Experimental, *ad hoc, online*, inter-university student e-contest during the pandemic – Lessons learned

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Abstract—Purpose: We analyze the effect of the current pandemic on students e-contests. Method: We compare the e-contest with the 10 previous editions of the same but face-to-face contest. Statistical and NLP analysis are applied. Conclusions: Apparently the competition did not suffer because of being a virtual one; the basic interconnectivity means arise no serious technical issue. Disadvantages found: the interconnectivity is more limited than for the face-to-face case; online jury-competitors interactivity is poorer than face-to-face interactivity; human factors, higher uncertainties in the organization process, and less time to spend in the process for the local organizers are major limiting factors; concerns on the participation and evaluation fairness are higher; involuntary gender discrimination seems lower, but persists; there are serious concerns related to privacy, including differential privacy; peculiarities of the presented topics and of the evaluation process emerged, but it is unclear if they are related to the online nature of the competition, to the extra stress on the participants during the pandemic, to other factors, or are random. Some conclusions may be valid for the analyzed case only, yet some are general enough for being worth reporting. A preprint was published in ArXiv.

Keywords—online education, student competition, pandemics, fairness, privacy, differential privacy, education experiment, microsystems.

I. INTRODUCTION

Numerous studies have been recently devoted to the need of and requirements for online learning under the conditions created by the current pandemic [1-6]. However, no such study was published on extra-curricular activities, such as student competitions. The topic becomes more important as several countries plan online national-wide examinations (A-levels, GCSEs) and vocational qualifications, and universities struggle to find methods of replacing various types of examinations, including graduating examinations with online ones or surrogates, such as ‘prediction of results’ grades issued this summer by the relevant recognised authority’ as Oxford University vaguely describes [8].

Online competitions are not new – such competitions are regularly organized by universities in the field of computer science, in Romania and in many countries. In the domain of hardware, probably the best known international competition is the Create the Future Design Contest, which “was launched in 2002 by the publishers of NASA Tech Briefs magazine to help stimulate and reward engineering innovation” [9]. Also, research project competitions are the rule in EU, USA, and many other countries. However, none of these took place in conditions similar to those of the current pandemic, and only few have been thoroughly analyzed and publically documented.

II. PARTICIPANTS AND ORGANIZATION FACTS

This is a student project competition with the only restriction related to the topic of the project, which must include at least one operational microcontroller or microsystem. The projects are judged by their complexity, innovative ideas, applicability, level of functioning and operability, presentation, and demonstrated knowledge of the presenting students. The open theme of the competition differentiates it from the similar contest on designing with hardware and software over Internet is as good / less good / better than in face-to-face examinations or competitions. A preprint of this paper is at https://arxiv.org/abs/2005.12087.
TABLE I. PARTICIPATING UNIVERSITIES IN THE EXPERIMENTAL, ONLINE STUDENT COMPETITION DURING THE LOCKDOWN

| University (U) and city | Number of teams | Number of students |
|-------------------------|----------------|------------------|
| Politehnica TU București| 3              | 5                |
| TU Cluj-Napoca           | 3              | 3                |
| TU of R. Moldova, Chisinau| 2          | 3                |
| U. ‘Stefan cel Mare’ Suceava| 3          | 6                |
| U. ‘Dunarea de Jos’ Galati| 3              | 8                |
| TU ‘Gheorghe Asachi’ Iasi| 4              | 7                |
* TU stands for Technical University

Presentations were accepted for registration up to the very morning of the competition. The average time of presentation was similar with that for previous, face-to-face editions of the contest. A comparison of the 2020 contest with the previous ones in its series is given in Table 2.

TABLE II. COMPARISON BETWEEN THE EXPERIMENTAL 2020 EDITION AND THE PREVIOUS 10 EDITIONS OF THE CONTEST

| Feature | 2020 (during pandemic) | Previous 10 contests (average) |
|---------|------------------------|-------------------------------|
| Number of student teams | 18 | 24 |
| Number of students per team | 1-3 | 1-4 |
| Number of participating universities | 6 | 6 |
| Number of members of the jury | 6 | 12 |
| Ratio of academic vs. firms members of the jury | 4/3 | 1/1 |
| Number of supporting firms | 4 | 7 |
| Number of local organizers active in the online contest | 2 | 4 |
| Time for students teams to prepare (months) | 3 | 5 |

* Based on incomplete personal archive

III. INSURING THE QUALITY OF THE PROJECT EVALUATION PROCESS: ACADEMIA-INDUSTRY JURY

The uniformity of grading was a serious concern because of the inherently limited interactivity of the jury with the teams, offline, because of the lack of hands-on interaction of the jury with the presented projects, and because of the limited or null interactivity of the members of the jury during the presentations – unlike face-to-face competitions. Therefore, this crucial matter is investigated first.

The uniformity of grading is a good test for the homogeneity of scope during grading, i.e., clarity of grading criteria. The standard deviation of the grades per member of the jury is also a good indicator of efficient evaluation; the dispersions of grades assigned by the members of the jury are similar, denoting consistency in grading, see Fig. 1. At the team level, the standard deviation of the evaluation by the members of the jury is ideally null; however, this cannot and may not be good for the evaluation process, because each member of the jury may have specific competencies. Interestingly, null STDEV was obtained for the lowest grade and for the third and fourth highest (both graded with 9.00).

In principle, there should be no relationship between the spreading and the average of the grades of the teams. The average grade per contest was 8.22 and the STDEV of all grades was 0.68. The average of the STDEV of the individual grades given by the jury members, for all the teams was 0.52, which shows a reasonable uniformity in the grading, only slightly larger than the random choice between successive grades (which is 0.5).

Surprisingly, there is a weak correlation between the overall grade (average grade) and the standard deviation of the grades assigned by the jury for the team, see Fig. 2. The slope of the regression is negative (-0.16) meaning that for every extra point in the grade, the precision of the grade is 0.16 point better ($R^2=0.115$). There are three ‘outlier’ grades, with zero standard deviations. If these outliers are removed, the slope becomes -0.2 and the coefficient of determination of the linear regression is even higher ($R^2=0.29$), Fig. 3. This result call into question the grading process improvement, with more time spent with those teams less convincing.

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Overall, the online paralinguistic communication is still poor and at time frustrating in the educational process, including in the online competitions. Unfortunately, these issues cannot be solved before the summer and autumn examinations planned in 2020, under the COVID-19 pandemic restrictions.

The online presentation in the contest was found to have several disadvantages:

- Lack of interactivity of the students; the students don’t make friends, don’t exchange impressions about their campuses, universities, teachers, employability and student life;
- Students don’t interact easily and fully with their colleagues and with the jury;
- Although we have not a proper statistic, it seems that the average number of questions asked by the members of the jury per project was slightly lower than the same number during the previous, face-to-face competitions.

On the other hand, as already said, the online evaluation posed no problem, with low overall average and maximal spreading between the grades between the jury members, for all the participants (Fig. 1).

V. FAIRNESS AND DISCRIMINATION CONCERNS

Discrimination was also a concern in this experimental competition. Fairness in grading and prize allocation is always an issue when students are enrolled in different study years. Among the many possible approaches to fairness, in all the eleven editions of this contest, the study-year blind approach was used. This fairness criterion is considered, in fact, unfair. Small adjustments have been made, including this year, by offering a honorable mention diploma to the youngest participant(s). However, this approach is disputable and we plan to adjust the grades by coefficients determined on a larger statistics of the grades in previous years.

Of special concern is that only one member of the jury was a woman. The situation was the same for several other editions of the competition, and in many previous editions the jury was all-male. This may discourage female participants. The issue needs to be corrected in future editions and should be considered in all online contests, because that may have even more impact than in face-to-face competitions.

VI. LEXICAL AND SEMANTIC ANALYSIS OF THE CONTEST

It may seem that the NLP-type analysis of the presentation is useless. However, similar studies in various domains, from marketing to patent analysis, have proved able to reveal interesting aspects based on limited information from the documents, for example based on similarities of patent titles, abstracts, and claims [18,19]. Also, NLP analysis is well known to reveal stress and sentiments. Because the pandemic, the lockdown, and the novelty of the online competition, stress was probable. Therefore, an NLP analysis is justified.

The titles and textual content of the presentations have not been analyzed in relation with student contests, we believe. Yet, such an analysis, even when reduced to the titles of the presentations may shed some light on the level of the presentations. The titles of the projects had an average number of words of 7.45, and a standard deviation of 5.6 words; the number of words in the titles varied between 3 and 21. The three longer titles were 21, 18 and 17 words length. The average length of the words in the titles was 6.5; the total number of words in the titles was 134 and the total number of letters (without spaces) was 866.

The number of lemmas used in the titles is 77; 68 of them occur once. Nine lemmas are repeated twice or several times. These repetitions are instructive, because they show how many projects may adopt the same broad pint of view, or have similar topics, or use similar approaches.

of the competition as follows:

\[
I_{C1} = \frac{\text{count of number of repeated words}}{\text{number of unique words}} = 0.43 \tag{1}
\]

This index indicates how much the titles are innovative and consequently how much the titles are similar at the lexical level because of repeated words. When computing \(I_{C1}\), stop words are removed.

\[
I_{C2} = \frac{\text{number of titles with double occurrence words}}{\text{total number of titles}} = 0.435 \tag{2}
\]

This index indicates the degree of similarity between the titles of the presentations in the competition. When computing \(I_{C2}\), stop words are preserved. Notice that \(I_{C2}\) also includes titles with more than a single word in common.

Both indices are less than but not far from 0.5, thus indicated a moderate spreading of the topics of the projects. The indices may inform project advisors on the need to be
more innovative and on the trends in the interests of the students.

The most frequent words after removing the stop words (Fig. 5) indicate that participants emphasized on the complexity of the projects (using the words “system” and “intelligent”) and addressed mainly monitoring (“monitorizare”) and control applications, followed by energy conversion. The rank-frequency distribution of words (Fig. 6), after removing the stop-words (which is not usually done in this kind of analysis), does not follow Zipf’s law; this may be due to the small number of cases in the statistic.

A fact that is surprising is that six of the first seven projects had a longer title than the average, see Fig. 7. The linear regression of number of letters in the title vs. grade has a positive slope and the coefficient of determination is 0.187. Linear (number of words) vs. rank words in the titles of the presentation, in the 2020 competition.

The differential privacy problem is to provide complete information on a population while preserving full anonymity of the individuals. The problem is key to learning because the learner needs feedback from the teacher and vice versa, moreover improvements of the learning process require detailed knowledge on the learner population. The problem is known to have no solution; therefore, limited differential privacy issues

VII. PRIVACY, LIMITED DIFFERENTIAL PRIVACY, AND SECURITY CONCERNS – ONLINE COMPETITIONS

Privacy issues

Competitions raise significant privacy issues for the participants. While student wish to participate to gain recognition and increase their chance of early employability, they may also fear that a poor performance may harm their future employability and peers’ respect. When the results of the competition are kept in company databases or are made openly public, the harm peril is very real, as is the perspective of gains for the best performers. The amount of data allowed to be stored in competitions is an issue. When only very limited data is recorded, such as the name of the participants and the prizes they obtain, if any, the dangers are much lower than when full video recordings are made, which may be used in human resources departments in various ways. Openly posting on the Internet the contest may bring much harm to all participants and to the jury as well. Therefore, the way of documenting the contest should be chosen with great care and with a legal perspective too.

Pandemics pose new challenges to privacy and security [20], [21]. As any limited-public and partly public-restricted performance, an Internet based competition may pose certain privacy issues. For examples, the student presentations are not public in a face-to-face contest as long as the student teams do not choose to make them public. Also, the members of the jury and the participants are not meant to be filmed and then shown in live movies in a face-to-face contest, except when they agree so in written form and after being suitably informed. In this way, a limited degree of openness – and a limited degree of privacy – according to the “contained public venue” vs. “open public venue (see [22])”, or equivalent “semi-open learning environments” [23] was enforced in face-to-face contests.

Even when a written consent is obtained, the person posting has responsibilities in the use of the content; moreover, copyright issues may occur with the content of the presentations. Therefore, we clearly informed from the beginning of the competition all the participants and the jury that taking pictures or movies is not allowed, except pictures of themselves. However, we still feel that the legal background for student competitions on the Internet is unclear and should be addressed in the near future, if the Internet based education were to expand. For example, the competition organizers have no means to control that the participants do not take pictures, or to enforce all the competition rules. There is no clear reference in the legislation on the responsibilities of the participants and of the organizers – a gap that should be filled in as soon as possible. Actually, the same deficiencies apply to online classes and examinations.

Limited differential privacy issues

The differential privacy problem is to provide complete information on a population while preserving full anonymity of the individuals. The problem is key to learning because the learner needs feedback from the teacher and vice versa, moreover improvements of the learning process require detailed knowledge on the learner population. The problem is known to have no solution; therefore, limited differential
privacy is the main topic of research [24], [25]. Adapting in the case of a contest the words of [24], the differential privacy dilemma for participants is to decide on the "difference between the probability of harm given that they participate and the probability of harm given that they do not participate" in the contest, taking into account the ways the contest is documented and its level of public openness.

For understanding the differential privacy issue in the context of competitions where the competitors know who the members of the jury are, and vice versa, consider an example. Because firms bestow their own prizes, the specific firm prize winning competitor easily derives that the firm representative in the jury gave her a large grade, while the other firm representatives have not conferred the largest possible grade. Thus, the competitors gain some very specific information at least on some of the members of the jury. When a competitor gets two firm awards out of the possible few, but does not win any general prize of the competition (for which the academic members of the jury have a vote), information on the vote of the professors is obtained. That information, in turn, may influence the grading of a professor by the respective student. To remove this and fairness concerns, the academic members of the jury should not be allowed to vote for students from their university. Also, it is advisable that the prizes offered by the firms are proposed as sets of choices by the firm representatives and decided with the vote of the academic members of the jury. This would reduce the information gained from the firm prizes.

Under crises, there is a danger that people have less time to decide on privacy issue and that the competitions are more publically open that they need to be. Also, the online character, even when with a limited public, increases the odds of privacy issues. One member of the jury did not agree to use video communication, using audio only. Also, concerns for the members of the jury may have arisen because his supervisors were also able to see the jury deliberations, although he was not a participant in the jury,

Security issues

The security concerns relate to the security and non-disclosure of the files of the deliberations of the jury, the personal data of the jury members, and the private data of the participants, including e-mail addresses, grades obtained, and potentially sensitive details of their projects. The security measures the organizing team of the competition has at hand are scarce, if any, beyond those in place at their Internet provider. Especially in times of crises, legal protection for the organizers, members of the jury, participants, and universities have to be established more clearly. As far as we were able to determine, such legal protections are unavailable today in countries in EU and North America.

VIII. A BRIEF SWOT ANALYSIS

Although it is too early to suggest a true SWOT analysis, we suggest that the following aspects may be supported by some private messages from the participants and by our personal experience in the competition.

(S) An obvious advantage is that competitors that belong from distant cities are able to participate with no travel costs (in all previous competitions, the local university supported the meals and accommodation on site, but not the travel fees.) Also an advantage may be that potential members of the jury who are too busy to travel to the organizing university from other cities could accept to participate in the jury when the contest is online.

(W) The clear weakness of the online competitions is the impossibility of manipulation and testing by the jury of the presented physical hardware. Also, it seems that the winners enjoyed less the online prize announcement than during physical ‘hand-shaking’ congratulations. Otherwise put, the winners are interested to touch the prizes. The presentations are online but the prizes should be “palpable”. The interconnectivity is between two real worlds by a virtual link, therefore both parts are waiting for concrete and real results: the jury wants to see physical structures and the participants are waiting for real prices (diplomas and physical prices).

(O) An untested opportunity is undoubtedly the lower costs of the organization. Also an opportunity might be the more agile organization, with less bureaucratic burden and easier, so faster reaction from the participants, who are no more obliged to seek financial support for the travel. It may be also possible that the number of participants increases. Also, it may be true that the efforts of the sponsors, which are companies interested for future employers, are almost the same in face-to-face and online version. An online edition could be helpful to establish new contacts with students.

(T) The organization burden for the online contest is concentrated to a single organization, with participants expecting to join the contest with no contribution of their universities in the organization. Also, if too many participants wish to enroll in the competition, it is difficult to make a pre-selection online. In the previous, offline competitions, the co-organizing universities made selections.

The above SWOT analysis indicates that some form of a hybrid competition has to be tested, because such a mixed type may have advantages of both online and offline contests yet have fewer disadvantages than both types.

IX. CONCLUSIONS

There are several conclusions that may be useful for the organization of other online student competition under harsh conditions. The main positive conclusion is that the interconnectivity means arise no serious technical issues; current broadband connectivity and numerous good platforms allow reliable and good enough, although limited interactivity. However, it was apparent that online jury-competitors interactivity is poorer than face-to-face interactivity and may have created some frustrations on both sides. The main issues are related to human factors, to higher uncertainties in the organization process, and to much shorter time to spend in the process by the people in the local organizing team. There are several issues specific to the online contest, including concerns on the lower degree of fairness in the participation and evaluation, and serious concerns related to privacy. The analysis of the evaluation process and of the topics of the presentations revealed some unexpected peculiarities, but it is not clear if these are due to the online nature of the competition, to other factors, or are random variations.

Note. A preliminary version appeared at arxiv.org/abs/2005.12087. The only citable version of the paper is this one.

Disclaimer. The article reflects only the opinions of the authors.

Conflict of interests. HNT is the initiator of the contest in 2009 and has been a member of the organizing team since then.
Authors’ contributions. MH and HNT were the local organizers of the contest reported. MH wrote the SWOT section. HNT wrote all the other sections of the paper.

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Reference note: A preliminary version of the paper, (Experimental, ad hoc; online, inter-university student e-contest during the pandemic – Lessons learned), due to H.N.T. only, is at https://arxiv.org/abs/2005.12087 (not including section VIII in this paper).

Annex: The Student Competition of Microsystems and Microcontrollers ‘M. Konteschweller’, 2009-2020

The competition is related to micro-systems and microcontrollers and their applications. Representatives of universities and firms in the field always participated in the contest jury. This year was the eleventh of the contest and it was the first to be organized fully online.

M. Konteschweller was a Romanian-born engineer who worked at Bristol, U.K., France, and Romania; he demonstrated radio remote control of ‘robotic’ devices such as boats in the early 1930’s in Romania; he also served as a professor in the Polytechnic (technical) university of Iasi. He was an inventor with the patent GB400467A “Improvements in or relating to motor cars” obtained in U.K. in 1933 (1933-01-25) [A1], cited in [A2].

According to an account of the TU Gheorghe Asachi of Iasi, [10 “Proiecte], “This is one of the few competitions without an imposed theme”, and “A good feature of this competition is that we attract and encourage two ... categories: on one side the students on the other the companies, and we put them face-to-face.” (Prof. Cristian Aghion, in [11]). This has as a result that the students “all are winners, irrespective of the prize” (Dean, local organizing Faculty, Prof. Daniela Tărnăcieru) [10].

[A1] GB400467A, priority 1933-01-25, published 1933-10-26, Mihai Konteschweller, Improvements in or relating to motor cars.

[A2] US2822214A, Interconnected vehicle front door and steering wheel for easy access to seats. 1953.