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STRATEGIC FORESIGHT - THE WAY FOR AN EFFICIENT DEVELOPMENT IN THE EDUCATIONAL FIELD

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Abstract

Education has always evolved alongside technological change, and the current shift toward digitalization and a knowledge-based economy makes this evolution more urgent than ever. One issue that stands out in today's educational landscape is student anxiety, and this paper looks at non-formal education as a possible way to ease that pressure while still supporting well-rounded skill development. To explore this problem, we applied the 2×2 matrix method, a scenario-planning tool commonly used in corporate foresight, to study how two drivers: Digitalization and Non-Formal Education. These interact when treated as independent variables. Placing each on a high/low axis produces four possible scenarios. At one extreme, heavy reliance on digital tools without non-formal engagement risks isolating students and weakening critical thinking, despite giving them access to advanced resources like AI-based learning platforms. At the other extreme, students may build strong social skills through community or exchange programs (such as Erasmus) but struggle to keep pace with a labor market that increasingly rewards technical fluency. A third scenario, where both drivers are weak, tends to leave students under-equipped on nearly every front, while the fourth - where both are strong and appears to offer the most balanced outcome. We also built a small Python interface so users can select high or low values for each driver and immediately see which scenario applies, making the framework easier to apply in practice rather than just on paper. Based on this analysis, the strongest results come from combining

meaningful digitalization with structured non-formal learning, since this pairing seems to give students both the technical grounding and the social/critical-thinking skills needed to thrive going forward.

Keywords: Foresight, Education, Scenarios, Digitalization, Python

INTRODUCTION

Education stands as a crucial aspect of individual development within society, a focal point since antiquity, constantly striving for enhancement and alignment with technological advancements. The synergy between education and scientific progress has long been acknowledged for its societal benefits. In the 21st century, amidst the fourth industrial revolution and the advent of a weightless economy characterized by digitalization, global development priorities have gravitated towards this transformative element. Addressing one of the paramount challenges in education – student anxiety, the present initiative seeks to harmonize the level of digitization across various educational tiers. Non-formal education emerges as a promising avenue in mitigating this concern. Employing the 2*2 matrix analysis method, akin to strategic foresight practices in corporate settings, the project scrutinizes potential trajectories of digitization within a non-formal educational framework. Such an approach offers students a conducive environment to hone their skills, fostering healthier engagement with their respective fields of endeavor. At the same time, in this project there is also a program made in the Python programming language to render a graphic interface of the interpretation of the scenario matrix according to the 2 chosen parameters – driver 1 (Digitalization) and driver 2 (Non-Formal Education).

LITERATURE REVIEW

Strategic foresight is defined as the systematic exploration of several plausible futures in order to inform decisions taken in the present, and it is presented as a complement to forecasting and conventional risk analysis rather than as a replacement for them [1]. Methodological reviews classify scenario work according to the question it answers, what is likely, what is possible and what is preferable, and stress that the choice of technique should follow the purpose of the exercise [3], [4], [5]. Within this body of work the 2x2 matrix is one of the most frequently used deductive techniques: two factors judged to be simultaneously high in impact and high in uncertainty are placed on orthogonal axes, and the four resulting fields are developed into contrasting narratives [2], [6], [7]. The technique is valued for the speed with which a group can generate differentiated futures and for its use in testing whether a policy

direction holds across several environments. It is limited by the same feature, since reducing a complex system to two axes leaves out drivers that may prove decisive [2].

Education is one of the fields in which scenario work has been applied at system level. The OECD consolidated its 2001 Schooling for Tomorrow scenarios into four scenarios for schooling in 2040, namely schooling extended, education outsourced, schools as learning hubs, and learn as you go [8]. Two features of that exercise are relevant here. First, the OECD states that scenarios are neither predictions nor recommendations, and presents them as instruments for revealing assumptions, testing plans against unexpected shocks and building a shared view of the future. Second, the four alternatives are not treated as equally desirable, and a closing chapter is devoted to the tensions and paradoxes each of them produces. The present study applies the same logic on a smaller scale, to the interaction between two drivers rather than to the institution of the school as a whole.

Digitalization is treated in European policy as a measurable competence rather than as access to equipment. DigComp 2.2 describes twenty one competences grouped in five areas, information and data literacy, communication and collaboration, digital content creation, safety, and problem solving, and its 2022 edition adds examples that concern systems driven by artificial intelligence [13]. The framework is linked to the Digital Education Action Plan 2021 to 2027 and to targets of at least 80 percent of the population with basic digital skills and 20 million ICT specialists by 2030 [13]. The evidence on effects, however, is not uniformly positive. A mixed method study of 666 participants reports a negative association between frequent use of AI tools and measured critical thinking, mediated by cognitive offloading, with the strongest dependence and the lowest scores among the youngest respondents [15]. Digitalization therefore combines high impact with genuine uncertainty about its effect on higher order skills, which is the profile the 2x2 technique requires of an axis [2].

The distinction between formal, non formal and informal learning was popularised by Coombs and Ahmed, who used it to describe organised educational activity carried out outside the formal school system [10]. European policy has since given the category an operational definition. The Council Recommendation of 20 December 2012 describes non formal learning as learning that takes place through planned activities, defined in terms of learning objectives and learning time, in which some form of learning support is present, and it asked Member States to put validation arrangements in place by 2018, naming youth work and instruments such as Youthpass among the relevant practices [11]. Operational guidance for those arrangements is set out in the European guidelines for validating non formal and informal learning [12]. On outcomes, the Erasmus+ Higher Education Impact Study, based on almost 77 000 survey responses covering two million participants between 2014 and 2018, reports gains

in intercultural openness and in employability skills among mobile students [14]. Non formal education is therefore high in impact, while remaining uncertain in the sense that provision and recognition still differ markedly between education systems [11], [12].

The problem addressed by the present study is documented at international scale. PISA 2015 measured schoolwork related anxiety among students in 72 participating countries and economies. On average across OECD countries, 59 percent of students reported that they often worry a test will be difficult, 66 percent reported feeling stressed about poor grades, and 55 percent reported feeling very anxious before a test even when well prepared; girls reported higher schoolwork anxiety than boys in every country [9]. The same analysis found that the level of anxiety was related less to the number of school hours or the frequency of testing than to how supportive students perceived their teachers and their school to be [9]. This finding is what links the problem to the two drivers used here: if anxiety follows perceived support more closely than workload, then the mix of learning environments through which a student moves is a plausible point of intervention.

Taken together, the literature offers a well documented technique [2], [6], [7], a system level application of that technique to education [8], and separate bodies of evidence on digitalization [13], [15] and on non formal learning [10], [11], [12], [14]. What we did not identify is a study that treats digitalization and non formal education as the two axes of a scenario matrix, or one that makes the resulting fields operable through a tool that a user can query directly. The present paper addresses that gap.

METHODOLOGY

Foresight employs various approaches, including monitoring emerging shifts, examining megatrends, and crafting diverse scenarios, to uncover and deliberate on valuable insights regarding the future. Subsequently, these insights are leveraged to enhance decision-making and prompt immediate action. This approach constitutes a methodical and organized framework for utilizing future-oriented ideas to anticipate potential opportunities and obstacles, thereby enhancing readiness for change. [1]

In this technique, the two factors that combine the greatest importance with the greatest uncertainty for the question under study are used as the axes of a matrix, and the four fields obtained in this way become the starting point for distinct scenarios. Because the resulting set tests whether a direction of action holds across several contrasting environments, the approach is frequently applied to medium and long term policy questions [2].

The two drivers were selected against the criterion that the technique requires, namely high impact combined with high uncertainty [2]. Digitalization meets the impact condition

because it is an explicit European policy objective with quantified targets for 2030, and the uncertainty condition because the evidence on its effect on higher order skills is mixed [13], [15]. Non formal education meets the impact condition because validated non formal learning outcomes are treated as part of qualification and employability pathways [11], [12], [14], and the uncertainty condition because provision and recognition vary considerably between education systems [11]. The selection was made by the authors on the basis of this literature and was not derived from an expert panel or a Delphi round, which is stated as a limitation below.

Each of the four fields was then described qualitatively along two outcome dimensions kept constant across the scenarios: technical and digital skills on the one hand, and social skills including critical thinking on the other. No primary data were collected. The descriptions are inferences drawn from the sources reviewed above and are presented as plausible alternatives rather than as predictions, in line with the way scenario sets are framed in [8].

RESULTS

As can be seen in Figure 1, depending on the 2 key elements – DIGITALIZATION (DRIVER 1) and NON-FORMAL EDUCATION (DRIVER 2) it can perceive 4 scenarios:

Scenario I: high digitalization, low non-formal education

Scenario II: high digitalization, high non-formal education

Scenario III: low digitalization, low non-formal education

Scenario IV: low digitalization, high non-formal education

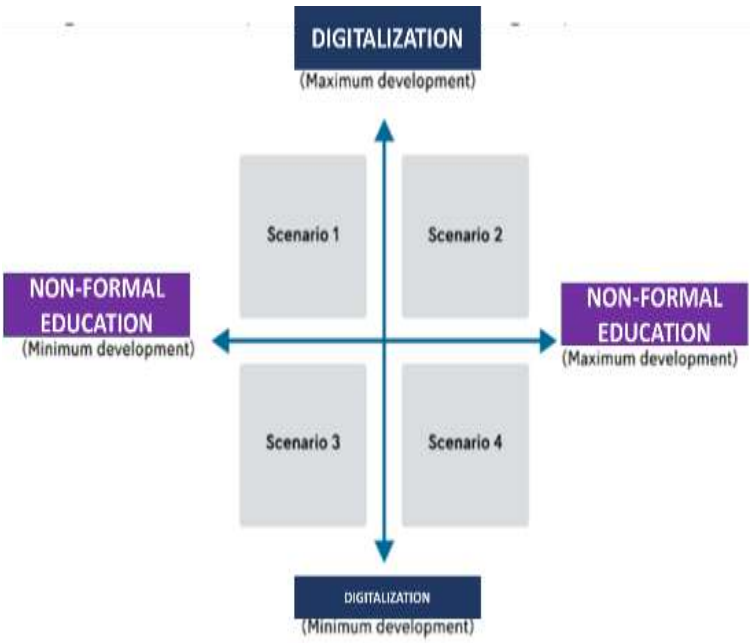

Figure 1. Matrix and the drivers of the study case [3]

If Scenario I is analyzed, it can be deduced that digitization can help to learn using quite a few different tools. However, in this landscape you can go to study by yourself, so the level of socialization in the community can decrease.

At the same time, there are quite advanced tools thanks to AI such as ChatGPT, so the opportunities for developing critical thinking are at a disadvantage.

If Scenario II is analyzed, it can be deduced that digitization as well as various non-formal education methods make a good team. Through digitization, effective ways of completing lessons and mediating distance learning are exposed. And through various non-formal education methods, such as participating in various Erasmus projects, social skills such as critical thinking and critical thinking in a multicultural environment can be developed. A balance is achieved between having social skills and digital/technical skills.

If Scenario III is analyzed, it can be deduced that we tend towards an environment in which the student's development is poorly optimized. Due to poor digitization, the student does not accumulate the knowledge and skills necessary to integrate into the current society, which is based on the economy without weight. At the same time, at the level of social skills, it is a total discussion because it matters how motivated the respective student is: if he is in a healthy social environment, then he will develop, if not then it will depend on him if he finds the necessary resources to leave comfort zone.

If Scenario IV is analyzed, it can be deduced that we tend towards an environment in which, at the level of social skills, you manage quite well, but it may be a problem related to adapting to the rigors of the current society, in which the processes try to be as more efficient in terms of resources. Thus, without the skills developed through digitalization, it will be difficult for the individual to find an environment that offers comfort from several points of view (economic, academic, etc.).

For a better viewing of the scenario interpretations, a graphic interface was created using the Python programming language - Figure 2. - in which the two parameters are chosen according to intensity/impact - HIGH or LOW. And depending on the combinations made, the results for each scenario are displayed.

The interface takes the two drivers as binary inputs, HIGH or LOW, and returns the description of the corresponding scenario, so that the matrix can be queried directly rather than read off a diagram. It was implemented in Python using [library to be specified by the authors], and the source code is available at [repository link to be added by the authors]. Figures 1 and 2 are the authors' own elaboration.

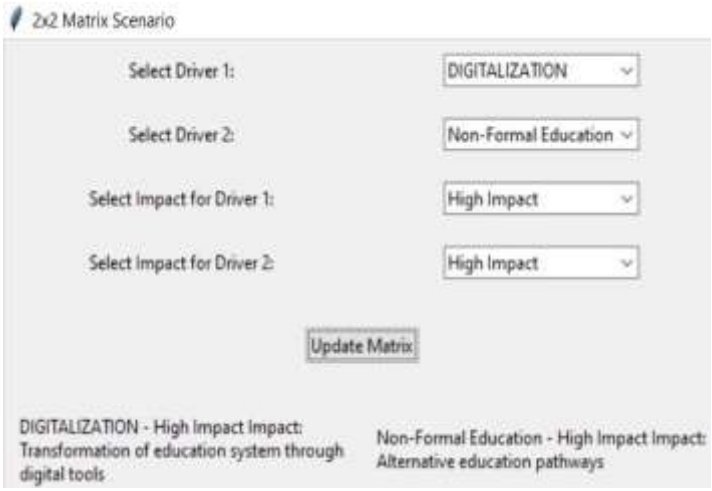

Figure 2. Python interface for scenario analysis [4]

LIMITATIONS

Three limitations should be stated. First, the study is conceptual. No primary data on student anxiety were collected, so the relation between the scenarios and anxiety outcomes is argued from the literature reviewed above and is not tested here. Second, the two drivers were selected by the authors rather than through a participatory or Delphi procedure, and the 2x2 technique is reductive by construction: a third driver, for example the socio economic composition of the student body, could change the ordering of the fields [2]. Third, the scenarios have not yet been validated with teachers, students or decision makers, and such a validation workshop is the natural next step.

CONCLUSIONS AND IMPLICATIONS

From the scenario analysis, the most suitable is Scenario II, in which there is a maximum correlation between digitization and non-formal education. Through digitalization, you manage to satisfy the technological needs of the current century, and through non-formal methods, the development of social skills necessary for any area of activity is encouraged.

The analysis has consequences for three groups. For schools and universities, the result suggests that digital provision and non formal activity should be planned together rather than as separate budget lines, since Scenario I and Scenario IV each show one dimension developing at the expense of the other. For teachers, the PISA finding that schoolwork anxiety is related more closely to perceived support than to workload [9] implies that adding digital tools without changing the support relationship is unlikely to reduce anxiety on its own. For decision makers, the matrix is useful as a way of testing a proposed direction against four contrasting

environments, in the sense in which the OECD frames its own scenario set [8], and not as a forecast.

RECOMMENDATIONS

Given the applied nature of this research, the following recommendations follow from the analysis.

1. Pair digital provision with a structured non formal component. Each digitally delivered module should be matched with an activity that requires interaction in a group, so that the conditions of Scenario II are approached rather than those of Scenario I.

2. Document non formal participation instead of leaving it informal. Institutions should use the validation arrangements called for by the Council Recommendation of 2012 and the associated European guidelines, for example Youthpass, so that the social skills acquired become visible in qualification terms [11], [12].

3. Define digitalization as competence, not as equipment. Progress should be measured against the five DigComp 2.2 areas, including the examples added in 2022 for systems driven by artificial intelligence, rather than against counts of devices or platforms [13].

4. Protect the tasks that require independent reasoning. Because frequent use of AI tools has been associated with lower measured critical thinking through cognitive offloading [15], part of the assessment should remain in formats in which the reasoning, and not only the answer, is produced by the student.

5. Validate the matrix before it is used in decisions. The next step is a workshop with teachers, students and decision makers to test the four descriptions, together with a measurement of schoolwork anxiety before and after a pilot intervention, which would turn the present conceptual result into an empirical one.

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