An IDEA for design pedagogy: Devising instructional design in higher education 4.0

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Abstract
The purpose of the present study is to constitute a basis for integrating instructional design into higher education 4.0 curricula, aiming at a design pedagogy approach. A conceptual model including the prominent concepts and characteristics of this distinction is suggested with rationales from recent literature. The proposed Instructional Design for Educational Actuality (IDEA) Model uses the dynamics of instructional design and curriculum development processes for higher education and suggests a continuous evaluation and revision procedure. Centering the attention on design issues, the study seeks to advocate for the use of technology in all applicable phases of instructional design process, as is in education 4.0 contexts. Design, development and implementation are the crucial phases of this process, since a design pedagogy approach is followed. The rest of the process, namely analyze and evaluation phases are also subject to design pedagogy, however they are quite individualistic and require a personalized approach. Following technological applications of a symbiotic relationship between instructional design and design pedagogy in higher education contexts, the study ends with a series of implications on stakeholders' roles, concepts-technologies and pedagogical motives.

Keywords:
design pedagogy, instructional design, education 4.0, curriculum development, higher education.

Introduction
The world encounters a global health situation, and in these pandemic times education at a distance is a more powerful alternative than ever before. As learning moves from face-to-face to online, design issues are raised for pedagogical contexts. In this process, the need for an instructional design (ID) policy somehow becomes a compulsory attempt for many countries, as an obvious rapid prototyping model. While people stay in their homes, a tremendous tendency for an instructional immigration takes the stage at the same time. As the ways we retrieve information and transform it into knowledge evolve, many opportunities and challenges come to the fore. For both of these aspects, knowledge-based technological approaches are the prominent concerns since our perceptions of design are changing every day. These changes require revisiting design issues and e-learning pedagogies in different contexts.

Conole (2014) described four categories for pedagogies of e-learning. The first category is called *Associative*, and mainly focuses on traditional associative and reinforcement-based instruction, centring on the individual. *Cognitive* is another category that makes e-learning dynamic, task-based and tries to scrutinize information. *Situative*, the third category gives importance to social presence and interaction, and a self-paced learning. Finally, the last category, namely

Connectivist is a tribute to Siemens' (2004) theory of Connectivism, and advocates a networked learning, specified links for a learning organization and engagement. As a particular type of connectivist and cognitive approach, Grodotzki, Ortelt & Tekkaya (2018) aimed to develop, introduce and evaluate remote and virtual laboratories into higher engineering education. A tele-operative material characterization testing cell was conceptualized and implemented, along with a remote lab for incremental tube forming. Moreover, a Massive-Open-Online-Course (MOOC) was created to make further use of remote labs, and a virtual experimentation lab was developed. At this point, connectivist approaches come to the fore. According to McGreal and Siemens (2012), students in a connectivist MOOC typically perform four activities:

1. Aggregate: Students are asked to pick and choose the content that looks interesting to them and seems to be most appropriate according to their personal learning goals from a wide range of information spilled on the Internet.
2. Remix: Students keep track of the information items they accessed by using any tool from lists offline on their computers to online blogs, Twitter, or the like.
3. Repurpose: Students describe their own understanding of the material they aggregated and remixed before and thereby create new knowledge based on already existing materials.
4. Feed Forward: Students share their thoughts and understanding on the Internet with other course mates and the world at large.

The *Feed Forward* activities here require serious planning and infrastructure. With a similar understanding, both online and offline educational activities require a comprehensive curricular groundwork. Among these, ID can be regarded as the factory floor of many curriculum design efforts.

A well-known ID model, namely ADDIE (Analyze-Design-Development-Implementation-Evaluation) experienced many changes in nearly forty-five years' time. The model was first created for the US Army (Branson et al., 1975) and like many similar processes, continued with organizations and finally educational institutions. Another conception for the model is called instructional systems design, which was first echoed by Watson (1981). Figure 1 summarizes tasks for each model phase:

Analyze	Design	Development	Implementation	Evaluation
•Needs analysis •Task analysis •Institutional analysis •Determining educational priorities	•Stating the objectives •Developing tools for measurement and evaluation •Creating audiovisual equipment	•Writing out lesson plans •Preparing the textbook •Preparing the teachers' guidebook	•Creating a work schedule •Setting the environment •Creating the budget •Training the trainers	•Formative assessment •Revisions •Summative assessment •Future insights

Figure 1. The ADDIE model

Every subphase of the model can be subject to technology integration and the role of an instructional designer here is important to characterize a framework for instructional efforts. The success of these efforts also relies on a comprehensive ID teamwork. The following top-ten-skills were announced by the World Economic Forum (2016) as a forecast for 2020 within the context of industry 4.0 era, which can be also matched with the expectations from an ID team:

- Complex problem solving
- Critical thinking
- Creativity
- People management
- Coordinating with others
- Emotional intelligence
- Judgment and decision making,
- Service orientation,
- Negotiation
- Cognitive flexibility.

An ID team may consist of instructional designers, ID specialists, online learning support specialists, instructional technologists, multimedia designers and/or specialists, researchers, web application developers, teachers, students, measurement and evaluation specialists and many other members with respect to scope and context of the design work. Distinct technical staff are needed and added to the team for the purpose of meeting the above mentioned skills in many cases. Moreover, industry 4.0 understandings require an Internet of Things (IoT) based implementation, which should be originated from a comprehensive analysis of both technology and end users. These analyses provide a good background for educational realities and pedagogical purposes, since more socio-semantic versions of web based education remain on the agenda.

Recent studies expose a tendency to big data analytics, artificial intelligence, augmented reality, cloud computing and internet of things (Ellahi, Khan & Shah, 2019), factors affecting the industry 4.0 adoption in the curriculum of university students’ occupation relevance, skills, facility conditions, and social influence impacted on the intermediates variables, namely, relevance advantage, perceived usefulness, behavioural intention-to-use, and actual use (Nguyen & Nguyen, 2020). In the relevant literature, the main components defining education 4.0 are open access, individualized education, mental transformation, integration of digital technologies to education seamless learning environments, lifelong learning, exploratory education and multidisciplinary education (Himmetoglu, Aydug & Bayrak, 2020). For the experiential aspects of these concerns, Knowlton (2016) highlights design studios’ role in transforming instructional design and technology because of the continuous use option of studio classes. This option is also important for education 4.0 understandings since they support the use of different types of technologies in the relevant contexts to enhance learning experience.

As an obvious rationale for this study, Tracey and Boling (2014) touch upon a need for descriptions and models for aspects of designing in the field that move beyond process to describe designers and design teams, the individual activities and tools of design, and the mechanisms of invention. On the other hand, Drysdale (2018) investigates how organizational structures influence leadership over online learning initiatives for dedicated instructional designers in higher education. The results show that decentralized dedicated instructional designers experienced significant disempowerment, role misperception, and challenges in advocacy and leadership, while dedicated instructional designers with administrative reporting lines experienced a high level of role misperception specifically related to technology support. Positional parity between dedicated instructional designers and faculty, in conjunction with implementation of the recommended organizational structure, was found to be critical to empowering designers to be partners and leaders. Moreover, Fredericksen (2017) points out that instructional designers are not widely recognized as leaders, formally or informally, due to challenges in staffing, role perception, and scalability of resources for instructional design teams. In one sense, these realities make their role more important since the rising need for online learning specialists and initiatives is becoming a current concern in these pandemic times.

Purpose of the study

The purpose of the current study is to propose a conceptual model for instructional design efforts in an education 4.0 context, with a design pedagogy approach. The following research questions are sought to be answered:

1. What are the main pedagogical motives for devising instructional design in a higher education 4.0 context?
2. What purpose does instructional design serve for educational agendas and curriculum development?

From an education 4.0 viewpoint,

3. what is the main structure of ID integrated design pedagogy?
4. which technologies are offered to be used in an ID integrated design pedagogy procedure?
5. who are the stakeholders of an ID integrated design pedagogy process?
6. what are the implications for an ID integrated design pedagogy practice?

Significance of the study

Integrating design pedagogy and instructional design is a new and interesting concern, with an education 4.0 understanding. The specific idea of this study is that providing a strong education 4.0 practice lies in a comprehensive ID work, which fits a design pedagogy approach. Moreover, the absence of methodology for the ID oriented design represents a gap in the current literature. The study makes a useful contribution to the existing design pedagogy literature with an ID viewpoint.

This study also provides a series of implications regarding stakeholders and pedagogical motives for a current ID-based education 4.0 practice. In this sense, it may hold significance for instructional designers, researchers and also education policy makers. Instructional designers may benefit from the ID team suggestions while selecting from a wide variety of possible stakeholder groups. Researchers may use the pedagogical motives and the whole model as a starting point for applied researches, and education policy makers may benefit from the study to monitor education 4.0 in a more comprehensive way.

Methodology

According to Miles, Huberman & Saldana (2014, p. 20), “A conceptual framework explains, either graphically or in narrative form, the main things to be studied and the presumed interrelationships among them”. As a graphical part of this understanding, the present study unpacks design pedagogy, instructional design and education 4.0 concepts to propose a conceptual model for today’s digitalised education. A systematic literature review was conducted on these three concepts, and the following phases were realised throughout the research process:

Phase 1: Conduct a systematic literature review for the current state of the prominent concepts,
Phase 2: Determine recent existing models and frameworks touching upon the idea for integrating ID, design pedagogy and education 4.0,
Phase 3: Seek for a recent model for design pedagogy to integrate ADDIE and education 4.0 centred curriculum,
Phase 4: List the stakeholders for an ID integrated, education 4.0 process aiming at a design pedagogy approach,
Phase 5: List the pedagogical motives for a new conceptual model,
Phase 6: List the most recent technologies suggested for technology mediated education, or digitalised education,
Phase 7: Constitute the new conceptual model and
Phase 8: Pose and discuss the implications for current design pedagogy practices.

For the Phases 4, 5 and 6 the studies in the systematic literature review were grouped with respect to the interrelationships among them. Such methodology helped not only support the model, but also take a closer look into it to pose implications. The following sections present the rationale for integrating design pedagogy, education 4.0 and ID processes with the help of relevant literature.

Design pedagogy

Design pedagogy is a primary knowledge-based approach that bridges technology and pedagogy and poses various opportunities to lead the way for educational technology. One of the earliest uses of the concept of design pedagogy was echoed by Deamer (1999) in accordance with studio pedagogy. Compared to typical classroom scenarios, studios are active sites where students are engaged intellectually and socially, and evaluative modes of thinking in different sets of activities (Dutton, 1984). A similar and newer conceptual approach can be visited within the context of technological pedagogy knowledge which is a component in technological pedagogical content knowledge (TPACK) framework (Mishra & Koehler, 2008). This type of knowledge focuses on the technological foundations and also outcomes of pedagogical efforts, and can be addressed in a philosophical manner, independently of content. However, this is controversial, and in fact a challenge for ID issues since the ID is a standalone process, with no distinction.

Design Pedagogy is originated from Design Thinking (Brown, 2008) and Design-Based Learning (DBL) and provides a look from the learner side of this pedagogical approach. Camburn, Mignone, Arlitt, Venkataraman & Wood (2016) describes some key ideas for DBL:

- Adapt and adopt a Design Innovation or Design Thinking process that is age appropriate, ensuring an environment of creative and innovative opportunities, also open-ended problems,
- Implement a 4D (Discover, Define, Develop and Deliver) Design Pedagogy in the curriculum within and across core subjects,
- Create physical classroom and learning environments encouraging design and creative projects,
- Design and include epitome and capstone projects allowing students to integrate and extend learnings,
- Connect with upper-level programmes and industry for outreach programmes, facilitators, and mentors to initiate and sustain DBL
- Start small and grow a DBL programme across subjects, courses, terms, and co-curricular activities.

Determining learner characteristics is among the most important concerns in a DBL context. Such approach provides information on potential designers' cognitive and psychosocial background which serves as learner analytics for both curriculum and ID.

There are a number of distinct studies touching upon different aspects of design pedagogy and design-based pedagogy (DBP) in a qualitative manner. Exter, Gray & Fernandez (2019) aimed to explore the similarities and differences in the meaning of design for eight faculty members of different faculties. Design definitions included common themes, namely creation of something new, human-centred design focus on problem framing over solution development. The participants were reported not to agree with a strong relationship between design and problem solving and scientific reasoning. Another notable result from the study is that instructional alignment is an important consideration in designing a transdisciplinary learning experience. Since design is an umbrella term and should not always be ascribed to a profession, a number of realities come to the fore for non-designers. Royalty (2018) conducted a study by surveying 27 educators who are non-designers but practice DBP and asked them about the variables they manipulate while creating learning experiences. Then three widely known learning environment frameworks, namely Instructional Design Framework for Authentic Learning Environments, Constructivist Learning Environments and Educause Learning Space Rating System, were compared with DBP. The results of the study show that DBP is more robust than the three frameworks and has a potential in order to have more control over the experiences. Moreover, variables of tone, fun, food, budget and size of class were found to have no connection with the frameworks. DBP is realized to have a standalone strong structure, but sensitive to size of classes. In another descriptive study (Anu, Jorma & Sinikka, 2013), design-oriented pedagogy (DOP) approach was realized through a case study, with 32 multi-age students (aged 6-12). Storytelling videos were analysed and an emerged learning ecosystem was examined. The results showed that inquiry-driven learning tasks and afforded learning resources guide students to search for strategic types of knowledge to understand the given phenomena and communicate their study processes. The learning ecosystem that emerged in the study includes information resources, technological resources, community resources and an open learning task, each constituting a symbiotic pair with any phenomenon.

Apart from the qualitative studies above, some studies directly focused on field-dependency issues, centred design and did not aim to produce quantitative or experimental data. Acharry, (2014) suggested art-supported and engineering solutions for converting both learning content and technology from 2D to 3D, for pre-engineering students. This solution included four learning stages. An instructor gives a basic lecture on basic art composition with examples from engineering design applications, illustrates architectural model making, assigns students to design 2D works of art, and finally carries out 3D pieces of civil engineering conceptual models. Also, this comprehensive method ends with building up 3D mass models and test process was realized through in-class experiences. With a general outlook on the whole process, such methodologies seem more capable of combining theory and practice. Similar results were found in a study of contemporary art and design practice (Page, 2012) which aimed to enable both beginning teachers and post-age-16 pupils to work together for developing new approaches and strategies within the context of in-class activities. For beginning teachers, the study reported that they have had their identities constructed as artists and designers, and if these two identities are supported, modelled, explored and created beginning teachers' *artist* identity turns into *artist-teacher* and also *learner*.

From an Education 4.0 perspective, a design pedagogy understanding basically constructed on creating cutting edge technologies and also concepts which can be exemplified as cybernetics, robotics, machine learning, big data, nanotechnology, artificial intelligence and global citizenship. More clearly when thinking design pedagogy with education 4.0, concept learning is not centred and a productive pedagogy accompanied by active learning processes is preferred. In one sense, encouraging creativity and design is far more important here. As is known, a higher education student is expected to show an acceptable level of abstract reasoning, creativity and design motivation. Among these, creativity is a primary concept which is used in devising design pedagogy for higher education, and its facets are depicted in Figure 2:

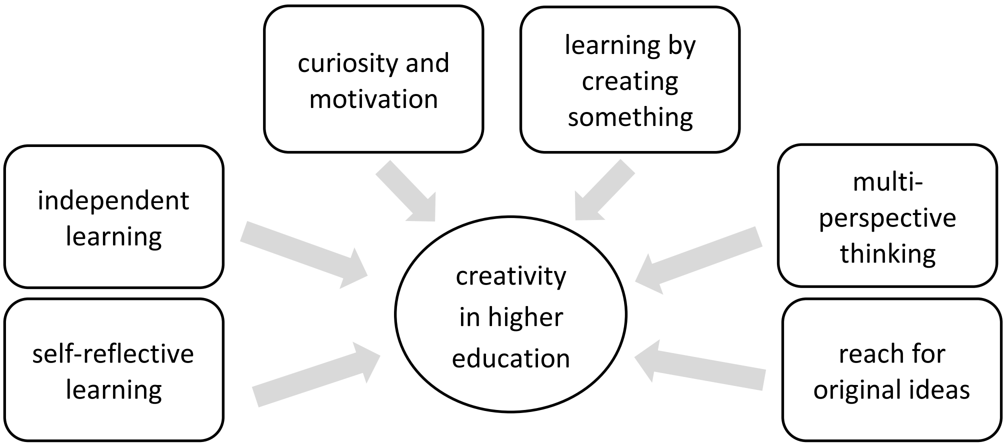


Figure 2. Six facets of creativity in higher education (Terkowsky & Haertel, 2013, p.15)

Multi-perspective thinking leads to multitasking and today each task can be learnt independently. Open and distance education, video lectures and virtualized-adaptive course content which are accessible from all around the world bring out a new learning type that one can call a self-paced, modular learning. Following a design thinking process is crucial here for instructional designers, since non-linear learning occurs during the implementation phase. As the responsibility level of the learners increases, more stable, up-to-date, standardized and interestingly flexible courses are needed, especially for design-based curriculums. Although the term persuasive technology was put into words nearly twenty years ago (Fogg, 2003), the need for changing attitudes and beliefs rises and persuasion has become a standing factor.

Education 4.0 from an instructional design perspective

Innovation interruption that produces education 4.0 that focuses on educational development and skill has made future learning more customized, hyper, intelligent, portable, worldwide and virtual (Shahroom & Hussin, 2018). Education 4.0 offers cutting edge technologies for a digital education, as echoed in this conceptual model. This new face of learning requires a comprehensive system adaption for all countries aiming at innovation. In a recent European Commission report on digital education (Conrads, Rasmussen, Winters, Geniet & Langer, 2017), the following key design principles were addressed for effective system policies:

1. Follow a holistic approach targeting systemic change,
2. Establish both a long-term vision and short-term achievable goals,
3. Deploy technology as a means not an end,
4. Embrace experimentation, risk-taking and failure,
5. Consider the importance and the limits of impact assessment,
6. Involve all stakeholders in a structured dialogue,
7. Let schools and teachers have a say, and
8. Build up teaching competence.

In the similar vein, Gunn (2019) raised a debate for design education in higher education and questions whether it is an academic profession or all about vocational education. In fact, this comparison is about ID processes and particularly implementation phase shows the prominent clues for taking a side. More clearly, an ID team answers this question with their efforts in the field in case the team undertakes both of these professions. Another potential application for implementation phase is constituting digital ecosystems, particularly for e-learning. Recent developments give an impression of a flipped version of learning, with more out-of-school activities.

Digital representation of factory in real time, horizontal integration, data analysis of vertical integration and self-controlling manufacture and logistic are the four stages described for the implementation phase of education 4.0 (Benesova & Tupa, 2017). Digitalization is a key factor in integration and automatization of educational processes for industry 4.0 and opens the gate for implementation practices in a possible ID policy. Also, as Schwab (2018) mentioned, digitalization serves for a possible globalization era after these fourth versions. These digitalization efforts may include both the educational materials and training types for the actors in the continuum. Digitalization ensures data classification and coherency if a comprehensive scheduling and data entry procedure are followed.

Hussin (2018) suggests recording and editing audio clips, creating engaging video content, using social networking sites to discover new content and grow professionally, using blogs and wikis to create participatory spaces for students, creating engaging presentations, digital portfolios and non-traditional quizzes as the digital skills for education 4.0 instructors. Creating and using virtual and augmented reality, can be added to this list, considering the recent developments in educational technology and also changing expectations from teachers. Also not only creating and using the mentioned technologies are important in education 4.0. Supporting student success is also another prominent factor for the implementation phase of the ID processes, as can be seen in a study conducted by Ciolacu, Tehrani, Binder & Svasta (2018). In this study, an early recognition system was developed and predicted the final score of the students before they take the final examination. The study presents artificial intelligence support as a notable Education 4.0 example. Similarly, focusing on student success in pre-college electric engineering education, Chou and Feng (2019) conducted a quasi-experimental pretest posttest design to investigate how tablet computers influenced learning and success. The results of the study showed that the instructional effectiveness was the same, regardless of whether they used tablet or laptop computer. However, those using the tablet computers achieved greater learning improvement. Similarly Karim, Abu, Adnan & Suhandoko (2018) found that most of higher education believe that mobile devices can help them in learning. The study shows that the students mostly use mobile devices for activities such as discussing course content with classmates, asking classmates questions and exchanging ideas about in-class materials.

Considering the fact that distinct examples of design require more steps and stakeholders, this time education 4.0 produces two sub-concepts, namely learning factory and teaching factory. Mourtzis, Vlachou, Dimitrakopoulos & Zogopoulos (2018) presented a good example of a teaching factory work, which aimed to construct a radio controlled-electric car. Three phases were followed for reaching the final version of the factory work:

1. Participants get to interact with their design, examine it detect any flaws that could drastically affect the final assembly and the functionality of the final solution.
2. The parts of the remotely controlled car are manufactured. Based on their designs, the participants are called to simulate and schedule a production line that will be manufacturing the designed product.
3. An assembly procedure of the final product is realized in two parts. The first part is performed with the aid of a robotic arm, under the human-robot collaboration framework. This process is done also with the help of augmented reality googles. Then a group work is conducted to collect data for the digitalization of the whole process. Finally, each group tests the produced radio-controlled electric car, testing it in a sequence of trials. With all of these efforts, participants acquire a set of highly useful skills that will support their integration in manufacturing.

Apart from teachers, another crucial education 4.0 stakeholder is academicians. Ishak and Mansor (2020) investigated the relationship between knowledge management (KM) and organizational learning (OL) with academic staff readiness for education 4.0. Results showed that both KM and OL had a significant, positive but weak relationship with academic staff readiness for education 4.0. Capturing knowledge in KM and informal learning in OL are the only predictors for the readiness of the academic staff.

In a recent qualitative study on the role of games, gamification and industry 4.0 tools in education 4.0 (Almeida & Simoes, 2019), 25 case studies of innovative projects in Portuguese higher education institutions were analysed. The results showed that serious games and gamification approaches only appeared in less than 20% of the projects. Stakeholders were teachers, students, university managers and other multidisciplinary fields. A limited number of studies used robotic, video-conference, augmented reality, simulation, cloud computing and system integration. When examined in more detail, the case studies that used the mentioned technologies reported challenges and difficulties especially for little involvement of participants, lack of documentation and simplification of the real world. As can be seen in the study, every innovation has its strengths and weaknesses. Lawrence, Ching and Abdullah (2019) aimed to discuss the strengths and weaknesses of education 4.0 in the higher education institution. Interviews and focus group discussions were addressed and the results of the study showed that education 4.0 creates an opportunity for educators to engage in new technological tools and it promotes the development of technology classrooms to 21st century skills. On the other hand, weaknesses were reported about the role of technology in disconnecting learners from the real world, and a high resistance to adapt and use the education 4.0 technologies due to a belief that these will limit the engagement and involvement of both educator and the student. A comprehensive example for overcoming the claims about these weaknesses, motivation and interaction variables came to the fore. Recent years show a rise in the use of response systems for the motivation problems in education 4.0 applications. However, especially clickers, which are used as remote controllers in these systems, have their own benefits and also disadvantages, as echoed by Stehling, Bach, Richert & Jeschke (2012) in Table 1.

Table 1: Benefits and disadvantages of clickers

	Student	Lecturer
Benefits	interaction without fear of compromising oneself	identification of knowledge gaps
	immediate feedback	identification of shortcomings of the lecture
	checking learning outcomes	student engagement
	be an active participant in class	keeps students focused and involved
	anonymity	higher attendance
	enhancement of learning	better control of the learning progress
	classroom experience more enjoyable	-
Disadvantages	equipment/software functioning	clicker questions take up time pre and during class
	equipment accessibility	the implementation itself costs time and money
	costs occurring when only option of contributing for the student is a text message	equipment/software functioning
	-	diversion by using technical devices in class

As can be seen in Table 1, there are more benefits than disadvantages and these technologies can be accepted and integrated in many instructional contexts. However, technological design and sustainability may become a serious concern when at least mid-tech design issues are not followed (i.e. web support mechanism, database and log management). In recent years anonymity arises, particularly in the Web, and therefore instructional environments will be subject to this new understanding. In fact, prioritizing this need may be beneficial for instructors in the meaning of focusing on the learning outcomes and instruction, independently of student characteristics.

Devising instructional design for curriculum development

According to New Media Consortium's Horizon Report (EDUCAUSE, 2017), 2021 and 2022 were predicted to be important years for robotics and mixed reality, and 2019 Report (EDUCAUSE, 2019) underlines artificial intelligence, blockchain and virtual assistants the most. In fact, all these topics are popular recently, because of the changing needs and beliefs in both learning and teaching. From a robotics perspective, coding and algorithmic thinking are the two crucial point to be addressed. An authentic process should be followed for coding since there are obvious examples in everyday life, like poetry and sign language. A second-order version of this process is customizing these examples for course contents. More clearly, describing only the concepts of variable, character, object and applying them for coding will not be enough for possible robotics work. Such instructional attempts can be described as constructivist in philosophy, but behaviourist in the lesson. From all reasons above, a systematic, ID-based procedure has the potential to meet theory and practice.

Standardized ID processes are crucial for a sustainable curriculum design in an Education 4.0 context. Standards are not only important for ID itself, they are also important for stakeholders. Shahroom and Hussin (2018) touched on changing landscapes about education 4.0, which are also important for the ID process. These are drawn up as changing landscapes of employment trends, technologies, students' attitude and behaviour and demands. Similarly, Coskun, Kayikci & Gencay (2019) proposed a framework that focus on curriculum, lab preparations and student clubs for adapting engineering education to industry 4.0 visions.

The OECD Learning Framework 2030 (2018) offered a vision for the future of education systems and environmental, economic and social challenges are reported for societies. Individual and societal well-being are central for the shared vision, and digital literacy, health literacy, data literacy and numeracy that are offered for students. Moreover, common concepts for stakeholders are reported as taking responsibility, reconciling tensions-dilemmas and creating new value. A 2030 vision is declared also by UNESCO (2017). A framework of future competencies is developed and seven stable competencies are listed as follows:

1. Lifelong learning
2. Self-agency
3. Interactively using diverse tools and resources
4. Interacting with others
5. Interacting in and with the world
6. Trans-disciplinarity
7. Multi-literateness

In the same framework, competence is claimed to be more complex than skill and that it comprises knowledge, skills, values, and attitudes. The most recurring examples that were reported include:

- Creativity, communication, critical thinking, problem solving, curiosity, metacognition
- Digital, technology, and ICTs skills
- Basic, media, information, financial, scientific literacies and numeracy,
- Cross-cultural skills, leadership, global awareness
- Initiative, self-direction, perseverance, responsibility, accountability, adaptability
- Knowledge of disciplines, STEM mindset.

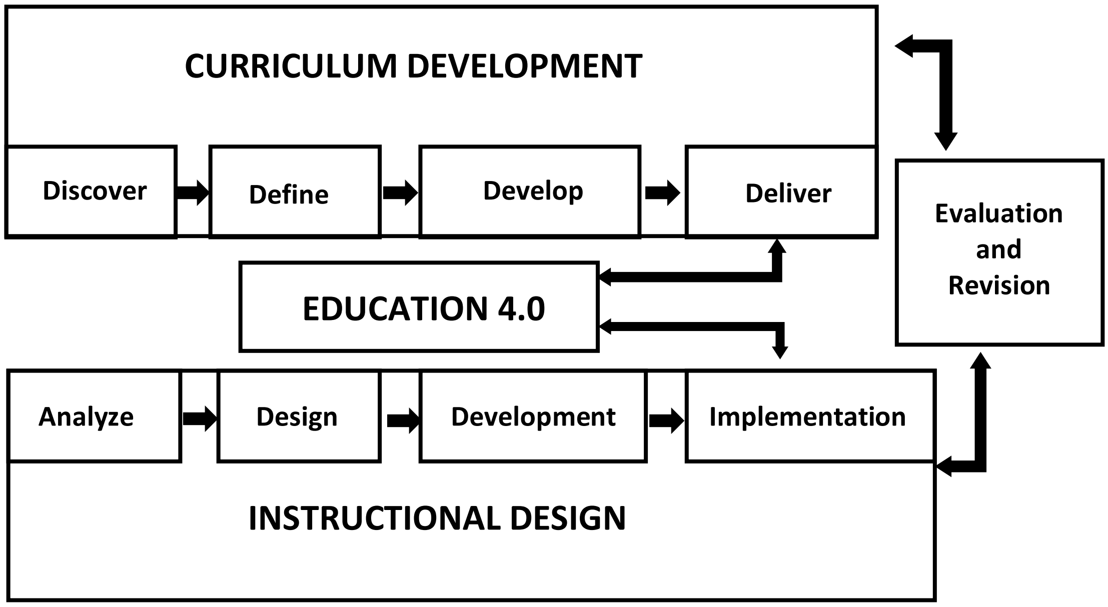
The above examples show that not only cognitive skills affect competencies, and affective processes should be approached in different cases, from a single course to curriculum scale. In an example of these efforts, Kaplan (2017) aimed to create a short course for teacher training, which provides an overview of issues and theories in technology and education and guides participants into integrating issues and theories into lessons, policies and technology creations. Module 5 in the course content included teaching and learning by design and problem and case-based learning. Lesson plan and project design are the two main tasks in the module and this model is important since planning and project design are also crucial in ID processes. In addition, STEAM can be added to STEM mindset, to improve designing minds (Keane & Keane, 2016).

Wark and Ally (2020) proposed an emergent technology integration framework and draw attention to assisting stakeholders in identifying, selecting, and designing educational contexts that cohesively and coherently bind theory with practice from more than one paradigmatic stance. This approach may be quite beneficial for both integrating technology itself, and also for project design as in Kaplan's (2017) proposed course. The proposed Paradigm Shift Framework included reflection phase for behavioural or pedagogical processes, and when a critical reflection gains currency, shifting and an andragogic approach is followed. Finally, for a perceptual or heutagogic approach reflexivity is a prominent understanding. The framework advocated a shift between teacher-directed instruction and learner-determined learning. In a similar vein, Boitshwarelo and Vemuri (2017) proposed a conceptual learning design framework called *The Curriculum-pedagogy Alignment Framework* for contemporary learning environments. The framework aims to bridge between four considerations, namely epistemological, pedagogical, implementation and review. Epistemological considerations included knowledge types (declarative, procedural, contextual, metacognitive and created) and learning processes (acquisition, application, reflection, creation). Pedagogical considerations included pedagogical approaches, strategies and media. Implementation considerations included didactic, activity-based, authentic, complex-dynamic and open-ended learning environments. Finally, review considerations included self-evaluation, student evaluation, peer evaluation and evaluation on the basis of student performance.

A conceptual model

The proposed Instructional Design for Educational Actuality model, or its abbreviated form IDEA prioritises instructional design as a factory for curriculum development, from pedagogy to education. (see figure 3) Educational actuality refers to recent developments and understandings related to educational realities, and an instructional design team is expected to have skills not only in subject or field knowledge, but also multiple literacies to solve current problems. The model focuses on three main dimensions: 1) Choosing the most suitable pedagogical motive for curriculum development 2) Devising ID for curriculum development 3) Delivering education 4.0 outcomes in the field. Design pedagogy is used as an umbrella term for the model, in common with many design & development models. Moreover, pedagogical motives, stakeholders, concepts and technologies were included in order to depict the scope of the model.

Pedagogical motives were selected among the last twenty years' constructivist pedagogies. The rationale for selecting such approaches is that they all serve creativity. The Curriculum Development phase is implemented through aforementioned 4D Design Pedagogy, which is echoed by Camburn et al. (2016). Four phases namely *discover, define, develop and deliver* are used both for the most suitable technology and pedagogical understandings. The rest of the curriculum development process is realized through ID mechanism. Ever so, design pedagogy serves as a bridge between each phase of ID, since the subphases may also require pedagogical design. Finally, education 4.0 structures receive the outcomes that the proposed model produces, and these can be content, tools, mechanisms, procedures and even ideas for integration. In other words, the term education 4.0 should not only be ascribed to specific technologies and should be approached more broadly.



PEDAGOGICAL MOTIVES

- Design pedagogy
- Studio pedagogy
- Productive pedagogy
- Dialogic pedagogy
- Active pedagogy

CONCEPTS & TECHNOLOGIES

- Cybernetics
- Robotics
- Machine learning
- Big data
- Nanotechnology
- Artificial intelligence
- Mixed reality
- Global citizenship

STAKEHOLDERS

- Students
- Instructional designers
- Instructional design specialists
- Online learning support specialists
- Instructional technologists
- Multimedia designers
- Researchers
- Web application developers
- Measurement and evaluation specialists
- Teachers
- School heads
- District administrators
- School boards
- Parents
- Artists
- Craftsmen
- Engineers

Figure 3. The Instructional Design for Educational Actuality Model

Discussion and implications for current practice

The literature gives a clear impression of a grey zone for technology types and expertise issues in many technology-mediated education studies. First of all, using technology in all applicable phases of an instructional design process raises a debate for making a clear classification of technologies. As a matter of fact, for the implementation and delivery phase of this model web 2.0 platforms may create an uncertainty for medium & media debates on the roles, functions and capabilities of distinct technologies in learning, since it is difficult to determine which one is the current concern in today's technology integration ideas. Although most of the concepts-technologies in this model are in media category; cybernetics, nanotechnology, and robotics should not be evaluated independent from medium. From a medium viewpoint, web-based platforms can be used as a medium to integrate them into a specific field. This reality makes both instructors and students show an extra effort to learn these platforms and choose the most suitable one among hundreds of them. On the other hand, a socio-semantic version of web provides a background for both Analyze and Discover subphases of this conceptual model. Because semantic web can be used for stereotype student models so that student characteristics can be stored and updated in a sort of live database. The two concepts in the model namely big data and global citizenship are highly associated with these possibilities. Web application developers, online learning support specialists and multimedia designers take the stage here. For all of these aspects, privacy and security issues should be revisited in platform-based, national and global contexts.

Expertise is another concern for discussion. Managing experts from different fields is a challenge for an instructional designer. To overcome time and management issues an interactional process should be taken into account for education 4.0 contexts. Also, systems engineers can be added to engineers' team for outcome management. Such approach is evaluated within the context of Deliver and Implementation subphases. Some flipped course versions including expert videos may provide good examples for bridging industry 4.0 and education 4.0.

Current lists, frameworks and vision documents show that a more independent, personalized and multifaceted learning is offered in today's digitalized education. The success of the IDEA Model primarily lies in facilitating the interaction among the ID team members, making sure that the students know how to learn a distinct technology with a specific purpose and informing also the students about the pedagogical rationales for a current design-based implementation.

The stakeholders list which is originated from the recent literature, shows the massive design pedagogy family itself. Instructional designers are the central stakeholder in the list. To improve current practice, more student-centred approaches are suggested to be implemented accompanied by an interactional structure. This structure may be an online platform to share both ideas and elements of student portfolios.

For technical staff, a possible ID platform should be supported by visualization and programming features. Accordingly, both designing and reporting should be empowered by standalone, cloud aided and conversational agent-based technologies. Design-based platforms are suggested to contain more interactional structures to share ideas and works.

In an IDEA structure, the main role of instructional designers is to conduct task analysis and manage sustainability issues. To achieve these, they are expected to team with researchers, measurement and evaluation specialists and instructional technologists to maintain evaluation and revision processes.

The technologies echoed under the model can be grouped in an education 4.0 context by conducting a comprehensive preliminary ID work. In a small district, interaction effects may be controlled due to urgent planning. On the other hand, when planned in urban contexts accessibility is an advantage to share industry 4.0 opportunities with smaller districts. From an educational perspective, platforms like Edmodo, Google Classroom and Schoology are sufficient for student-student and student-teacher interaction. Canvas, Moodle and Sakai are also subject to powerful interaction, however they are quite massive and in Edmodo parents can easily be added to the stakeholders group. In smaller examples, Edmodo is more powerful for interaction. These platforms are subject to Discover and Define phases and can be approached within the context of e-learning scenarios. On the other hand, a studio pedagogy approach is more powerful for realizing Develop and Deliver phases, which will serve for creativity. Finally, another group is school heads, district administrators and school boards which can be supported with a service orientation and coordination.

Concluding remarks

Technology is a tool in every integration effort. When considered as a purpose or accepted as a unique reference, it has the potential to overshadow learning. Curriculums processed with this manner may not be successful in training and may focus on programming the learners. On the other hand, technology begins to lose its catalyst role in learning. It is being affected by instructional processes and also by various stakeholders implicitly or explicitly. The fact that technology is used in more phases of ID, design pedagogy and even design based research context does not show that it provides a solution to every problem, but shows that it is used more than the traditional methods.

The fieldwork for design thinking, which is an important component for design pedagogy, is realized through STEM and similar applications. Non-digital examples of coding, programming and algorithms can also be adapted into curriculums to show the basics of symbol systems first. Being implemented independent of these understandings, block-based coding and visual programming efforts will be unable to go beyond memorizing drag and drop logic.

Culturally-aware design is another key factor in design pedagogy. Oral and written culture, or in brief, tradition for training becomes a powerful motive, and culturally-responsive design provides, in a sense, a storyboard for ID efforts. In this sense, it is thought that design styles and efforts should also be brought into the forefront to save curriculum development from a highly cognitive structure. For design education contexts, ID efforts are suggested to focus on *analyze* and *design* phases for the intellectual aspects of design work. Specification of educational priorities, analyzing the target group, stating the instructional objectives, assigning the strategies and creating the audio visual equipment are also technologies, when looked at an intellectual side. All the subsequent ID phases are constructed on this intellectual understanding.

As the IDEA model suggests, integrating ID and design pedagogy requires a serious standardization, task analysis, usability and sustainability praxis. It is a challenge to confront more ID phases to integrate technology and standardize them for education 4.0. Thankfully, this standardization is also an opportunity to better understand the role and timing of technology in pedagogical design issues.

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