Electronic, didactic and innovative platform for learning based on multimedia assets

e-DIPLOMA

Funded by
the European Union

Initial analysis conclusions of the e-learning ecosystem for practice-based learning with disruptive technologies

HISTORY OF CHANGES			
Version*	**Publication date**	**Beneficiaries**	**Changes**
V1.0	30.06.2023	TU	▪ Final version

(*) According to the section “Review and Submission of Deliverables” of the Project Handbook

1. Technical References

Project Number	101061424
Project Acronym	e-DIPLOMA
Project Title	Electronic, Didactic and Innovative Platform for Learning based On Multimedia Assets
Granting Authority	European Research Executive Agency (REA)
Call	HORIZON-CL2-2021-TRANSFORMATIONS-01
Topic	HORIZON-CL2-2021-TRANSFORMATIONS-01-05
Type of the Action	HORIZON Research and Innovation Actions
Duration	1 September 2022 – 31 August 2025 (36 months)
Entry into force of the Grant	1 September 2022
Project Coordinator	Inmaculada Remolar Quintana

Milestone No.	M3: Initial analysis conclusions of the e-learning ecosystem for practice-based learning with disruptive technologies
Work Package	WP2: Focused view on European current situation of e-learning and co-creation of educational practices with emerging technologies
Task	T2.2: Analysis of remote e-learning in teacher training.
Dissemination level*	PU- Public
Type of license:	CC-BY
Lead beneficiary	▪ Tallinn University (TU)

PIC of the Lead beneficiary	▪ 999421653
Author(s)	▪ Kai Pata (ORCID: 0000-0002-8952-7698) ▪ Terje Väljataga (ORCID: 0000-0001-8109-0674)
Due date	28. 02. 2023
Actual submission date	31. 08. 2023

2. Table of Contents

3. Summary report of Deliverable 2.2

The Deliverable 2.2 of e-DIPLOMA project explored the remote e-learning practices with disruptive technologies on experiential and practical topics aiming to discover existing opportunities, barriers, and risks. The goal of the review was to amplify the current knowledge at European level about the suitability of institutional capacities for using disruptive technologies for experiential practice-based education. The report was based on:

- the empirical desktop analysis of recent research papers about using disruptive technologies for practice based learning;
- the values' workshops to elicit the values related to potential learning scenarios with disruptive technologies;
- the survey analysis of the current situation of distance learning in higher and vocational education institutions in participant countries that take part in this project paying special attention to experiential teaching.

The main research question of this report was:

What are potential, opportunities, barriers, accessibility issues and sustainability and ethical risks of using emerging technologies for teaching and learning?

The particular sub-questions were formulated for the i) literature review analysis, for the ii) values workshop and for the iii) survey analysis.

Literature review:

RQ 1: What was the state of art of practice-based e-learning at pandemic time?

RQ 2: What does research already know about using e-learning and disruptive technologies for achieving specific learning goals in practice-based learning?

RQ 3: Which obstacles do e-learning modes, multimedia learning and using disruptive technologies create for practice?

Values workshop:

RQ 4: What ethical and sustainability dimensions do people associate with the learning scenarios with disruptive technologies?

The survey:

RQ 5: What is the capacity of educational institutions in countries to perform practice-based e-learning with disruptive technologies?

RQ 6: What are the main gaps in the capacity to perform practice-based e-learning with disruptive technologies?

The deliverable empowered the next phases of the e-DIPLOMA project codesign of e-learning modules with disruptive technologies. It also highlighted the critical instructional design criteria that should be considered when setting different learning goals with disruptive technologies.

State of Art of Practice Based Learning: Brief overview of the learning gap for practice-based e-learning.

The Covid pandemic time outburst of e-learning in European universities raised the e-learning practices. We investigated what way the practice-based e-learning was conducted at the pandemic time and which gaps there were for conducting hands-on learning in e-learning mode. The literature analysis (between

2020-2022) was conducted. From 106 papers, only about 10 papers actually investigated how the pandemic period rapid transition to e-learning affected conducting practical learning activities. Challenge of practice-based e-learning was delivering the situated practice and problem-solving. There was a preference for synchronous delivery of practice-based class sessions as well as video demonstrations that kept the learners as more passive viewers. The main issues of e-learning during crisis were:

- slowing down the pace of learning;
- limiting abstract thinking;
- creating social, emotional, and cognitive engagement;
- limiting bodily practices;
- decreasing the intensity of the experience;
- catering to diverse student needs;
- providing holistic learning experiences in e-learning.

These findings showed that there is the need for developing different approaches to how practice-based learning may be mediated in distant learning format in case of emergency situations, but also as an opportunity for the universities to move towards course delivery in an e-learning mode.

Overview of the literature about disruptive technologies for e-learning

e-DIPLOMA project aims testing out disruptive technologies in experiential learning scenarios as an opportunity to find best solutions for practice-based distance learning. In report D 2.2 we collected a sample of recent (from the period of 2019-2022) studies of disruptive technologies - virtual learning environments, extended and augmented reality, artificial intelligence and chatbots in learning, gamified virtual learning environments. We explored these empirical and meta-studies regarding what types of learning practices, and scaffolding practices, and interaction types were used with disruptive technologies. We viewed which learning outcomes were measured and documented in these studies, to discover the opportunities and gaps in cognitive, metacognitive, affective and psychomotor and embodied learning domains. We also reviewed the main theoretical constructs that guide learning designs with disruptive technologies. Our literature analysis indicates that practice-based learning models, student interactivity, learning support and social dimension in learning environments with disruptive technologies so far have followed a rather traditional approach not yet systematically disrupting education towards active learning practices.

- We found that although there are plenty of experiments with disruptive technologies, there is not sufficient clarity on what way the technologies provide useful changes to practise based digitised learning.
- There is a lack of this knowledge how the new type of immersive, gamified and with personalised adaptive feedback loops learning medium may impact on learning, and which premises the disruptive environments offer to practise based technology mediated activities.
- Research in empirical studies is focusing only on limited types of learning outcomes. Few studies relate psychomotor and embodied learning effects with cognitive, metacognitive and affective effects.
- The learning experiments with disruptive technologies lack the collaborative coworking dimensions.
- The interactivity in activities involving learning artefacts falls short of reaching adequate levels.
- The learning process results are conceptualised at individual learner level.

Interaction has been promoted as the key added value of digitalisation (Väljataga et al., 2015). We observed that the potential of disruptive technologies for shifting patterns of power, roles, and responsibilities in educational settings is underused. For understanding students' interaction with disruptive technologies and content, the following category was taken as a basis (Väljataga et al., 2015):

- Consume - The simplest and most static method to engage with the technology and content. This relates to watching a video, listening to a podcast, or just reading a text. The content item will remain untouched by its users, no changes will be done with the actual content of that artefact.
- Annotate - Content can be annotated with several forms of information, including highlights, likes, ratings, tags, and comments. As the user interacts with the content, mostly at the metadata level, annotation gives it significance and a personal touch. In online communities, some annotations (such as tags and bookmarks) can be shared.
- Manipulate – Students are engaged in interacting with some components of the content by, for instance, clicking on hot spots, dragging and dropping some elements to correct location, or filling in some fields in a digital form. The content itself can't be modified or new content added. The technology might give immediate personal feedback to student's interactions with content. The student's interaction level remains restricted and temporary, as digital content is not changed permanently.
- Submit – On this level, the students are prompted to solve some problems, manipulate interactive content or enter responses to questions. In contrast to the previous level, the outcomes of such interaction will be presented to the teacher or other students for evaluation and feedback. The input requested from students and the feedback given by the teacher will not be included in the content itself.
- Expand - Students can edit or complement an artefact, add some micro content to the original artefact, however, the core content of that artefact remains mainly intact. For instance, merging together some video clips, filling in blanks in a self-test, adding a story to a photo etc. With this level the original content itself will be complemented with some additions, however, the core parts of the content are still visible and recognisable.
- Remix - Students can alter the original state of the content by adding, removing, and/or changing pieces of the item. It is difficult to extract its initial version and parts. The main characteristic of remixing is that it appropriates and changes other materials to create something new. The original meaning of the content and the intention of the author might change entirely and the student makes the material her own.
- Create - Students can create a totally new artefact from scratch. In this case the students don't make use of any other content, but develop their own.

Our literature analysis of various cases showed rather modest modes of interaction with the content (see Figure 1).

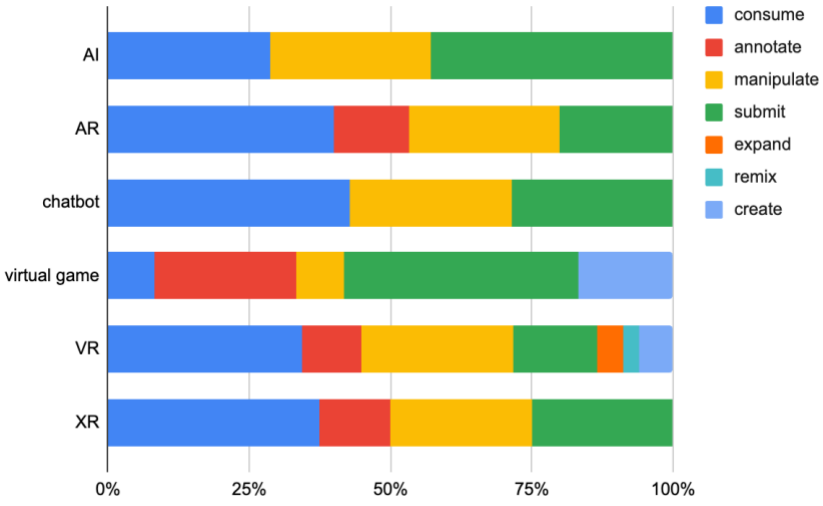

Figure 1. Students' interactivity in learning scenarios with disruptive technologies based on our empirical literature review.

Pedagogical design with disruptive technologies very often followed knowledge transmission or information acquisition view and treated students as passive consumers of ready-made content. Thus, from the pedagogical perspective, disruptive technologies like AI, AR, VR, chatbots, and virtual games do not yet appear to have the capacity to change how education is currently conducted, in particular, to support more advanced forms of interaction. Prevalent interactivity types in learning scenarios with disruptive technologies were the lowest (consume, annotate, manipulate), meaning, students can simply consume static content without an option to modify it or add new content. The technology may provide the student with instant, personalised feedback on their interactions with content; but, the teacher or other students are unable to observe, hear, or analyse the learner's responses. A rather typical interaction mode with disruptive technologies was also submit, i.e. the results of such interaction or problem-solving will be submitted for review and feedback to the teacher or other participants in the process of learning. Only in a few cases, learning scenarios with VR have been designed in a way that students were actively engaged in interaction with the content in the role of a creator.

Scaffolding as an instructional method by providing students with guidance, feedback, and support, can be provided by means of appropriately designed technologies. Four scaffolding types have been determined by Hill and Hannafin (2001), Hannafin et al. (1999):

- Conceptual scaffolding helps students to reason through complex problems as well as concepts.
- Metacognitive scaffolding supports students' learning management processes and thinking about a task.
- Procedural scaffolding emphasises various ways to utilise the available resources and tools within a given environment.
- Strategic scaffolding guides students about tools and resources that are accessible and could be beneficial in certain situations, and offers instruction on how to utilise them.
- Affective scaffolding supports emotions and motivation (Steinert, Marin & Roeser, 2022).

We can draw from the literature analysis that scaffolding was not always explicitly designed into the practice-based learning with disruptive technologies. Conceptual and procedural scaffolding were the most common types that have been implemented with disruptive technologies (Figure 2).

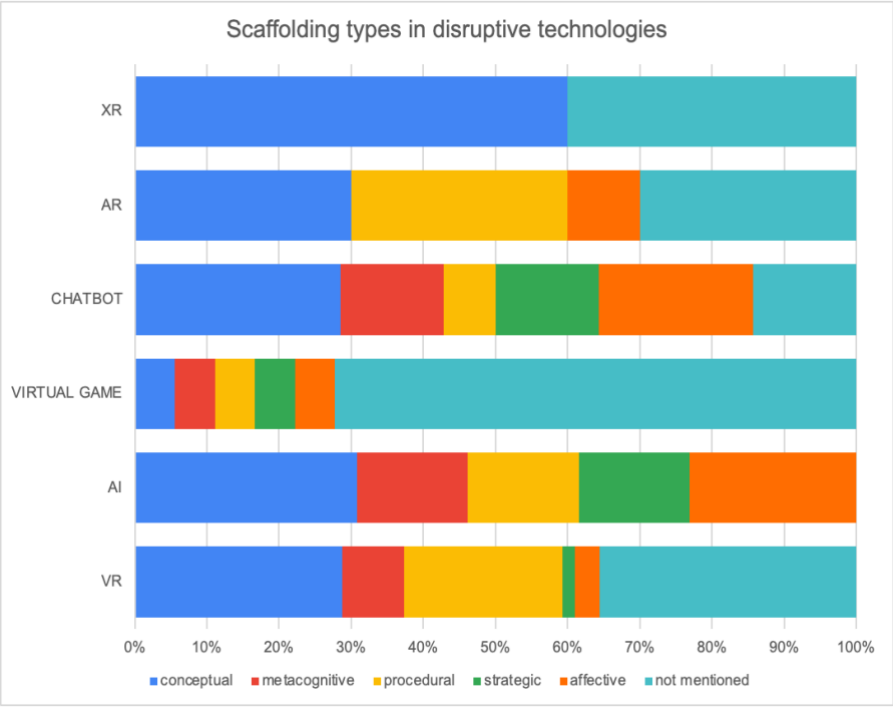

Figure 2. Scaffolding types in practice-based learning scenarios with disruptive technologies based on our empirical literature review.

In our literature analysis we took a closer look at different learning modes in practice-based learning scenarios with disruptive technologies:

- individual - practice based learning activity is carried out individually
- pair with facilitator - practice based learning activity requires or enables one-to-one interaction with the facilitator, takes place in multiple forms through various communication channels
- group with facilitator - practice based learning activity requires or enables group interaction with the facilitator
- peer-peer - practice based learning activity require or enables peer-to-peer interaction, learners to interact with other learners
- peer-group - practice based learning activity requires or enables interaction with the group.

Figure 3 below demonstrates the current situation regarding the learning modes in practice-based learning with disruptive technologies. It is evident that individual tasks make up the majority. A few examples were provided in reviewed papers of the learning modes of pair with facilitator and group with facilitator. Peer-to-peer and peer-to-group learning modes were seldom demonstrated in the studies.

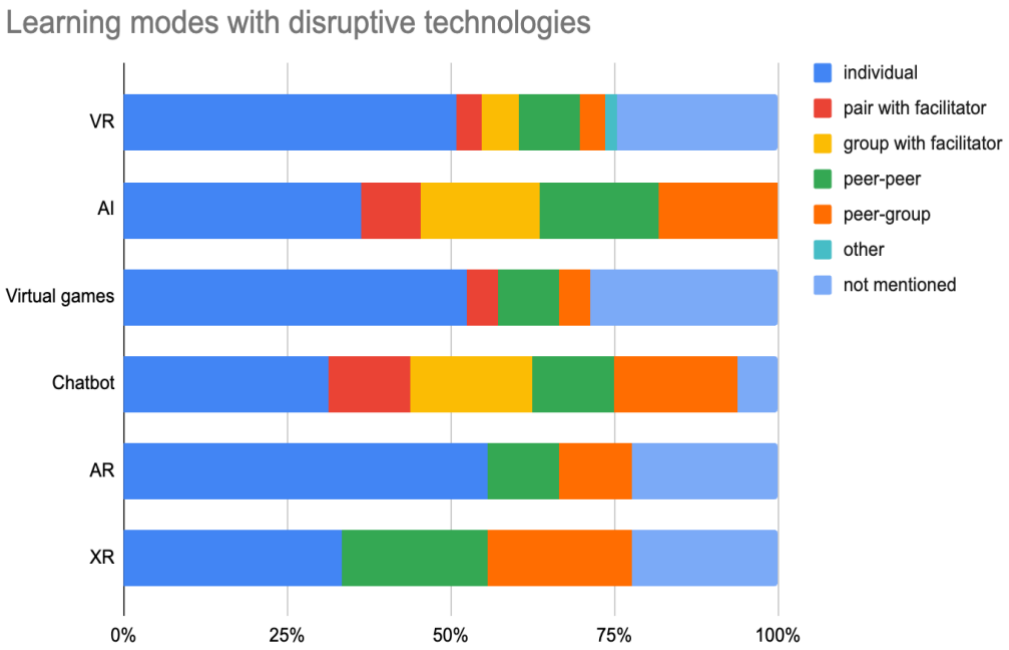

Figure 3. Learning modes with disruptive technologies based on our empirical literature review.

For exploring the possible effects on users, we selected four domains: cognitive effects, metacognitive effects, affective effects, and psychomotor, behavioural and embodied effects. We viewed these effects on the level of individual learners, as well as in the situations with facilitators or in peer groups. D 2.2 provides an overview of all the findings. The literature analysis showed that there are several wellbeing related issues that may arise from using disruptive technologies, particularly related with vision, hearing and motor-balance system.

The values and sustainability issues of using disruptive technologies

We collected at the values-workshop an empirical data of how the practice-based example learning scenarios with disruptive technologies are perceived. The data were collected in partner countries from 8 workshops where the users could read about the learning design scenarios with disruptive technologies and then discuss the values they perceived regarding these learning situations. We used in the workshops the instrument with 45 values to elicit values in discussions about 4 learning scenarios in which disruptive

technologies were used. We collected the values of people associated with four different learning scenarios with disruptive technologies.

The value space around the practice-based learning scenarios was described associating the perceived values and concerns with the learning scenarios, with learners, with the technologies and with the learning effects.

The highest frequency to be considered important while working with disruptive technologies were the values of accessibility, adaptability, autonomy, trust, control, coercion, surveillance, but also accuracy, responsibility, and sustainability. The value dimensions that occurred in all four scenarios (flexibility), or in at least three scenarios (accessibility, connectivity, vulnerability, trust, involvement, autonomy, control, surveillance, challenging, effectiveness, productivity, accuracy, sustainability, and satisfaction) indicate the value perspectives that meant most to people when they saw the learning scenarios with disruptive technologies. Proportionally in all workshops in different countries about the same number of values were mentioned.

The analysis of the values mentioned in case of different learning scenarios revealed (see Figure 4) that some types of scenarios such as learning with VR and AR were perceived in relation to larger number of value dimensions, compared with the scenarios of AI and telepresence robots. We also noticed that in the latter two scenarios, there were more concern-related values, such as trust, vulnerability, equity, fairness, and autonomy. However, the negatively connotated values such as confidentiality, privacy, coercion, control and surveillance were also perceived in regards to scenarios with augmented reality (AR) and virtual reality (VR), and not only with AI.

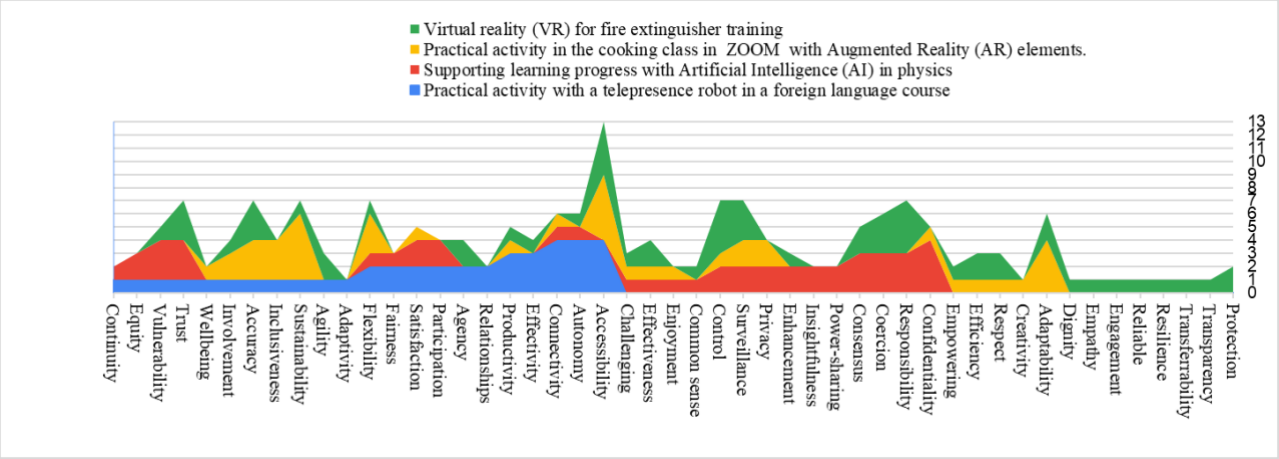

Figure 4. The frequency of value dimensions mentioned in case of different types of learning scenarios

Main findings about value dimensions from qualitative analysis:

- One finding was that understandings of the learning potentials of the disruptive technologies was not clear to learners.
- The needs coming from future workplaces to use disruptive technologies, and the opportunities to keep learners more engaged and motivated were seen as drivers of designing new practices in education.
- The designing complexity of learning situations with disruptive technologies, the skill-demanding nature of preparing learning situations, and the costs were perceived as sustainability threats of disruptive technologies.
- The learners had a belief that the built disruptive environments may be rigid as learning places and may decrease the teachers' and students' flexibility in planning the learning.

Both the literature report and the values workshop revealed a number of physical and societal concerns that using disruptive learning environments creates.

The training ecosystem capacity for using disruptive technologies in e-learning

We investigated in partner countries with the survey the capacities for using disruptive technologies in 6 partner countries' higher educational and vocational institutions.

The answers were collected totally from the following number of the technology specialists-experts (N=96), the educators (N=351), and the students (N=516). Below we present the final sample in the countries (regions) (see Table 1). The generalizability of the data is limited due to the sampling structure: we did not attempt to reach regional coverage because countries in our sample differ greatly in size and we had limited resources for large scale analysis. In Estonia responses were collected from 9 institutions (3 vocational schools and 6 HEIs). In Bulgaria responses were from 3 institutions (all HEIs). In Cyprus responses were from 3 institutions (all HEIs). In Hungary responses were from 6 institutions (1 vocational school and 5 HEIs). In Spain responses were from 116 institutions (28 high schools, 41 vocational schools, 47 HEIs). In Italy responses were from 9 institutions (4 HEIs and 5 social enterprises).

Table 1. The sample distribution among different types of respondents.

Role	Country	Total (N)	%
Expert	Bulgaria	6	6.25
	Cyprus	0	0
	Estonia	11	11.45833333
	Hungary	3	3.125
	Italy	9	9.375
	Spain	67	69.79166667
	Total	96	100
Lecturer	Bulgaria	34	9.686609687
	Cyprus	11	3.133903134
	Estonia	19	5.413105413
	Hungary	29	8.262108262
	Italy	28	7.977207977
	Spain	230	65.52706553
	Total	351	100
Student	Bulgaria	77	14.92248062
	Cyprus	7	1.356589147
	Estonia	49	9.496124031
	Hungary	47	9.108527132
	Italy	87	16.86046512
	Spain	249	48.25581395
	Total	516	100

The survey viewed the capacity for practice-based e-learning from the perspectives of technology specialists that provide support at institutions, lectures who conduct practice-based lessons, and students who participate at practice based lessons.

The survey was composed of four blocks of capacity elements:

- infrastructural capacities,
- normative and regulatory capacities (institutional level),
- teaching cultures (community level),
- competences, attitudes and values (personal level).

The analysis revealed specific gaps in the capacity.

- We found that the specialists, lecturers and students perceived differently the capacity elements. There were some differences in the capacity to use disruptive technologies for practice-based learning in the partner countries.
- We discovered that there are not yet sufficient infrastructures and tools and competencies for using disruptive technologies in higher and vocational education in partner countries.
- The potential to use disruptive technologies for practice-based learning in higher education and vocational institutions is highest in Spain, as other partner countries have significant gaps that hinder the usage of VR, AR, AI in courses.

As part of the general data we asked about the impairment that might hinder using disruptive technologies (see Figure 5). The participants were free to not answer this question. The proportion of the respondents in the sample who do not have any impairment issues to use disruptive technology or who decide not to answer is 89%. The proportion of respondents (11 % of the sample) who noted some health issues that might influence the use of disruptive technology, the most common were vision issues (39%), Motor and balance issues (20%) and cognitive issues (19 %). This information is useful to plan the special needs related appropriations of technologies and learning scenarios.

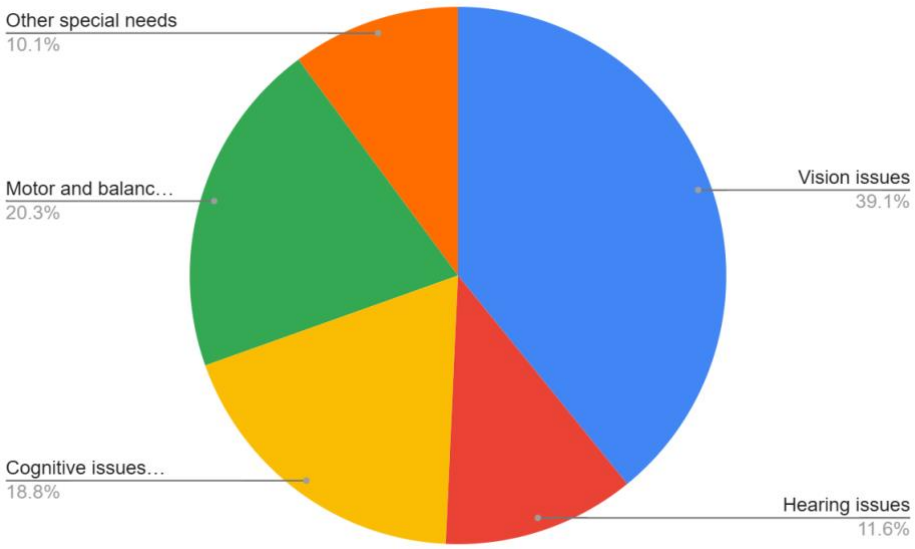

Figure 5. The proportion of respondents who have some physical issues to use disruptive technologies (N=69, 11% of the whole sample)

We analysed with the survey the institutional learning ecosystem capacities from the organisational, normative, learning culture and personal competences attitudes and values aspects. Some important trends were the following:

Infrastructural capacity

- The infrastructures for using disruptive technologies in large scale are yet to be developed in countries and institutions.
- Most of the institutions do not have availability of using disruptive technologies in learning process, mainly experimental approaches have been tested out.
- The costs, FAIR principles and sustainability issues must be regarded when designing in countries and internationally the learning resources in metaverse and learning support mechanisms with AI and gamification.

Normative capacity

- The higher education system is on the crossroad to decide if to move towards increased e-learning, this decision should be a collective decision agreed upon justified claims how technologies improve learning and approved by different stakeholders in education.
- There is an unused potential to create normatives and regulations that promote sharing of the disruptive technologies across education-industry borders to be more sustainable and aligned in how and why we use certain technologies in the society.

Learning culture capacity

- There is a gap between how the technology specialists, lecturers and students perceive the readiness to use disruptive technologies for learning.
- The opportunities of lecturers and students to learn the skills to use and design learning scenarios with disruptive technologies can be extended towards more hands-on cross university-industry forms.
- The learning situations can be moved towards more authentic problem based collaborative practices, the potential of disruptive technologies supports authenticity, but is yet rigid in concerns of collaborative practices.

Personal capacity

- The lectures, specialists and students do not yet have sufficient skills to develop and use disruptive technologies.
- There are rather positive but not evidence-based beliefs about the values of disruptive technologies for learning among the higher education institutions.
- The concerns to using disruptive technologies in education are not prominent among the specialists, teachers and learners.

Learning design recommendations for practice-based e-learning with disruptive technology support

The report D 2.2 provided general suggestions that e-DIPLOMA project should follow when designing learning modules with disruptive technologies for experiential practice-based e-learning. We generalised from the research papers the design elements for learning scenarios with disruptive technologies.

- Develop authentic situations for transfer, provide anchored elements (concepts, scaffolds) (Cognitive)
- Be presentation mode specific: Do not use the overlay text features, control buttons that simulate 2-D or analog situations (Cognitive and Psychomotor)
- Consider the position of the learner in situations, the mediateness of control over learners' body and movement (Psychomotor)
- Consider that the distribution of objects in 3D space may cause attention and navigation issues with objects (Cognitive and Psychomotor)
- Use instructions that provide several interactions types between agents-contents-objects-technology (Cognitive)

- Focus on student-centred learning models (Metacognitive)
- Increase the level of student agency in a practice-based learning with disruptive technologies (Metacognitive)
- Provide the interaction opportunity with the other agents or with the situations to receive feedback and scaffolds (Metacognitive, Cognitive, Affective)
- Use in designs the social learning aspects in the forms of collaborative learning (Affective)
- Develop opportunities for the learner adaptation to the situations, provide adaptive to the learner interactions, learning contents or scaffolds (Cognitive, Metacognitive)
- Make use of the motivation management with gamification elements, avatars, authenticity, interactivity (Affective)

We suggest that these design principles should guide the development of e-DIPLOMA learning modules in the next project phases. The deliverable empowers the next phases of the e-DIPLOMA project codesign of e-learning modules with disruptive technologies.

Conclusions

This research report opened up several gaps in planning practice-based learning with disruptive technologies. e-DIPLOMA project research with the development of e-learning modules with disruptive technologies for experiential practice-based learning will make an attempt to use the learning design elements and enhance the capacities for learning with disruptive technologies in institutions. Drawn from the analysis of extensive literature, value focused workshop results and institutional capacity survey, we can say that we already know some aspects of learning and teaching with disruptive technologies, however, a lot of research and interventions studies still need to be carried out to understand the specifics, the nature and added value of disruptive technologies in education. Nevertheless, we have managed to provide some guiding design considerations for initiating the next step of the e-DIPLOMA project.

The project will plan in the next steps which learning effects to measure during the learning scenarios with disruptive technologies, and which cognitive, affective, metacognitive and psychomotor and behavioural learning outcomes each learning module should target. We see the need to explore the collaborative dimensions of practice-based learning with disruptive technologies, since the design approaches, learning effects and learning outcomes at interpersonal level are less known.

References

Hannafin, M. J., Land, S. & Oliver, K. (1999). Open learning environments: foundations, methods, and models, in: C. M. Reigeluth (Ed.) Instructional design theories and models: a new paradigm of instructional theory (vol. II) (London, Lawrence Erlbaum Associates), 115–140.

Hill, J. R., & Hannafin, M. J. (2001). Teaching and learning in digital environments: The resurgence of resource-based learning. Educational technology research and development, 49(3), 37-52.

Väljataga, T. (2010). Learner Control and Responsibility: Expanding the Concept of Self-direction in Higher Education. Tampere: Tampere University of Technology.

e-DIPLOMA

Funded by
the European Union