IF YOU PLEASE, DRAW ME A RESILIENT CURRICULUM!

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ABSTRACT

The COVID-19 pandemic significantly impacted Higher Education as a whole, and the various educational institutions. It resulted in unexpected circumstances and unavoidable trade-offs to ensure that the curricula became more agile and flexible. Resiliency is also now a cornerstone, in order to navigate the disruptive change with the high levels of volatility, uncertainty, complexity and ambiguity. Ten universities in South-East Asia and three in Europe have since 2018 been engaged in a project aimed at improving the quality of their STEM programmes. In the context of this capacity building framework, this paper outlines a curriculum design workshop to stimulate curriculum transformations for VUCA contexts. The paper shares insights into facilitating international collaboration, which enabled different perspectives and representations of an original curriculum to emerge. The value of online tools as a way of promoting international collaboration and curriculum development is also discussed. The approach is based on a serious games model, to train curriculum designers to better embrace change, to collaborate and work across cultures. It is transferable to locally support the future transformation of programmes, by sharing and challenging ideas. Target participants are University programme leaders, deans, educational quality managers, accreditation bodies, curriculum heads and council stakeholders, as well as partners from industry, and even students. The main objectives and phases of the collaborative workshop are presented, followed by implications and recommendations aimed at developing a Resilient Curriculum framework.

KEYWORDS

Higher Education, Curriculum Design, Cooperation, VUCA, CDIO Standards: 3, 10, 12.

INTRODUCTION

In Science, Technology, Engineering and Mathematics (STEM) Higher Education (HE), Technical and Technological Universities are increasingly faced with the challenges and tensions of developing the competencies and employability of their graduates, which has been further exacerbated by the global pandemic (García-Morales, et al., 2021; Govindarajan & Srivastava, 2020; Mishra, et al., 2020). During the last decade, considerable emphasis has been placed on designing educational programmes and courses to develop the core and transversal skills as capabilities of future engineers and professionals, largely within a stable context. At a more systemic level, it is critical to identify international best practices regarding curriculum transformation processes in the context of a volatile, uncertain, complex and ambiguous (VUCA) world (Krishnamurthy, 2020).

Krishnamurthy (2020:2) argues that the "move to emergency remote teaching due to COVID-19 provides a discontinuous disruption to business-as-usual" and that it is critical to "unbundle and re-invent teaching, learning, assessment and certification". Unexpected disruptions may be particularly relevant for engineering education. For example, several CDIO standards refer to interpersonal skills that rely on direct interaction between students (e.g. Standard 4 on Introduction to Engineering or Standard 8 on Active Learning when considered experiential) and physical workspaces and laboratories (Standard 6 on Engineering Learning Workspaces). The quality levels of these standards, as examples, can easily be impacted due to a crisis, as the recent pandemic is one example, and hence the curriculum designers need to consider and develop a contingency plan for a more resilient educational program that might not be instantly apparent. Marinoni van't Land and Jensen (2020) in their study emphasised "the important degree of stress and constraint currently experienced by higher education institutions around the world. Almost all institutions that responded to the survey are affected in a way or another by the COVID-19 crisis and the crisis has affected all institutional activities… the incredible amount of pressure on higher education institutions to cope during the current crisis and at the same time their resilience and creativity." Taking into account the VUCA and multiple disruptions, STEM curricula in their structures are to become more adaptable, responsive, and resilient.

What could a resilient curriculum (RC) entail? Is it possible to reconcile HE stakeholders with cooperation design, in order to create a common understanding and develop hands-on methods? To address the question of curriculum resiliency, this paper proposes a process to facilitate STEM resiliency curriculum development with collaboration tools for curriculum design, which is largely based on a collaborative workshop, which was designed and run in 2021, with international programme designers, from diverse cultural backgrounds. As part of a European project, our aim was to bring together ad-hoc practices around agile thinking, with tools based on a serious game, from a playful and virtual perspective. The game also brings together sharing, conceptualization and collaboration, beyond the skills of the participants, around the design of agile and resilient curricula.

The proposed collaborative workshop can assist HE institutions to pave the way towards a Resilient Curriculum Framework (RCF), which can also help improve the quality and relevance of their curricula. With an international collaboration perspective, it is to facilitate innovative curriculum design activities, by exchanging or developing new practices and methods, and inspiring and learning from others. The proposed workshop is very much in line with the spirit of CDIO as reflected in its emphasis on integrated curriculum (Standard 3) where Faculty can play an active role in designing, as enhancement of faculty competence for effectively improving curriculum (Standard 10), by creating forums for sharing ideas and best practice.

CURRICULUM AGILITY AND RESILIENCY

Curriculum agility is important when relevant professional disciplines are developing rapidly, as in engineering (Brink et al., 2021). Brink et al. developed a shared vision on curriculum agility, where an agile curriculum is responsive and adaptable to changes in society and business, as well as student characteristics and needs, by having the capacity to change structures, learning outcomes, and learning activities in a timely manner. They introduced nine principles of curriculum agility, which defines or refines the concept of curriculum agility. Agility is perhaps now more than ever an unavoidable property of curricula to meet the transformational challenges of educational programmes in a more continuous manner, due to the various crises impacting the HE sector (García-Morales, et al., 2021; Govindarajan & Srivastava, 2020; Mishra, et al., 2020). In 2022, within the CDIO community, the development of self-assessment rubrics for the agility identified principles is underway for three clusters: Curriculum Vision & Strategy, Curriculum Quality & Provision, and Curriculum Design & Research principles. These rubrics are to support programme leaders in assessing the agility of their curricula to support the change processes in a common maturity scale (cf. CDIO standard 12).

The 2020 pandemic emphasised the need for curriculum flexibility and agility at all educational levels. There is also growing interest in system-level resilience within the 2030 Agenda for Sustainable Development[1]. According to IROWH (2016), the word "resilience" comes from the Latin verb "*risalire*", which means to rise again (to bounce back). A resilient community is able to cope with change, and retain its structures and functions after disturbances in order to keep up with continuous development. Resilience. Some HE programmes were particularly resilient for the pandemic, as for a University of Bristol programme which implemented a new curriculum in undergraduate Engineering (Berthoud et al., 2021). With a process of developing programme-level intended learning outcomes, followed by a process of linking the content and assessment of the programmes to focus on these learning outcomes, it resulted in a simplification of the structure of their programme along the pandemic. Flexibility and diversity of content delivery methods allowed teaching to large cohorts in a variety of situations due to changing restrictions thanks to the constructive alignment approach.

Curriculum development and collaboration in curriculum design require a change in mindset in VUCA contexts. HE curriculum designers and Faculty need to be able to embrace change, and be immersed in and able to cope with perturbations. It is important that they are more adaptable, cooperative, innovative, able to collaborate and work across cultures.

SOURCES OF INSPIRATION

The curriculum design workshop was mostly inspired by two sources. These are relevant examples of serious games, which facilitate stakeholder collaboration and cooperation to help identify alternative strategies and structural solutions. First, University of Utopia is a serious collaborative game intended for HE teachers (Laplanche and Escrig, 2019). It allows pedagogical concepts presented via concept cards to be transferred to teaching situations defined collectively in order to improve the quality of learning activities. The participants develop a mono and multidisciplinary educational activity project on a poster. Second, the Climate Fresk (CF) offers workshops to raise awareness of climate change issues (www.fresqueduclimat.org). It promotes individual and/or collective awareness and facilitates

[1] https://sdgs.un.org/2030agenda

a constructive discussion, creating a will to act in the face of the challenge of an ecological transition (cf. Figure 1.a).

Figure 1.a Climate Fresk sample in 2021 with students at IMT Atlantique, and 1.b online with EASTEM curriculum designers

Background

Since 2018, ten universities in South East Asia and three European universities have been partners in a project aimed at improving the employability of students after graduation (www.eastemproject.eu) and industry collaborations (Rouvrais et al., 2020). This European project also aims to develop the skills of teachers, to promote the creation of networked educational services (cf. network of STEM centers[2]). The collaborative approach stimulates the sharing of good practices (Bennedsen & Rouvrais, 2016) and is a source of inspiration.

Cooperation kick-off

Some project members participated in a first workshop to stimulate and reinforce cooperation skills between partners involved in programme transformations. To commence with, as a cooperative design, participants first experienced an online CF on an international scale in 2021 (see Figure 1.b). It lasted approximately four hours, and was held online on Zoom in October 2021. Mural was used for the CF, and interaction was ensured through the use of Zoom breakout rooms, which facilitated group interactions. Eleven participants from diverse countries, including France, Iceland, Indonesia, South Africa, Vietnam and Thailand, participated. A qualitative and quantitative questionnaire allowed for analysis. The feedback primarily related to duration, group size, rhythm, STEM topic alignments, pros and cons, and the use of the Mural tool. Overall, it was found to be a pedagogically fruitful workshop to engage in systems thinking and intercultural cooperation. As a cooperative design, overall 60% of the participants liked the CF workshop (strongly agreed), 30% agreed, 20% neither agreed or disagreed (Likert scale). Twenty-five percent appreciated (strongly agreed) that collaboratively using cards in a design and system thinking workshop can be beneficial for a future RC workshop, 50% agreed, 12.5% neither agreed or disagreed, and 12,5% disagreed.

Best practices from the CF gameplay were further explored for the novel workshop. One RC workshop was then held online in November 2021 on Zoom, with five participants from different institutions, participants collectively exploring how first to design curricula.

[2] https://www.fsf.vu.lt/en/eastem-centers-platform

CURRICULUM DESIGN WORKSHOP

"When the mystery is too impressive, we dare not disobey… I took out of my pocket a sheet of paper and a pen. But then I remembered that I had mainly studied geography, history, arithmetic and grammar and I told the little guy (with a little bad humour) that I did not know how to draw" (Antoine de Saint Exupéry, The little prince, chapter 2, 1943).

The RC workshop was designed with the aim of developing collaboration between training managers, program directors, teachers, students and industry. In order to "get out of its own walls" and exchange in complete neutrality, the groups are to be mixed between stakeholders and institutional cultures to "draw" the main lines of an imaginary training program, resilient to the unforeseen. Under a serious game schema, and informally following some design thinking methods, the RC workshop stimulates a collaborative innovation in curriculum transformation with a view to analyse VUCA readiness of programmes.

In curriculum modelling, arrays including course blocks and semesters columns are often used, with learning pathway constraints between core, broadening or elective courses. It often takes very long to develop new programme architectures, and other challenges arise, such as deep managerial perspectives, resistance to change or administrative duties, which could limit the innovation and freedom for redesigning existing structures. A curriculum architecture representing a set of study program curricula of a faculty cluster helps to reach resilience principles when it already supports the basics of agility at more systemic levels. Participants reflected on the fact that there was a lot of paperwork, administration, and sometimes little freedom on structures, with respect to the university curriculum framework, accreditation standards and other requirements.

Six drawings were proposed, e.g. (i) curriculum architecture of all study programs in ITD (with four Faculty and three domains), (ii) a postgraduate diploma in Business Administration at UKZN with course structure, (iii) pillars and structure of a biomedical engineering BSc. at RU, (iv) an industrial design engineering bachelor with flexible choice-based curriculum.

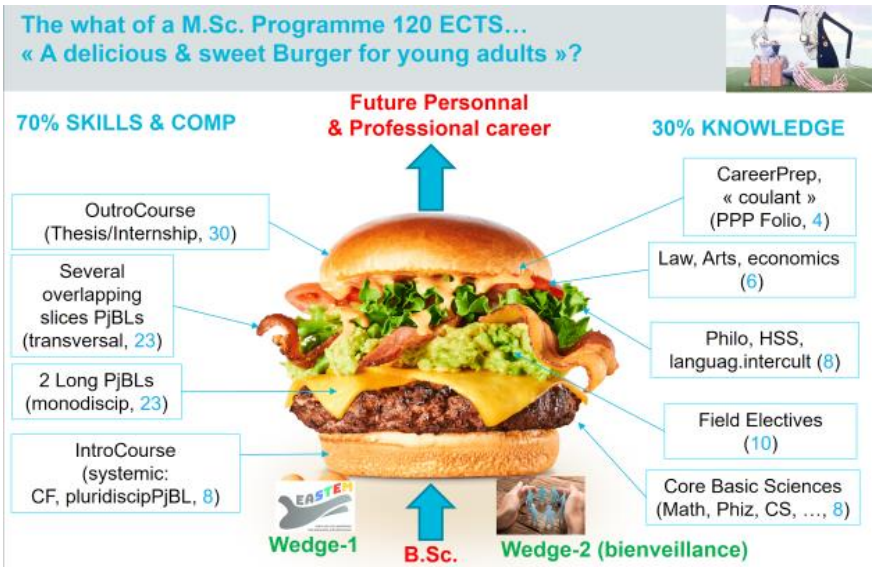

Figure 2. Curriculum drawing sample.

Among the six drawings, as an example, in Figure 2, the revamped burger-styled curriculum inspiration came from a meeting in Paris in June 2014 with members from UpCERG group from Uppsala University, Aalto University, and IMT Atlantique. It was recognized as attractive

and flexible, but with few temporal links between too abstract courses. As a metaphor, it offers a kind of menu for curriculum blocks. The workshop highlighted how architectural representations of the curriculum suggested by the international participants varied considerably, both from a structural point of view and from the informal artefacts used. Five participants were asked to cooperatively sketch a resilient curriculum, echoing arbitrarily a BSc in cybersecurity. The participants however experienced challenges in designing a common understanding and reframing the problem in a human-centred and graphical way. They were questioning the main aim, problem, assumptions and implications. As a future activity, VUCA scenario could then be introduced to reflect on the resilience of the various participant's structures.

The RC workshop concluded with a short debriefing session and dialogue. Table 1 indicates preliminary elements of analysis, based on feedback.

Table 1. SWOT of the RC trial workshop.

Strengths	Weaknesses
• Collective work in favour of acting together • Based on plural and international experiences • Sharing good practices and enrichment • Serious playful games in accordance with motivational factors • Flexibility and freedom of graphic language for the design-thinking phase	• New approach with that needs appropriation of tools and techniques • No real concrete feedback yet quantitatively and qualitatively analyzed • No immediate post-workshop application under a concrete continuous improvement approach to programs
Opportunities	**Threats**
• Flexible and intuitive representation language • Transferable to other disciplines • Transferable to other universities or programs • Potential sharing of strategies, goals, action plans and quality indicators of the developed outlines • Agility and resilience analysis support at architectural level	• Modeling curriculums too restrictive when a too formal graphic language • Lack of support from decision-makers due to the variety of participants • Loss of motivation of partners with regard to repetitive serious games • Competitiveness between participants with regard to transparency

REFLECTIONS AND IMPLICATIONS

Intercultural encounter

The RC workshop allowed participants to identify many intercultural, professional and personal skills and aptitudes, which are mobilised by the participants. Problems of cross-cultural adaptation however remain. As noted by Kennedy et al. (2019), design and implementation of a programme may be influenced by cultural methods for conducting business and maintaining knowledge integrity, by taking interdisciplinary teams of academics on a journey towards 'curriculum reconciliation'.

As an example, for the Indonesian author, the "gotong royong" principle is anchored as related to its ideological basis. Gotong royong in literal meaning is "mutual assistance"**,** a kind of collaboration with empathy, compassion in order to share burdens. During the 2019-pandemic, the Indonesian government encourage "gotong royong" to overcome the crisis. For the South African author, the African philosophy or concept of Ubuntu arose. This could be translated as "I am because we are" or "I am because you are", linked to Zulu, and in Xhosa,

the meaning is also broadening to "the belief in a universal bond of sharing that connects all humanity". For the Icelandic author, “þetta reddast” is described as the country’s motto. Þetta reddast can be translated to “it will all work out okay”. Life could often be difficult in this barren, harsh country and over time Icelanders have developed a mentality which can sometimes seem a bit carefree. When faced with difficulties Icelanders always maintain a belief that things will work out in the end; no matter how big the problem, a solution will always present itself”[3].

Cooperation to stimulate thinking out of the box

It is important to note that the development of resilience takes time, especially in systems that are characterised by tight control and little room for risk-taking and innovation, as may be found in many HEIs. This workshop was thus exploratory in nature, with the purpose of primarily focusing on how best to support the development of resiliency and agility. It is important to bring together multiple, diverse stakeholders, who can journey through a process whereby their mindsets and traditional ways of working are challenged. The diversity of the group further led to participants being exposed to multiple perspectives and fresh thinking to attempt to address common problems plaguing HEIs.

It is important that members of HEIs, especially those on the ground, have the necessary skills and capabilities to drive change. The fixed organisational culture of HEIs which can be quite focused on policies and plans, can ensure efficiency, but can lead to staff being inhibited and unable to respond and recover quickly in the face of adversity. If the individuals in HEIs are unable to bounce back quickly, then how much more challenging is it going to be when examining the curriculum, especially when considering that it is the individuals in the system who are responsible for achieving outcomes. We thus argue that resilience-building of the curriculum is dependent on the extent to which individuals in the system themselves are capable of embracing change and being responsive and proactive.

Diversity of viewpoints

Participants highlighted the value of being able to hear the experiences of others, especially international perspectives. There was some value in the metaphors-direction, to help people think about curriculum as something other than just a timeline of courses planned over three or five years. The hamburger abstract design, in particular, was especially received well and led to the other participants thinking more creatively, as well during the second collaborative design from scratch phase; thus, emphasizing different characteristics of a curriculum. Increasingly, more and more criteria on HE programs are offered in quality procedures, sometimes even imposed by accreditation agencies.

To date, there is no global and unified framework for visualizing and discussing curriculum designs. The workshop presented was without any real constraints in terms of modeling, able to guide actors in HE to collaborate more effectively in their curriculum transformations. This informal and cooperative workshop makes it possible to start to act together in the construction of action plans in connection with strategies set by Universities, Ministries or accreditation systems. In our VUCA times, the present impact of the "turbulence" on the curriculum is being experienced worldwide.

[3]Iceland Magazine, by Sara McMahon, June 19/2014.
https://icelandmag.is/article/what-does-thetta-reddast-mean

Many HEs suffer because they have a rigid curriculum, with specific courses which are fixed. It is critical that the curriculum is both agile and resilient. As an example, in Indonesia, the Ministry of Education started to run the MBKM (Independent Learning-Independent Campus), formed at the beginning of 2020. Students of the 4-year Bachelor program are given the freedom to take the opportunity to spend one semester outside the study program and two semesters of carrying out learning activities outside the university. The credits of those semesters are taken into account in the academic transcript. It means that the curriculum must support a "big room" for MBKM activities and its credits. If the curriculum is not agile or is not resilient, it creates problems for the study programme. Students learn and gain experience from real world professionals, by doing the activities outside the university, especially through internships (in industry, government offices, research centres or in the community).

CONCLUSION

The main purpose of the RC workshop is to train curriculum designers to share a common understanding with intercultural colleagues and team members, to later transform (redesign/reform) their own curricula according to local challenges, traditions, culture, etc. What HE in VUCA times will entail, still remains a question for our future, even more in the context of international programme interoperability as to be seen in the ongoing European Universities movement. They are opportunities to allow organisations to increase the quality and relevance of curriculum design activities and to increase capacity to operate jointly at transnational level for programme interoperability. The RC workshop, held as a trial in Fall 2021, aims to identify alternative curriculum design strategies as curriculum solutions which may not be instantly apparent. It questions the problem and investigates whether it is possible to reconcile HE stakeholders with cooperative design, in order to create a common understanding and develop a collection of hands-on methods for curriculum transformation in VUCA contexts.

The workshop can assist curriculum developers and facilitate resilience of educational systems facing VUCA events. The tool paves the way to resilience investigations within a curriculum framework, to include models, methods, and processes transferable to local institutional contexts according to the local needs and challenges, for curriculum renewal, transformation and reconciliation. The tool challenges assumptions, strategies, alternatives, implications and foresight solutions. The RC workshop, which was presented in this paper, is a preliminary activity, to highlight why and how collaboration is needed between different stakeholders to open mindsets and innovation. On an international scale, the RC workshop demonstrated that collaboration of all stakeholders in curriculum design can be done effectively with serious games using various online tools. Sustaining all the CDIO standards during VUCA times is a challenge, for example because it relies on interpersonal skills, active learning and dedicated workspaces, all of which can easily be disrupted by unexpected VUCA events. An open minded cooperative workshop as outlined here may indeed be fruitful when developing strategies for more resilient and interoperable CDIO spirited engineering programs.

Globally, HE has to contemplate and start to develop resilient curricula, and this paper is a very first step in that direction. In 2022, in the context of reconfiguration of HE and the quality assurance landscape in Europe and worldwide, roles and challenges for STEM schools and accreditation bodies have been questioned. As a first recommendation, a RC Framework could be investigated, to include models, methods, processes and tools for guiding transformations of STEM programmes. As a starting point, graphic languages for the representation are now to be studied, maybe with a system modeling approach which makes sense to meet such challenges of exchange and interoperability (Rouvrais and Chiprianov, 2012). As a second

recommendation, the RC workshop may be complemented with concept cards and strategic canvas to guide participants to identify more specific strategies and solutions under VUCA constraints.

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