SOCIO-TECHNICAL CHALLENGE IN THE SELECTION OF THE REMOTE E-LEARNING PLATFORM

Liviu GĂINĂ, Ioan-Dănuț BĂLOS

"Transilvania" University of Braşov, Romania
liviu.gaina@unitbv.ro, danut.balos@gmail.com

Abstract: *The current pandemic context represents, without any doubt, the most serious challenge for all working environments, implicitly and educationally. Students and teachers alike are unwittingly deprived of such a natural meeting characteristic of the learning process in an amphitheatre or laboratory and thus put in the challenging situation of continuing their efforts to achieve the goal, by making the efficient use of the online environment in all its complexity (hardware infrastructure, educational platforms, accessibility to the internet connection). The article deals with the selection of the distance education platform by using a mathematical model of multi-criterial analysis of the factors involved. It is essential that education does not interrupt its course and continues to evolve, thus adding value to society. Moreover, our future, of all, depends on our ability to cope with the highest standards, the challenge created by distance education. By linking the skills of teachers and instructors, the potential of students and the optimization of IT resources, this desire is possible provided that each of the elements involved contributes to the achievement of the ultimate goal: preparing generations of young people for the uncertain future. The resilience of the public and private education system is dependent on the use of tools appropriate to the purposes assumed.*

Keywords: remote learning, socio-technical system, educational platform, multi-criterial analysis, management performance

1. Introduction

For the whole spectrum of corporations, from the most varied fields, as well as for educational institutions, in the pandemic context governed by social distance measures that have forced the activities to be carried out remotely, the choice of a working platform and distance learning has become a particular socio-technical challenge. The fact of the theme is evident in the pandemic context, but we wish to emphasize the importance of the selection of the distance education platform in this decision is an essential hub in the realization of the educational act with strong influences on the actors involved, the way in which the content is set up and

formatted, the methods of objective evaluation and, obviously, in the way of structuring the information and acquiring the competences of the future members of society. The selection of the distance education platform had as its starting point the personal empirical findings in the training of students' competence and constituted a major challenge whose resolution involved a carefully documented analysis.

2. Environment and Factors Involved in Distance Learning

Distance learning has become an extraordinary challenge for education systems as it involves a multitude of actors.

In the course of the research carried out, we found that the factors involved are both technical and human in nature, in a close connection constituting the typical architecture of an e-Learning system [1].

Their disparate analysis is difficult to achieve, the interdependence of the technical and human factors involved has determined us to start from the assumption that the identified factors comply with the requirements of a socio-technical system [2]. A socio-technical system often describes a "thing" (an interconnected mixture based on human systems, technology and their environment) [3].

Achieving the ultimate goal, that of obtaining the expected competence, requires the simultaneous fulfilment at a level that is less satisfactory of all the requirements of the system. We would like to point out that in the field of e-Learning there have been previous concerns of the interest being the establishment of educational resources complementary to face-to-face (F2F) education [4]. In a research report [5] we identified the factors involved in the distance learning process and their problems and tried to provide generic solutions highlighted in Table 1.

Table 1 The factors involved identify and Proposed solutions

The factors involved identify	Proposed solutions
Access to equipment	Involvement of institutions to identify the skills both at their own infrastructure level - for teachers, instructors and students + setting the minimum number of critical equipment
Internet connectivity	Ensuring broadband internet connectivity on at least 2 connectivity solutions that enable online activities to be carried out using synchronous capabilities (video, audio, streaming, simulation) and redundancy
Involvement of actors	Unitary training of trainers and students alike
Dedicated online educational platforms/applications*	Case study by multi-criterial analysis for the choice of e-learning platform
Translation F2F - online	Designing/adapting activities for the online environment and structuring online learning activities (balance between synchronous/asynchronous);
Educational resources (syllabus, content, etc.)	Identification/use/development of educational resources, including educational resources open (REDs);
Working on learning platforms;	Making tutorials and webex training of the actors involved
Rating/feedback	Using digital tools in the formulation of feedback/assessment;
Interaction, collaboration	Enabling, stimulating motivation and autonomy of students participating in online activities

The theme is broad [6] and can be the subject of future research. We chose to address at a detailed level the problem of the selection of the remote learning platform. Once the intended objective was identified, it was necessary to use a tool to

enable us to deal with the subject complexly. Analyzing the alternatives proposed in [7], we chose to use the method of multi-criterial analysis. According to the survey "on educational activities carried out in Romania, during the suspension of

school courses face-to-face" [5] the problems regarding participation in the learning process, sometimes real, sometimes only invoked to excuse the lack of involvement of the actors involved, caused by the lack of equipment (institution and terminal server: PC, laptop, tablet, smartphone) or internet connectivity (non-existent or narrow band). Solving these goals is constituted as requirements/resources required by the learning platform.

3. Case Study – the selection of the distance education platform using multi-criterial analysis

The current pandemic situation has created and continues to create challenges in all default areas in the field of education, education and research. In order to adapt to the new climate, it is necessary in education to use tools to enable the process of knowledge transmission and skills acquisition to continue, which can only be achieved by using an online e-learning platform capable of individually meeting the requirements of each institution.

3.1. Competitive e-learning platforms

In a world where information and ideas are propagating at overwhelming speed thanks to the online environment, high-profile companies are creating tools that try to meet market demand. [8] [9] From a larger list, following an initial selection by successive listing of competitive platforms, we have chosen five e-learning platforms that meet the needs identified at the level of our working group:

- Moodle by Moodle PtyLtd Australia [10]
- ILIAS also used by UNAp [11] [12]
- Teams developed by the Microsoft [13]
- Zoom developed by Zoom Video Communications, Inc. San Jose, California, U.S. [14]
- G_Suite balias Google Workspace/ Classroom developed by Google [15]

The multi-criterial stages of these products are the case study, the result obtained being the opinion of the authors of the study in order to choose the product to be used in

the distance learning process.

Of the five proposed platforms, we expect the form developed by Google to achieve the best result, since through the experimental use of the products, we have found that the performance of the human factor/ human performance envelope (HPE) is put at the forefront, which is rather neglected in Romanian culture in general and in the military organizational environment in particular. We believe that the justification for this is that logistics requires generous funds and conservative institutions show reluctance and latency in the allocation of funding. On the other hand, we must take into account the fact that the human factor requires a lasting investment through education and research and understandable through innovation and creativity. Solving the problem involves the following steps:

- configuration of objective, determining criteria;
 - choice of variants;
 - addressing the problem as a decision with several criteria;
 - solving the problem with multiple attributes using different methods;
- finding the set of methods that lead to a small number of variants.

3.2. Brainstorm [7]

The Brainstorm technique is indicated for the production of new ideas, after defining the problem and analyzing significant data. The members of the working group set up to choose the platform were not notified before the topic of the meeting, in the desire that the ideas be spontaneous. The variety of ideas was achieved by issuing ideas in the chain. Two sessions with an average duration of 35 minutes were held, the location being a nonformal one. Mediators exposed the issue, namely the nomination of criteria for choosing an e-learning platform to be used uniformly at the institution level. They then submitted the information gathered and the criteria analysis, after the exposure gave the floor to the members of the group in the order in

which they were announced. The members of the group wrote down their ideas and the results were translated into the following list of criteria:

- Existence of templates for learning modules and possibility of customize
- Creation and use of institutional accounts
- The ability to run apps from all types of low-resource devices (desktop, laptop, tablet, smartphone)
- Possibility of video call with minimum actors involved (teacher and 30 cadets)
- Possibility of recording activities and playing them later
- Cloud Server-Level IT Administration
- Easy transposition of F2F courses online
- Integration of the presence list and catalog
- Pragmatic and objective assessment of students with the possibility of identifying fraud
- Possibility of integrating data collected from systems used to date or complementary systems

- Interactivity with other services (calendar, activity reporting, forum, ranking etc.)
- Feedback loop from series to series and Reshaping the training system after entering feedback elements
- Resolution of desires encountered and Recalibration of the system
- Performance of the human factor
- Costs involved, budget allocation
- Easy maintenance and update

3.3. Development and implementation

At this stage the following desiderates were achieved: critical processing, filtering, combining, modifying the ideas issued at brainstorming. The mathematical apparatus will highlight which criteria are decisive and require special attention in harnessing the aspects that contribute to the management of the performance of distance learning. The results of the brainstorming sessions were taken into account and the following criteria were found to be analyzed in Table 2.

Table 2 Analyzed criteria

No.crt.	Analyzed criteria
1	Existence of templates and possibility of customize
2	Creation and use of institutional accounts
3	Possibility to run apps from all types of low-resource devices
4	Possibility of video call with the minimum of actors involved (teacher and 15 students)
5	Possibility of recording activities and playing them later
6	Cloud Server-Level IT Administration
7	Easy transposition of F2F courses online
8	Integration of the presence list and catalog
9	Pragmatic and objective assessment of students with the possibility of identifying fraud
10	Possibility of integrating data collected from systems used to date or complementary systems (compatibility)
11	Interactivity with other services (calendar, activity reporting, forum, ranking etc.)
12	Feedback loop from series to series and reshaping the training system after entering feedback elements
13	Human performance envelope (HPE) - involving actors in improving the learning process
14	Costs involved, budget allocation
15	Easy maintenance and update

After setting the criteria to be analysed, they were compared to each other in Table 3 square format. Depending on the relative importance between two criteria, values were given as follows:

- 1 if the criterion on the line is more important than the criterion on the column;
- 0,5 if the criteria are of the same importance;
- 0 if the criterion on the line is less important than the criterion on the column.

By summarizing the values on the line we calculated the score and determined the level of ordering their importance. We note that the highest score was obtained by criterion 14, so this criterion occupies level 1, being the most important. In the same vein, criterion 5 achieving the lowest score is considered the most insignificant criterion, level 15. If 2 criteria have achieved the same score, their level of

importance is similar, the value of the level is expressed as the average of the places occupied by them (for example criteria 3 and 11 respectively, they both scored 11 points and would have occupied level 4 and 5 respectively, but because they have the same score, they were both classified with level 4.5; the next level available, level 6, is occupied by 9.5 points by criterion 1). We used the formula (1) to calculate Weighting Coefficients (Cpi) and the results were then used to determine the most suitable educational platform.

$$C_{pi} = \frac{p + \Delta p + n + 0,5}{-\Delta p' + \frac{N_{crt.}}{2}} \quad (1)$$

where:

- p is the sum of the scores obtained (per line) by the item taken into account;
- Δp the difference between the score of the item taken into account and the score of the item at the last level; if the item taken into account is the one on the last level, p results in the value 0;
- n the number of criteria exceeded (exceeded in terms of score) by the criterion taken into account;
- $N_{crt.}$ the number of criteria considered;
- $\Delta p'$ the difference between the score of the item taken into account and the score of the first element (resulting in a negative value); if the item taken into account is on the first level, the value is 0.

For example for calculating Cpi for criterion 7, we have $p=12,5$, $\Delta p=12,5-0,5=12$, $n=12$ (criterion chosen for example occupying level 3, outperforms the other 12 criteria in the total of 15), $\Delta p'=12,5-14,5=-2$, so that in the Cpi expression, we get the sum of $12,5+12+12+0,5=37$, and at the

denominator $-(-2)+7,5=9,5$. The calculated report expresses the coefficient of weight for criterion 7, $Cp7=3,89$.

Table 3 Matrix of score, Level of ordering and the Weighting Coefficients

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Points	Level	Cpi
1	1	0	0	1	1	1	0	1	1	1	0	1	1	0	1	9,5	6	2,24
2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	13,5	2	4,71
3	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	11	4,5	2,91
4	0	0	0	1	1	1	0	1	1	1	0	1	1	0	1	8,5	7	1,85
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0,5	15	0,05
6	0	0	0	0	1	1	0	1	0	0	0	1	1	0	1	5	10,5	0,82
7	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	12,5	3	3,89
8	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	3	12,5	0,42
9	0	0	0	0	1	1	0	1	1	1	0	1	1	0	1	7	8,5	1,33
10	0	0	0	0	1	1	0	1	1	1	0	1	1	0	1	7	8,5	1,33
11	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	11	4,5	2,91
12	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	3	12,5	0,42
13	0	0	0	0	1	1	0	1	0	0	0	1	1	0	1	5	10,5	0,82
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14,5	1	5,73
15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1,5	14	0,20

After the weighting coefficients were established, the five proposed platforms were tested by the members of the working group. Following the tests, they gave contribution marks on each criterion (scale 1-10), which is highlighted in Table 4. subsequently the products between the

Ni(A-E) notes and the weighting coefficients, Cpi(A-E), which after their summation will be able to highlight which of the educational platforms is worth exploring and exploiting by the actors involved, the elements being highlighted in Table 5.

Table 4 Platforms awarded

	A	B	C	D	E
Criteria	NiA	NiB	NiC	NiD	NiE
1	7	2	9	2	8
2	9	9	10	3	9
3	9	6	10	9	10
4	1	1	6	9	9
5	1	5	9	9	8
6	8	8	9	8	9
7	9	6	9	1	8
8	10	3	9	1	9
9	7	9	8	1	8
10	8	7	10	2	9
11	8	8	10	8	9
12	7	8	8	5	7
13	8	7	8	6	8
14	9	8	1	9	1
15	7	8	10	8	9

Table 5 Initial scores (when cost involves was higher)

	A	B	C	D	E			A - Moodle			B - ILIAS		C - Teams		D - Zoom		E - G Suite	
Criteria	NiA	NiB	NiC	NiD	NiE		Criteria	Cpi	NiA	*CpiA	NiB	*CpiB	NiC	*CpiC	NiD	*CpiD	NiE	*CpiE
1	7	2	9	2	8		1	2,24	7	15,68	2	4,48	9	20,16	2	4,48	8	17,92
2	9	9	10	3	9		2	4,71	9	42,35	9	42,35	10	47,06	3	14,12	9	42,35
3	9	6	10	9	10		3	2,91	9	26,18	6	17,45	10	29,09	9	26,18	10	29,09
4	1	1	6	9	9		4	1,85	1	1,85	1	1,85	6	11,11	9	16,67	9	16,67
5	1	5	9	9	8		5	0,05	1	0,05	5	0,23	9	0,42	9	0,42	8	0,37
6	8	8	9	8	9		6	0,82	8	6,59	8	6,59	9	7,41	8	6,59	9	7,41
7	9	6	9	1	8		7	3,89	9	35,05	6	23,37	9	35,05	1	3,89	8	31,16
8	10	3	9	1	9		8	0,42	10	4,21	3	1,26	9	3,79	1	0,42	9	3,79
9	7	9	8	1	8		9	1,33	7	9,33	9	12,00	8	10,67	1	1,33	8	10,67
10	8	7	10	2	9		10	1,33	8	10,67	7	9,33	10	13,33	2	2,67	9	12,00
11	8	8	10	8	9		11	2,91	8	23,27	8	23,27	10	29,09	8	23,27	9	26,18
12	7	8	8	5	7		12	0,42	7	2,95	8	3,37	8	3,37	5	2,11	7	2,95
13	8	7	8	6	8		13	0,82	8	6,59	7	5,76	8	6,59	6	4,94	8	6,59
14	9	8	1	9	1		14	5,73	9	51,60	8	45,87	1	5,73	9	51,60	1	5,73
15	7	8	10	8	9		15	0,20	7	1,37	8	1,56	10	1,95	8	1,56	9	1,76
										237,74		198,76		224,83		160,25		214,64

3.4. Interpretation of the results

We found that due to the differences in financial accessibility (free-free vs. Acquisition and maintenance costs) mentioned previously in our case study, platform C and E although it achieved good marks compared to other platforms, it received a minimum mark on criterion 14 (costs involved, budget allocation) and thus the final score was lower than that obtained by platform A. During the processing and analysis of the data, two of the providers selected in the study (G_Suite and later Microsoft, platforms C and E respectively)

provided facilities to users giving that the platform they are used by an educational institution [16], the use of their platforms with all modules being facilitated free of charge by not involving costs (at least for a period). Thus, it was decided within the group to re-analyse the data in the new context, i.e. to the members of the group, to re-evaluate and to mark this criterion. This being revalued with the maximum score (highlighted in Table 6) produced the increase in the final score (highlighted in Table 7) and the advance of the counter-candidate platforms.

Table 6 Platforms awarded

	A	B	C	D	E
Criteria	NiA	NiB	NiC	NiD	NiE
1	7	2	9	2	8
2	9	9	10	3	9
3	9	6	10	9	10
4	1	1	6	9	9
5	1	5	9	9	8
6	8	8	9	8	9
7	9	6	9	1	8
8	10	3	9	1	9
9	7	9	8	1	8
10	8	7	10	2	9
11	8	8	10	8	9
12	7	8	8	5	7
13	8	7	8	6	8
14	9	8	10	9	10
15	7	8	10	8	9

Table 7 Final scores (when cost involves dispared)

		A - Moodle		B - ILIAS		C - Teams		D - Zoom		E - G Suite	
Criteria	Cpi	NiA	*CpiA	NiB	*CpiB	NiC	*CpiC	NiD	*CpiD	NiE	*CpiE
1	2,24	7	15,68	2	4,48	9	20,16	2	4,48	8	17,92
2	4,71	9	42,35	9	42,35	10	47,06	3	14,12	9	42,35
3	2,91	9	26,18	6	17,45	10	29,09	9	26,18	10	29,09
4	1,85	1	1,85	1	1,85	6	11,11	9	16,67	9	16,67
5	0,05	1	0,05	5	0,23	9	0,42	9	0,42	8	0,37
6	0,82	8	6,59	8	6,59	9	7,41	8	6,59	9	7,41
7	3,89	9	35,05	6	23,37	9	35,05	1	3,89	8	31,16
8	0,42	10	4,21	3	1,26	9	3,79	1	0,42	9	3,79
9	1,33	7	9,33	9	12,00	8	10,67	1	1,33	8	10,67
10	1,33	8	10,67	7	9,33	9	12,00	2	2,67	9	12,00
11	2,91	8	23,27	8	23,27	10	29,09	8	23,27	9	26,18
12	0,42	7	2,95	8	3,37	8	3,37	5	2,11	7	2,95
13	0,82	8	6,59	7	5,76	8	6,59	6	4,94	8	6,59
14	5,73	9	51,60	8	45,87	10	57,33	9	51,60	10	57,33
15	0,20	7	1,37	8	1,56	10	1,95	8	1,56	9	1,76
			237,74		198,76		275,09		160,25		266,24

4. Conclusions

By quantifying the criteria, ordering them and evaluating them, using multi-criteria analysis we were able to determine which of the proposed educational platforms is the best solution for meeting the requirements and needs of the actors involved in the educational process at the institution level. Without but and perhaps the subject has ramifications and connections in all areas and is a good example to follow in choosing any products online and beyond. Having dealt with the problem of the socio-technical system by selecting the

educational platform, a small part of the management of the performance of distance learning has found its solution. We consider this study to be an eloquent guide and will support the work of other institutions in the selection of the respective remote learning work platform. It should be borne in mind that each of the identified stakeholders is closely related, their interconnection becoming dependent throughout the educational process. Each criterion requires/allows an in-depth analysis with implications for the managerial decision which will be the subject of lively research.

References List

- [1] Finke, A., Bicans, J., E-learning System Content and Architecture Evolution, Proc. of 16th International Conference on Information and Software Technologies IT 2010.
- [2] Marvin, S., Rutherford, J., Understanding the socio-technical hybridisation of indoor-outdoor relations: Emergent, merged and stretched, doi: 10.1111/area.12715, May 2021.
- [3] Mumford, Enid, "Tips for an action researcher". Information technology and people. 14 (1): 12–27. doi:10.1108/09593840110384753, March 2001.
- [4] Dobre, I., Studiu critic al actualelor sisteme de e-learning, Academia Română, Institutul de cercetări pentru inteligență artificială, București, 2010.
- [5] "Learning at a distance. Survey on educational activities carried out in Romania during the suspension of school courses face-to-face", study carried out by the National Centre Of Policy And Evaluation In Education The Education Research Unit, August 2020, http://www.ise.ro/wp-content/uploads/2020/08/Invatarea-la-distanta_Raport-de-cercetare_august-2020.pdf
- [6] Prelipcean, G., Boscoianu, M., Lupan, M., Nastase, C. E., Innovative financing solutions based on Venture Capital and Private Equity to support the development of entrepreneurship in Romania, Transformations in Business & Economics 13, 2014.
- [7] Bobancu, Ș., Dumitrașcu, R., Creativity and Invention (C&I) – Course – Section 1 and 2, 11th Edition, UniTBv, 2019.
- [8] Boscoianu, M., Prelipcean, G., Lupan, M., Innovation enterprise as a vehicle for sustainable development- A general framework for the design of typical strategies based on enterprise systems engineering, dynamic capabilities, and option pricing , Journal of Cleaner Production vol 172, 2018.
- [9] Prelipcean, G., Boscoianu, M., Risk analysis of a hedge fund oriented on sustainable and responsible investments for emerging markets, Amfiteatru Economic, Volume: 22, Issue: 55, pp. 653-667, doi: 10.24818/EA/2020/55/653, Published: Aug 2020
- [10] <https://moodle.org/?lang=ro>
- [11] <https://en.wikipedia.org/wiki/ILIAS>,
- [12] <https://www.ilias.de/>
- [13] <https://www.microsoft.com/ro-ro/microsoft-teams/compare-microsoft-teams-options>
- [14] <https://zoom.us/>
- [15] <https://workspace.google.com/>
- [16] <https://www.microsoft.com/ro-ro/microsoft-365/academic/compare-office-365-education-plans?activetab=tab%3Aprimaryr1&market=ro>