highlighted by 2 responses (16.6%) (GR7). Additionally, ongoing support and scaffolding were mentioned as necessary to ease trainees into the methodology, with 2 responses (16.6%) emphasizing this need (CZ11).

4.2.2 Research Question 2. FDM Evaluation by trainers (MEQ-trainer)

The trainers' responses indicate high satisfaction and positive perceptions regarding the FDM (see Figure 6). The majority of the trainers rated the methodology as either Excellent or Very Good across all quality indicators. Specifically, the methodology's theoretical underpinnings are deemed up-to-date, and its comprehensibility to trainers is well-received. Additionally, it provides strong support for interdisciplinary collaboration, designing interdisciplinary projects, and cultivating computational thinking skills. However, there is some variability in responses regarding the methodology's support for designing blended learning projects which is also shown in the trainee's responses regarding the 3.4 and 3.10 questions regarding the use of simulators and the design of blended learning (see Fig. 6). These findings are also mentioned by the trainers who pointed out that while the methodology supports blended learning, there is a lack of motivation and clear guidance for its implementation, leading to a preference for traditional simulators over online tools (see Table 10, challenges regarding Blended learning), (UniWA, CUB). To improve this aspect, the FDM should provide more concrete examples and demonstrations of how blended learning tools can be effectively integrated into project activities.

Rather than the blended learning design challenges, the qualitative analysis revealed that trainers observed difficulties in integrating activity design within the FDM. Often, educators design their activities independently and then attempt to fit them into the methodology, rather than using the FDM as a guiding framework from the start. Trainers mentioned that "teachers first worked out the details of the project and then tried to fit the project into the steps of the methodology" (CUB).

Lastly, there is some variability in responses regarding the FDM's support for educators from different disciplines to collaborate, with a few trainers rating these aspects slightly lower (Figure 6).

Nonetheless, the general consensus suggests that the FDM effectively supports the design of blended-learning projects and meets the needs of trainers across diverse educational settings.

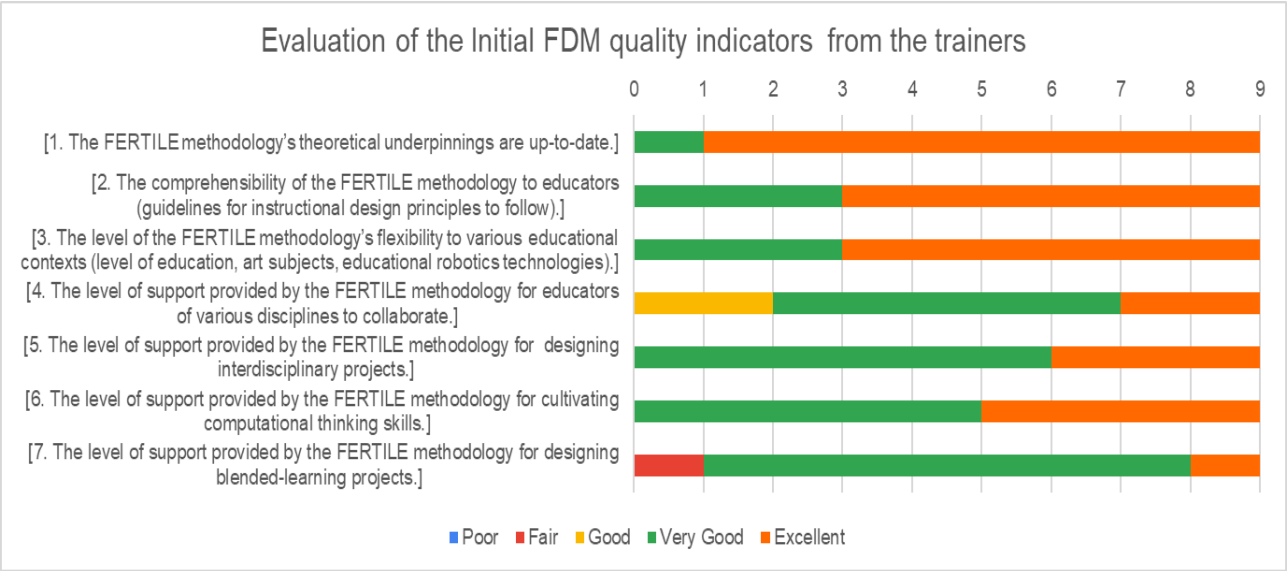

Figure 6. The trainers' responses on the MEQ-trainer regarding the evaluation of the FDM

Table 10. Two-Level Coding of Trainees' Perceptions on the challenges, and the strengths of the FDM. - inductive content analysis (responses=11)

Theme	Topic	Frequency of responses (n=11)	Representative Quote (Partner)
Challenges	Lack of time for collaboration between educators	3	"The collaboration is supported only if more teachers participate." (CUP), "It is very difficult for teachers to find the time to work together... And this problem is serious and the methodology cannot solve it." (CUB), "FDM provides good steps to support the design of artistic ER projects, although the collaboration among teachers is not directly supported through the FDM and it's something that teachers must work on their own." (URJC)
	Challenges regarding Blended Learning design	4	"The methodology supports blended learning but sometimes the trainees have not made use of this possibility and just used simulators in their f2f activities." (UniWA), "The methodology provides the opportunity to incorporate blended learning, but it does not force teachers to do so, so many did not use blended learning in their projects." (CUB), "The methodology did not convince the participants that it makes sense to use online blended learning tools." (CUB), "The motivation to use online tools was not clear or sufficiently demonstrated for teachers. This means that teachers were not enthusiastic about using blended learning." (CUB)
	Difficulty on integrating activity design into FDM	2	"Sometimes the teachers first worked out the details of the project and then tried to fit the project into the steps of the methodology." (CUB), "I noticed that the teachers prepare an activity, a project... think about everything, how they want the students to work... and only then try to integrate the individual parts into the FERTILE methodology." (CUB)

Strengths	FDM comprehensible	2	"FDM provides a very good support to design the project, it is easy to follow and understand and it has enough flexibility to adapt to different educational levels or subjects. I consider especially useful and very well integrated into the methodology the treatment of the different computational thinking skills." (URJC) , "The FDM guides the collaboration." (UniWA)

5. Refinement of the FERTILE Design Methodology

Both trainees and trainers appreciate the Fertile Design Methodology (FDM) for its structure, support, and comprehensibility. Trainees find the FDM steps and activity features useful and effective in organizing and synthesizing Artful ER projects. They reported high satisfaction with the methodology's ability to culminate design ideas (mean = 3.9, st.dev. = 1.0), organize projects (mean = 3.7, st.dev. = 1.0), and its overall comprehensibility (mean = 4.0, st.dev. = 0.9) (see Figure 3). Trainees also rated the usefulness of FDM activity features positively, with mean scores ranging from 3.7 to 3.9 out of 5, indicating moderate to high satisfaction (see Figure 4). Additionally, the FDM dimensions were rated highly for supporting interdisciplinarity between ER and Arts (mean = 4.1, st.dev. = 0.9), fostering creativity (mean = 4.3, st.dev. = 1.0), and promoting mutual understanding through collaborative activity design (mean = 4.5, st.dev. = 0.9) (see Figure 5).

Trainers echoed these positive sentiments, indicating a high level of satisfaction with the FDM. The majority rated the methodology as either Excellent or Very Good across all quality indicators (see Figure 6). They appreciated the FDM's up-to-date theoretical underpinnings and found it comprehensible. Trainers valued the methodology's strong support for interdisciplinary collaboration, the design of interdisciplinary projects, and the cultivation of computational thinking skills.

Despite the overall positive feedback, both groups identified specific areas for improvement. There were challenges regarding the clarity and efficiency of the steps, with lower scores indicating some trainees found the steps not always essential (mean = 3.6, st.dev. = 1.1), not straightforward to apply (mean = 3.6, st.dev. = 0.9), or timesaving (mean = 3.5, st.dev. = 1.1) (see Figure 4). Indeed, three trainees noted difficulties in differentiating between certain steps, such as "Formulating" and "Creating". Trainers also highlighted the need for clearer guidelines on differentiating steps within activities.

In addition, some trainees faced difficulties analyzing and differentiating steps within activities, particularly in creative parts like art, indicating a need for more precise conceptual explanations and better differentiation of steps. Trainers also requested more thorough training on the methodology and the extension of sessions to include practical exercises, allowing them to practice implementing the activities in a controlled environment. These suggestions highlight the need for enhancements in the training event itself, suggesting that more comprehensive training sessions and hands-on practice opportunities could further support the effective implementation of the FDM.

Trainers observed difficulties in integrating activity design within the FDM, with feedback indicating that educators often design activities independently and then try to fit them into the methodology. As noted by CUB, "teachers first worked out the details of the project and then tried to fit the project into the steps of the methodology". Providing more detailed guidelines and support for designing activities that align seamlessly with the FDM steps can help ensure a more cohesive and efficient project design process.

Regarding the trainers' perception on blended learning, there were slightly lower scores for triggering the use of ER simulators and applying blended learning, with qualitative feedback from trainers

indicating challenges in implementing blended learning. Variability in responses regarding the methodology's support for designing blended learning projects and its support for educators from different disciplines to collaborate was also noted. To improve this aspect, the FDM should provide more concrete examples and demonstrations of how blended learning tools can be effectively integrated into project activities.

Based on the challenges identified by the trainers and trainees, and the discussions of the consortium during the 5th Transnational Project Meeting held in Bratislava, we present the suggestions for improvement and their implementation in Table 11. This meeting facilitated a thorough review of the report results, leading to the finalization of these recommendations.

Table 11. Proposed improvements for the FDM

Challenge	Suggestions for Improvement	Implementation
Clear Explanation of Terminology	Trainers and trainees noted the need for clearer explanations of terms within the FDM methodology. There was ambiguity in defining and understanding different types of activities and their integration in each step.	• The UniWA team will release an editable version of the T.M. 4.1 Conceptualisation of the "FERTILE" Design methodology video to all partners, allowing them to add detailed explanations, examples, and translate the content to suit their local context. • Additionally, detailed explanatory notes and examples for each element within the methodology will be created. These resources will be provided on the Community platform to ensure thorough understanding of each step and activity.
Clearer Differentiation of Steps	Feedback indicated difficulties in differentiating between certain steps, such as "Formulating" and "Creating, and between activity types."	• Each partner will design two Artful ER exemplar projects on the Community Platform, demonstrating the application of each step and activity type in practice. • The outputs and scope of every step will be clearly presented in the authoring environment of the Community platform, providing users with concrete examples of how to implement each step effectively.

Blended Learning	Trainers pointed out that while the methodology supports blended learning, there is a lack of motivation and clear guidance for its implementation, leading to a preference for traditional simulators over online tools. This is also reflected in the moderate responses from trainees regarding the use of simulators and blended learning.	• Enrich the T.M. 3.2 ER simulators and indicative applications videos by developing and providing a new, more detailed video specifically for simulators. • Enhance the training materias a) T.M 3.1 Learning Design ideas for Educational Robotics in a blended learning context and b) T.M. 4.2 Interdisciplinary project idea culmination with detailed guidelines and examples on how blended learning tools can be effectively integrated into project activities.
Integration of Activities into Project Design	Trainers observed difficulties in integrating activity design within the FDM. This was also mentioned by some trainees. Educators often plan their activities independently and then attempt to fit them into the methodology, rather than using the FDM as a guiding framework from the start.	• Adjust training sessions to include video exemplars and provide opportunities for trainees to analyze these examples within the platform. This approach will help trainees understand how to align steps and activities seamlessly within a project, ensuring a more cohesive and efficient project design process.

6. CONCLUSIONS

The refinement of the FDM through the evaluation of its initial version and the evaluation of the final version of the FDM carried out in the training pilots, has provided significant insights into its effectiveness, challenges, and areas for improvement. This report builds on the findings from both studies, offering a comprehensive understanding of the FDM's capabilities and areas needing enhancement.

The conceptual foundation of the initial FDM proved solid, as evidenced by the positive feedback on its structured approach and logical sequencing (Table 2, Q1-Q2). The methodology's design successfully facilitated interdisciplinary collaboration and integration of CT skills (Table 2, Q6-Q7), highlighting its theoretical applicability across diverse educational contexts.

The evaluation of the FERTILE Design Methodology (FDM) revealed key challenges that do not pertain to the conceptualization of the FDM itself but rather indicate a need for improved communication and representation. Educators found the FDM time-consuming and complex, particularly when breaking down steps into individual activities. Additionally, implementing blended learning proved difficult, with the trainers expressing a need for more support and clearer guidelines for integrating face-to-face and remote activities. Furthermore, some trainees struggled to differentiate between certain steps, such as "Formulating" and "Creating".

Follow-Up FDM Evaluation Findings:

Reaffirmed Strengths:

The findings from the FDM evaluation confirmed that the FDM's structured approach and logical sequencing remained effective in supporting project design and interdisciplinary collaboration. The participants (educators from the evaluation of the Initial FDM and the trainees from the evaluation of the FDM) consistently found the sequence of steps helpful in organising and synthesising project ideas. The methodology continued to be praised for fostering creativity and engaging students in Artful ER projects. Educators valued the detailed activity features for idea generation and project planning.

Persistent Challenges:

Trainees still faced difficulties in differentiating between specific steps within the FDM. In addition, challenges in integrating activities into the overall project design persisted. Trainees sometimes designed activities independently and then attempted to fit them into the FDM. Furthermore, implementing blended learning remained as an issue.

Synthesis of Findings:

The findings from both the evaluation of the Initial FDM and the next evaluation of the FDM, reveal a consistent pattern of strengths and challenges. The structured approach, logical sequencing, and detailed activity features of the FDM are consistently praised for their effectiveness in supporting project design and interdisciplinary collaboration. However, challenges related to clarity, differentiation of steps, integration of activities, and the implementation of blended learning persist.

To address these challenges, the following areas need enhancement: a) Clear Explanations and Differentiation, b) Support for activity integration, c) support for blended learning integration, and d) more thorough training.

In **conclusion,** the FDM offers a robust framework for designing interdisciplinary Artful ER projects that integrate arts and educational robotics to cultivate CT skills in a blended learning context. By addressing the identified challenges and incorporating the suggested improvements, the FERTILE consortium can further support educators in effectively designing and implementing these projects, enriching the learning experience for students. The iterative evaluation and refinement process will ensure that the FDM continues to evolve and meet the needs of educators and learners alike. It is also important to note that the FDM, together with the training materials and the FCP, will be used during the upcoming multiplier events to validate further and refine the methodology.

7. References

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APPENDICES

APPENDIX A

FDM Evaluation Questionnaire" (MEQ-trainees)

FDM Evaluation Questionnaire (for trainees)

This questionnaire is intended to help you reflect on and evaluate your experience of applying the FERTILE Design Methodology (FDM) to co-design Artful Educational Robotics (ER) projects working together with a teacher of Arts or ER (based on your own discipine).

To complete this questionnaire, approximately half an hour is required.

* Υποδεικνύει απαιτούμενη ερώτηση

1. Note that this survey is confidential. The participants can be identified, but their identities are not revealed to anyone outside the study. Only the researchers know the identities of the participants, and measures are put in place to ensure that participants' identities are not revealed to anyone else. Confidentiality is best ensured through proper data management and security.
I have been informed that the data I will provide in the questionnaire will be used exclusively for research purposes. I wish to participate in the survey: *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ Yes

2. Please fill in your name or nickname (always use the same in every questionnaire) *

3. Sex *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ Female
- ◯ Male
- ◯ Prefer not to disclose

4. Age *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ 20-30
- ◯ 30-40
- ◯ 40-55
- ◯ 55+

5. Please fill in your discipline *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ Educational Robotics
- ◯ Arts

6. Please fill in your teaching experience (in years) *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ 0-3 (novice)
- ◯ 3-5
- ◯ 5+ (expert)

7. Level of expertise on learning design based on a particular methodology e.g. collaborative learning, inquiry-based learning, problem-based learning *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ Low
- ◯ Moderate
- ◯ High

8. Institution *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ University of West Attica
- ◯ Comenius University of Bratislava
- ◯ Charles University
- ◯ Universidad Rey Juan Carlos
- ◯ University of Valladolid

Part 1: FDM Steps

Reflect on and evaluate the proposed structure in steps for designing an Artful project as proposed by the FDM methodology

Topic: The usefulness of the FDM Steps & Sequencing

To what extent is the FDM Steps & Sequencing useful to you for designing Artful ER projects?

9. 1.1 The FDM steps sequencing supports me to culminate my design ideas. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

10. 1.2 The FDM steps sequencing supports me in organising Artful ER projects. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

Topic: The effectiveness of the FDM Steps & Sequencing

To what extent do you find the FDM Steps & Sequencing effective for designing Artful ER projects?

11. 1.3 The FDM steps are well-founded for synthesising Artful ER projects. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

12. 1.4 The FDM steps are comprehensible. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

13. 1.5 The FDM steps are all essential for synthesising Artful ER projects. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

14. 1.6 Applying the FDM steps is straightforward. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

15. 1.7 Applying the FDM steps is a timesaving process. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

16. 1.8 Please state your comments here (e.g. important remarks, critical points). Please feel free to explain any less positive rating on Part 1 (Steps) and suggest any improvements.

Part 2: Activities

Reflect on and evaluate the design of students' involvement in the Artful project through specific activities on each step as proposed by the FDM methodology

Topic: The usefulness of the FDM Activities

To what extent are the FDM Activity features (Activity Type, Duration, Modality, Class Orchestration, CT Skills) useful to you for designing Artful ER projects?

17. 2.1 The FDM activity features trigger my design ideas. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

18. 2.2 The FDM activity features support me to synthesise Artful ER projects. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

19. 2.3 The FDM activity features support me to describe activities adequately. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

20. 2.4 The FDM activity features support me in aligning activities' contents with a project's learning objectives. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

Topic: The effectiveness of the FDM Activities

To what extent do you find the FDM Activity features (Activity Type, Duration, Modality, Class Orchestration, CT Skills) effective for designing Artful ER projects?

21. 2.5 The FDM activity types are well-founded for synthesising Artful ER projects. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

22. 2.5.1 Please suggest other types of activity that you used (if any), not already included in the typology proposed.

23. 2.6 Matching the FDM activity to specific CT skill(s) is straightforward. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

24. 2.7 Breaking down the FDM steps in FDM activities is straightforward. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

25. 2.8 Selecting the type of an FDM activity is straightforward. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

26. 2.9 Describing each activity through the various features allows for representing and communicating design ideas about students' involvement among the disciplines (Arts, ER). *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

27. 2.10 Please state your comments here (e.g. important remarks, critical points). Please feel free to explain any less positive rating on Part 2 (Activities) and suggest any improvements.

Part 3: FDM Dimensions (Interdisciplinarity of ER with Arts, Blended Learning, CT skills)

Topic: The usefulness of the FDM

To what extent is the FDM a useful structured methodology to you for designing Artful ER projects?

28. 3.1 The FDM supports me in applying interdisciplinarity between ER and Arts educators. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

29. 3.2 Designing together activities for cultivating particular CT skills promoted mutual understanding of the disciplines involved. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

30. 3.3 The FDM promotes creativity in both disciplines. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

31. 3.4 The FDM triggers me to use ER simulators. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

32. 3.5 The FDM triggers me to apply blended learning. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

33. 3.6 The FDM triggers me to consider the cultivation of CT skills. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly useful

Topic: The effectiveness of the FDM

To what extent do you find the FDM an effective methodology for designing Artful ER projects?

34. 3.7 The FDM project categories are well-founded for synthesising Artful ER projects *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

35. 3.7.1 Please suggest other category(ies) of Artful projects that better match your own project.

36. 3.8 The FDM supporting distinctive objectives of ER and Arts scaffolds interdisciplinarity. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

37. 3.9 The FDM supports me in understanding how to cultivate CT skills through the project. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

38. 3.10 The FDM supports me in deciding which activities would be better-implemented f2f in the classroom or remotely from home (blended learning). *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

39. 3.11 Following the FDM to design an Artful ER project allows representing interdisciplinary design ideas and communicating them to other educators of both disciplines. *

Να επισημαίνεται μόνο μία έλλειψη.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Highly effective

40. 3.12 Please state your comments here (e.g. important remarks, critical points). Please feel free to explain any less positive rating on Part 3 (FDM Dimensions) and suggest any improvements. *

FDM Evaluation Questionnaire" (MEQ-trainers)

FDM Evaluation Questionnaire (for trainers)

This

questionnaire is intended to help you evaluate the FERTILE Design Methodology (FDM) as a trainer in the pilot study.

To complete this questionnaire, approximately 20 minutes is required.
Thank you for your contribution!

* Υποδεικνύει απαιτούμενη ερώτηση

1. Note that this survey is confidential. The participants can be identified, but their identities are not revealed to anyone outside the study. Only the researchers know the identities of the participants, and measures are put in place to ensure that participants' identities are not revealed to anyone else. Confidentiality is best ensured through proper data management and security.
I have been informed that the data I will provide in the questionnaire will be used exclusively for research purposes. I wish to participate in the survey: *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ Yes

2. Please fill with your name or nickname (always use the same in every questionnaire) *

3. Insitution *

Να επισημαίνεται μόνο μία έλλειψη.

- ◯ University of West Attica
- ◯ Comenius University of Bratislava
- ◯ Charles University
- ◯ Universidad Rey Juan Carlos
- ◯ University of Valladolid

4. 2. On a scale of 1 to 5 please evaluate the following indicators. *

Να επισημαίνεται μόνο μία έλλειψη ανά σειρά.

	Poor	Fair	Good	Very Good	Excellent
1. The FERTILE methodology's theoretical underpinnings are up-to-date.	◯	◯	◯	◯	◯
2. The comprehensibility of the FERTILE methodology to educators (guidelines for instructional design principles to follow).	◯	◯	◯	◯	◯
3. The level of the FERTILE methodology's flexibility to various educational contexts (level of education, art subjects, educational robotics technologies).	◯	◯	◯	◯	◯
4. The level of support provided by the FERTILE methodology for educators of various disciplines to collaborate.	◯	◯	◯	◯	◯
5. The level of support provided by the FERTILE methodology for designing interdisciplinary projects.	◯	◯	◯	◯	◯

6. The level of support provided by the FERTILE methodology for cultivating computational thinking skills.					
7. The level of support provided by the FERTILE methodology for designing blended-learning projects.					

5. 3. Please state your comments here (e.g. important remarks, critical points, main contributions). Any less positive rating must be also justified here. *