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Student's feelings and perceptions of working in ad-hoc virtual teams before and after COVID-19

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Abstract

Online courses with virtual teams have existed for some years but became normalized with the regulations for social distancing during COVID-19. Multinational students from institutions in three countries participated in the Global Entrepreneurship online course, an opportunity-centered Ideation Hackathon developed by the In2It-Erasmus+ team. This course has been conducted once a year since 2017. The instructors noted changes in the attitudes and emotions of the students before and after the pandemic outbreak. The psychological and technological barriers that virtual teams perceived before, such as unclear communications, disappeared after the lockdowns. The feedback surveys, completed after finishing the courses in 2019 (pre-pandemic - 127 students) and 2020 (post-pandemic - 155 students), were compared quantitatively and qualitatively to find dissimilarities. The students broadly acknowledged pedagogical content and teamwork. Social relations, particularly informal interactions, played a significant role in the success of the course and its resilience during the pandemic. The students developed a strong sense of belonging to their team, enabling them to overcome the problems usually encountered in distance learning courses. The enthusiasm of students about this course after COVID-19, in which they learn and practice, opens the door to new types of studies - multicultural, international, experiential, and cooperative.

Keywords: Virtual teams, international course, online course, multinational team, COVID-19.

Introduction

Virtual teams using Information and Communication Technology (ICT) for work or study have existed for more than two decades; however, with the outbreak of the global COVID-19 pandemic, entire populations have found themselves working and studying from home (MacKenzie, 2020), most for the first time. The pandemic suddenly forced every individual, business, and educational institute to adopt virtual communications. Thus, the pandemic has greatly changed all aspects of life, specifically education. Distance teaching has become the primary method of teaching in most schools and higher education institutions worldwide (Leiba & Gafni, 2021). This study is based on the Global Entrepreneurship (GE) online course, an entrepreneurial Ideation Hackathon developed on the In2It (Internationalization by Innovative Technologies EU Erasmus+) LMS platform. Students from British, French, and Israeli academic institutes were grouped in heterogeneous short-term multicultural virtual teams, aiming to learn entrepreneurial skills and mindset through this experience. The students never met in a face-to-face environment. This virtual course, which used a problem-solving approach based on students' learning experience (as opposed

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to a traditional course with lessons to learn and practice exercises), was conducted before and after the outbreak of the COVID-19 pandemic. The course instructors found differences in the attitudes of the students who participated in the courses before and after the pandemic. The instructors decided to investigate the results of the feedback surveys completed after the courses to examine if their perceptions were accurate and to understand any disparities. The article includes a literature review of distance learning (instructional, psychological, and technological aspects) and virtual teams (individual, collective, and technological aspects), methodology, findings, and discussion.

Literature Review

The literature review focuses on the influence of the COVID-19 pandemic, specifying before- and after-pandemic issues on various topics related to distance learning and virtual teams.

Distance Online Learning

*Instructional aspects **before** COVID-19* - Distance online learning in academic institutes has expanded during the last two decades, alongside the expansion of high-speed Internet (Seaman et al., 2018). Boling et al. (2012) investigate online experiences by examining contents, tasks, and pedagogical approaches, suggesting that social interactions and teamwork are essential in motivating and involving online students. Croxton (2014) and Teng et al. (2012) found positive links between interactivity during the course and students' satisfaction and persistence. Isotani et al. (2013) show how guided collaborative learning is an important key to the success of students. Teng et al. (2012) found that instructional design and facilitation positively affect students' learning experiences.

*Instructional aspects **after** COVID-19* - The rapid implementation of digital courses because of the need for social distance and lockdowns, without clear pedagogical strategies and plans created an “emergency remote teaching” (Bozkurt & Sharma, 2020; Iglesias-Pradas et al., 2021), which contributed to the rejection of the contemporary online education experience. The concern is not whether online teaching and learning methods can provide quality education but how academic institutions can suddenly adopt online teaching and learning (Leiba & Gafni, 2021). Skulmowski and Xu (2021) underline the necessity to balance the cognitive load in digital and online learning, such as interactive learning media, immersion, dysfluency, and redundant elements. Dubovi and Adler (2022) suggested implementing new teaching approaches to consider the adverse effects of anxiety. Emergency remote teaching (sometimes without preparation and skills from instructors and students) with effective online learning requires cautious design and planning of instruction (Adedoyin & Soykan, 2020). Interactivity and collaborative activities were more challenging during the pandemic (Tabatabaee-Yazdi, 2022).

*Psychological aspects **before** COVID-19* - Abedin et al. (2010) found that when a sense of community is developed, which is influenced by the characteristics of students, courses, instructors, and technical environment, it improves learning outcomes. Robinson (2013) explored online collaborative group work with the theoretical lens of self-regulated learning and community of inquiry framework and showed that engaging in group work was a source of emotion for the students. Most students report constraints and difficulties participating in online group work. Emotion is considered multidimensional, shaped by social practice and interactions with others,

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and affected by virtual relationships (Sieben, 2007). Conflicts are usually due to misunderstanding, reducing communication instead of increasing aggressive acts (Hertel et al., 2005). Preventing conflicts is difficult due to the reduced co-presence of team members and asynchronous communication. Physical disconnectedness in virtual teams makes it more challenging to implement common goals, the feeling of anonymity and low social control may induce social loafing, and self-efficacy is more challenging to maintain. Xu et al. (2013) found that students' emotion management in online group work is positively related to feedback, goals, and learning-oriented intentions. To understand the outcomes of distance learning, Shen et al. (2013) revealed that online learning efficacy predicts students' online satisfaction. Trust is crucial for virtual team collaboration (Tseng & Yeh, 2013). Positive factors include good relationships, trust, and communication among team members. Lack of communication and low individual involvement are negative factors. Familiarity and team cohesion play an essential role in establishing trust. Emotions linked to achievement are essential for students' competence in 21st-century skills like communication, collaboration, critical thinking, and creativity (Camacho-Morles et al., 2019). Pekrun and Stephens (2010) developed a grid with a three-dimensional taxonomy of achievement emotion (emotion before, emotion during, and emotion after activity), defining achievement emotion as: *"emotions that are tied directly to achievement activities (e.g., studying) or achievement outcomes (success and failure)"* (p. 239) and explaining that research including activity-related emotions, when emotions are positive, is often neglected. To foster the gap, both "sides" of emotion, positive and negative, must be considered (see below in Table 1). For this research purpose, the focus is on the specific dimension of the "after activity" or "outcome".

*Psychological aspects **after** COVID-19* - Zoom fatigue refers to the exhaustion caused by excessive use of videoconferencing tools (Riedl, 2022). This exhaustion includes somatic and cognitive symptoms like tiredness, anxiety, and headaches, based on various factors such as the lack of body language, eye contact, natural interactions with multiple faces, and multitasking during video conferences. Faculty reported tiredness, visual load, and fatigue due to multitasking and a significant drop in students' participation compared to face-to-face encounters, indicating a lack of motivation to be active learners (Leiba & Gafni, 2021). Despite the increase in technological innovation and internet accessibility, the effectiveness of online learning is uncertain as it lacks face-to-face interaction between learners and instructors (Joshi et al., 2020). Dubovi and Adler (2022) notice that the pandemic has negatively affected students, leading to disaffection, which concerns, according to Skinner et al. (2008), both behavioral components (passivity, withdrawal from participation in learning activities) and emotional components (boredom and frustration).

Table 1. Description of achievement emotions

	Positive = pleasant emotion		**Negative = unpleasant emotion**	
	Activating	**Deactivating**	**Activating**	**Deactivating**
Outcomes/ Retrospective	Joy Pride Gratitude	Contentment Relief	Shame Anger	Sadness Disappointment

Based on the table presented by Pekrun and Stephens (2010, p. 239).

*Technological aspects **before** COVID-19* - Online communication familiarity, such as social media, differs from network contributions and does not necessarily translate to effective online learning (Robinson, 2013). Studies suggest a positive correlation between technological self-

efficacy and student achievements (Shen et al., 2013). Teng et al. (2012) found that combining synchronous and asynchronous tools positively impacted students' experiences in a computer-mediated learning environment. Peers strongly influence the adoption of new technology, while ease of use is related to compatibility with existing tools. According to Gikas and Grant (2013), students saw the benefits of using mobile devices for learning but also experienced frustrations. Students did not accept video-based learning due to lack of motivation (Costley & Lange, 2017).

*Technological aspects **after** COVID-19* - Bad connections, provision of equipment and software, compatibility, and synchronous vs. asynchronous instructions were challenges and opportunities in digital learning during the pandemic (Adedoyin & Soykan, 2020). Al-Maroof et al. (2020) studied the effect of fear on technology adoption by students and instructors during the pandemic. Their classmates' reactions and behaviors influence students during virtual online classes, reducing fear and encouraging students to attend the scheduled class. Rot and Gafni (2021) found that students with low self-efficacy experience higher positive academic emotions when turning on their web cameras during Zoom lectures, suggesting that encouraging students to use them could be beneficial. Perceived COVID fear significantly influences perceived effort and performance expectancy (Al-Nuaimi et al., 2022). Satisfaction in online learning and digital platforms comes from eco-friendly technology, while engagement comes from interactions (Hummaira et al., 2022).

Virtual Teams

Hertel et al. (2005) define virtual teams: *"(a) two or more persons who (b) collaborate interactively to achieve common goals, while (c) at least one of the team members works at a different location, organization, or at a different time so that (d) communication and coordination is predominantly based on electronic communication media*" (p. 71). Virtual teamwork refers to ICT-based collaborations that transcend geographical boundaries and time zones (Sieben, 2007). Technology eases the extension of work tasks, allowing remote work and flexible schedules, enabling work to be done anywhere and at any time. Virtual teams, composed of students worldwide, are implemented in diverse disciplines: accounting, psychology, business management, communication, computer technology, education, engineering, information systems, software design, etc. (Gilson et al., 2015). Global virtual effective groups are engaged simultaneously and continuously in three functions: production (including solving problems and task performance), member support (member inclusion, participation, loyalty, commitment), and group well-being (interaction, member role, power politics) (Jarvenpaa & Leidner, 1999).

*Individual and collective aspects **before** COVID-19* - Fineman et al. (2007) called for research to consider how emotions are constructed, modified, or suppressed within virtual team environments. Across the literature, team member well-being has been discussed as theoretically important for member effect and performance because members are often dispersed, work alone on a shared project, and may be unfamiliar with others on their team (Gilson et al., 2015). Hertel et al. (2005) explain that virtual teams must be considered at the individual, organizational, and societal levels. At the individual level, virtual teams reveal some potential advantages: flexibility, time control, higher responsibilities, work motivation, and empowerment of the team members. Potential disadvantages include feelings of isolation, decreased interpersonal contact, increased potential misunderstanding and conflict, increased role ambiguity, and goal conflicts. During a virtual hackathon, the isolation of team members from proximity can result in motivational problems,

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reducing performance and increasing opportunities for interruptions and distractions that would not occur in physical proximity (Jussila et al., 2021). The lack of seeing facial expressions and bodily gestures of hackathon participants is a challenge in communication and collaboration (Jussila et al., 2021). Marlow et al. (2017) explore some propositions to explain the relationship between communication (frequency, quality, and content) and performance (viability, performance, and satisfaction) in virtual teams. Virtual teams tend to be less efficient because coordinating via ICT is more mentally and temporally demanding than coordinating face-to-face (Martins et al., 2004; O'Neill et al., 2016).

*Individual and collective aspects **after** COVID-19* - The COVID-19 crisis revealed the long-term challenges of virtual collaboration. Meluso et al. (2020) wondered if normative design techniques can help to understand individual emotional vulnerability. Kilcullen et al. (2021) propose future research on virtual teams, explaining the lack of literature that differentiates standard remote teams from teams that swiftly transition to virtual work. Rapid adaptation depends on how quickly teams must transition to virtual work and their experience with remote work (Gilson et al., 2015). Using ICT during the pandemic lockdowns was associated with lower feelings of loneliness, boredom, anger/irritability, and a greater sense of belonging (Canale et al., 2022).

*Technological aspects **before** COVID-19* - Virtual collocation involves integrating teams through ICT, like instant messaging, shared cloud documents, groupware tools and videoconferencing. However, these technologies can lead to negative effects like unclear communication, misunderstandings, status differences, and task complexity challenges (Jussila et al., 2021). ICT collaboration creates lags in information exchange, misunderstandings, fewer information-seeking attempts, and incoherent messages (Andres, 2012). Groupware tools can be categorized based on the level of coordination they require low interdependence tools are used for information exchange, while high interdependence tools are used for collaborative tasks (Hertel et al., 2005).

*Technological aspects **after** COVID-19* - The outbreak of COVID-19 and the regulations of social distancing and lockdowns worldwide necessitated rapid adjustments, prompting to move all in-person, face-to-face activities to remote or online, using information and communication technologies. Users increased interaction using technology to seek information and stay socially connected with their families, friends, and social networks. As society's reliance on technology increased during the pandemic and post-pandemic, there was a need to leverage technology to improve health and safety, reducing anxiety and stress (Lee et al., 2021). ICT has become more important in fulfilling basic needs like food supply, education, information, health care, and welfare (Fonseca & Picoto, 2020; Sommerlad & David, 2022) and is especially vital for addressing loneliness during lockdowns (Shah et al., 2020), due to the possibility of enabling online virtual conferences, team meetings, working from home, and online teaching and learning. These became almost the norm of daily life and business during the pandemic. A few examples of widely used online digital tools include Zoom, Microsoft Teams, GoToMeeting, and Google Hangout, which became more accepted and widely adopted during the pandemic. The expectation was that these tools would increase and become a daily business in many fields (Shah et al., 2020). ICT and virtual meetings can promote a higher perception of social support and improve social relationships, especially when close offline relationships are unavailable (Gabbiadini et al., 2020).

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Methodology

In this research, a mixed-method design was chosen, using both quantitative and qualitative research. Mixed methods research involves the collection or analysis of quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, and the data is integrated at one or more stages in the process of the research (Teddlie & Tashakkori, 2003). As Gilson et al. (2015) suggest, a longitudinal design was incorporated. To consider emotion, the literature review studied by Camacho-Morles (2021) defining the types of emotion measures was followed. The results from the quantitative method are explained by a qualitative collection of data (Greene et al., 1989). According to Creswell and Creswell (2018), a strong mixed method should contain at least three research questions: the qualitative question, the quantitative question or hypothesis, and a mixed methods question. Therefore, the research questions are:

RQ1 – Is there a difference in the proportion of positive and negative emotions between the pre- and post-COVID-19 courses?

RQ2 – What are the most important topics that differentiate the students' attitudes between the pre- and post-COVID-19 courses?

RQ3 – If there are differences (according to RQ1), what factors explain the change in the emotions between the pre- and post-COVID-19 courses?

Description of the Sample

The GE course is a joint course of three academic institutions from three different countries: Kingston University London, from the UK, Montpellier University of France, and The Academic College of Tel-Aviv-Yaffo from Israel (Goldstein & Gafni, 2019). The students, both undergraduates and postgraduates, studying Management or Information Systems, were manually grouped into multicultural virtual teams, following a "multicultural" criterion: each team consisted of students from different countries and institutions. The mission of these teams was to participate in a short-term virtual multicultural Ideation Hackathon. The course was conducted with different groups of students before (November 2019) and after (November 2020) the COVID-19 pandemic. The course was conducted in English, which was not the mother tongue of most of the participants. Table 2 presents the number of students from each institute in each course, the number of teams, and the number and percentage of answers to the feedback survey.

The Process Conducted

After finishing the course, the students had to answer a feedback survey. Both quantitative and qualitative analyses are based on the feedback survey data (Appendix 2). The survey was composed of closed questions, with six different statements, for the quantitative analysis and open questions for the qualitative analysis, which were validated during the first year the course was conducted. In the closed questions, students were asked about diverse aspects of the hackathon. The questions were scored using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The open questions were analyzed using qualitative lexical analysis, using the Textometry/TXM platform (Heiden, 2010), and a manual codification. This analysis highlights the differences or similarities between the two courses, the first conducted before the pandemic and the second conducted after. The influence of COVID-19 on the perceptions of the students was examined. The analysis is based on Sieben's research interpretive approaches (2007). The aim was

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to understand the underlying sense-making process. Instead of relying on predefined items, interpretive approaches drawn from ethnography or conversation and narrative analysis were used, focusing on the texts of episodes linked to emotion and virtual work. This was performed in several steps: preparing, coding data, describing, and identifying topics. Afterward, the emotions of each student's citation were examined to define the dimensions of the expressed emotions. The elaboration was performed by each researcher alone, then compared and decided together about the disconformities to get a consensus.

Table 2. Participants of the course

	Number of Answers			Total
Academic Year	Kingston University London	University of Montpellier	The Academic College of Tel Aviv - Yaffo	
2019-2020 (first semester, pre COVID-19)	43 *(21F, 22M)* (79.6%)	39 *(20F, 19M)* (95.1%)	32 *(16F, 16M)* (100%)	114 *(57F, 57 M)* (89.7%)
2020-2021 (first semester, post COVID-19)	56 *(28F, 28M)* (82.4%)	38 *(25F, 13M)* (97.1%)	47 *(21F, 26M)* (97.9%)	141 *(74F, 67M)* (90.9%)

Findings

The quantitative analysis - Cronbach's alpha was used to assess the internal consistency reliability of the research construct, the calculation of which was 0.902. The results of several aspects of activities (and their respective SPSS variables): content (Econtent), teambuilding process (TeamBuild), problem-solving (HPbsolv), teamwork (WorkTeam), communication within the team (ComTeam), and communication with mentors (ComMent) are described in Table 3. In addition to the variables reflecting the activities, the grades obtained by the students were also collected to reflect the results of these activities. This choice should enable the placement of the results in line with the work of Iglesias-Pradas et al. (2021), who looked at the performance obtained by the students during COVID-19 and compared it with the performance obtained before COVID-19. A difference in the average answers between the students who participated in the course before the COVID-19 pandemic started and after, given by scales, was noted.

Table 3. Descriptive statistics of activities performed

SPSS Variable (Activity)	Subgroup	N	Mean	Std. Dev.
Econtent (content)	19	114	3.52	1.146
	20	141	3.95	0.936
Teambuild (teambuilding process)	19	114	3.21	1.258
	20	141	4.05	1.016
HPbsolv (problem solving)	19	114	3.17	1.24
	20	141	3.82	1.066
WorkTeam (teamwork)	19	114	3.13	1.266
	20	141	4.14	1.138
ComTeam (communication within the team)	19	114	3.19	1.282
	20	141	4.18	1.082
ComMent (communication with mentors)	19	114	3.70	1.096
	20	141	3.89	1.029
Grades	19	114	13.96	2.548
	20	141	13.44	2.421

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Leven's equality of variance test indicates that students have more favorable opinions in 2020 than in 2019, except for communication with Mentors, as presented in Table 4.

Table 4. Results from the survey about activities and output

SPSS Variable	Variances	F	Sig.	t	Df	Sig. (bil.)
Econtent	Equal variances	8.401	0.004	-3.319	253	0.001
	Unequal variance			-3.25	216.82	0.001
Teambuild	Equal variances	7.552	0.006	-5.891	253	<0.001
	Unequal variance			-5.76	215.305	<0.001
HPbsolv	Equal variances	3.398	0.066	-4.491	253	<0.001
	Unequal variance			-4.42	223.887	<0.001
WorkTeam	Equal variances	3.494	0.063	-6.704	253	<0.001
	Unequal variance			-6.628	229.712	<0.001
ComTeam	Equal variances	12.387	0.001	-6.882	253	<0.001
	Unequal variance			-6.718	212.964	<0.001
ComMent	Equal variances	1.259	0.263	-1.384	253	0.167
	Unequal variance			-1.375	235.011	0.17
Grade	Equal variances	0.134	0.714	1.685	253	0.093
	Unequal variance			1.676	236.046	0.095

These initial results led to coding the last two questions of the survey, two open-ended questions designed to determine what students enjoyed during the course (Enjoy) and what they would suggest changing (Improve). Coding is a two-step process: First, the words were classified using the Pekrun and Stephens (2010) grid (Appendix 1), and then a number according to the degree of emotion was assigned (Table 5). Positive emotions are coded with positive numbers and negative emotions with negative numbers. When emotions are strong, the allocated code is 2 (+2 for Joy or Pride; -2 for Shame). When emotions are moderate, the allocated code is 1 (1 for Contentment, -1 for Disappointment). The neutral point is 0.

Table 5. Codification of open-ended question

Positive = pleasant emotion		**Neutral = no emotion**	**Negative = unpleasant emotion**	
Joy/ Pride/Gratitude	**Contentment/Relief**	**Description of activities**	**Shame/ Anger**	**Sadness/Disappointment**
2	1	0	-2	-1

The descriptive statistics for the two coded questions, presented in Figures 1a-1d, show a clear difference in the emotions expressed by students before and after COVID-19. Figures 1a and 1b show the differences in the Enjoy variable between 2019 and 2020, and Figures 1c and 1d show the differences in the Improve variable between 2019 and 2020. The graphs were generated automatically during the statistical analysis with SPSS software.

Linear regressions were calculated to better understand what determines enjoyment or improvement. The models used are based on previous research (Avry et al., 2020) that has highlighted relationships between student satisfaction and good or bad course experience (collaboration, team communication, course content). Here, the model is as follows:

Enjoy = Econtent + Teambuild + HPbsolv + WorkTeam + ComTeam + ComMent + b

(b - constant or residue)

The control variables are Country and Gender. The Country variable is divided into two zones: Zone I – Israel, and Zone E – Europe (France and UK). This distinction summarizes the differences

in social-cultural contexts (Pekrun, 2019). The socio-cultural contexts of the European countries were considered to be sufficiently similar to being analyzed as a single context. The Israeli context seemed unique and sufficiently distinct to be considered separately. The Stepwise method was used to select the most relevant variables and avoid collinearity bias. The analysis results show a positive and significant relationship between Enjoy and HPbSolv was found in 2019 (T=3.497; Sig = 0.01); for 2020, no significant relationship was found (Appendix 3).

Figure 1a. Descriptive statistics for *Enjoy* in 2019

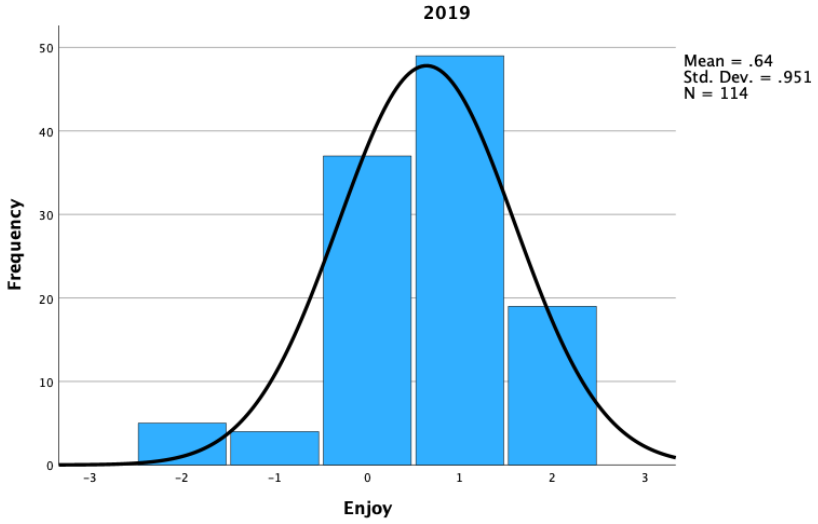
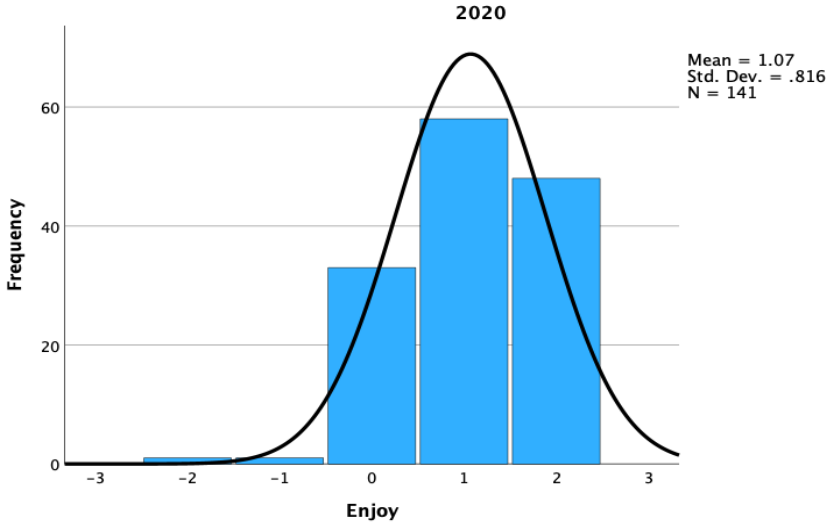


Figure 1b. Descriptive statistics for *Enjoy* in 2020



The same model was used for the Improve variable:

Improve = Econtent + Teambuild + HPbsolv + WorkTeam + ComTeam + ComMent + b

(b – constant or residue)

For the Improve variable, the model gives no relationship for 2019 or for 2020, meaning that students' suggestions for improving the course are not "influenced" by their experience of the

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course. When introducing the control variables Country and Gender, we found two relationships. A positive and significant relationship between the Improve and the Enjoy variables (T=2.251; sig=0.026). Similarly, a negative and significant relationship exists between the Improve and the Country variables (T=-2.988; sig =0.002). Students from Zone E express fewer positive feelings, and those from Zone I explain fewer negative feelings.

Figure 1c. Descriptive statistics for *Improve* in 2019

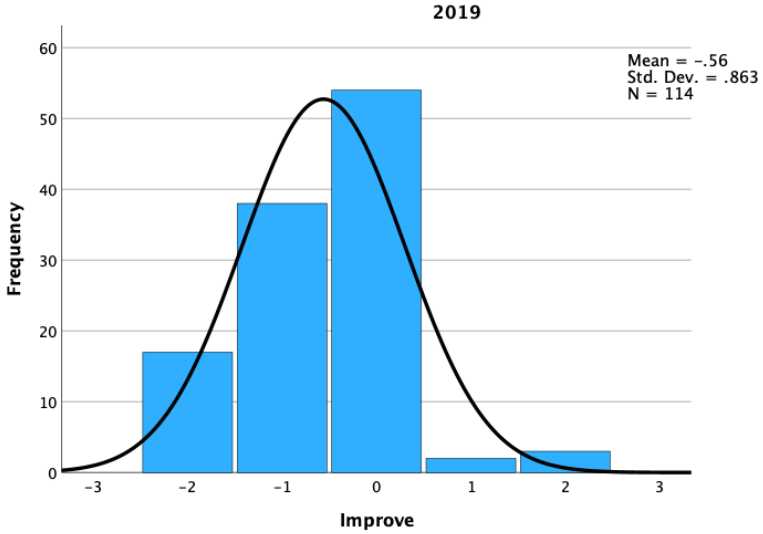
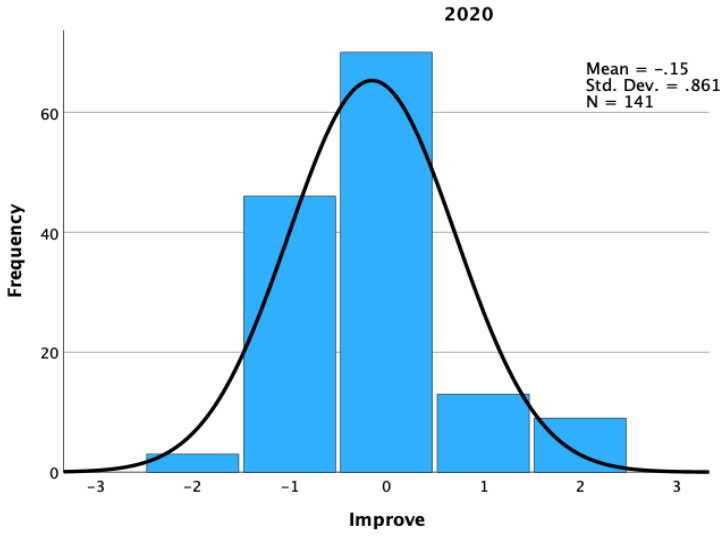


Figure 1d. Descriptive statistics for *Improve* in 2020



The qualitative analysis - The students' perceptions were investigated using two open questions.

Students' perception of what they have enjoyed

Table 6 presents the main themes and codes found to explore students' enjoyment. After using the TXM platform to analyze the students' enjoyment, the usage percentage of the keywords in each course was defined and presented in Table 7. The percentages do not sum to 100 because students could avoid mentioning a citation or could reference more than one topic.

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Table 6. Main codes used to explore data on *Enjoyment*

Main code	Keywords (separated by ;)
The international dimension of the course	International; Diversity; People abroad; Different culture
Teamwork	Work; Tasks; Solve the problem in a new way; and Collaboration
Teammates/personal consideration/feelings	Love my team; Amazing teammate; Great; Fun; Nice person
Meeting/communication	Talk to new people; Meet new students; Interact; and Communicate with new people.
Creativity/brainstorming	Find new ideas; Pitch; Collage; Exchange ideas; Brainstorming
Virtual aspect	Connection; People we don't know; Network
Topic of hackathon	Actual topic; Problems around us; Idea of sustainability
Negative /neutral experience	Enjoy nothing; Not really enjoy; It was interesting.

Table 7. Description of codes used by course for *Enjoyment* (differences between zones)

Main code	% of students who cited pre COVID-19 (2019)	% of students who cited post COVID-19 (2020)
The international dimension of the course	48 % (63% I; 43% E)	49% (43% I; 52% E)
Teamwork	18% (19% I; 18% E)	32% (30% I; 33% E)
Teammates/personal consideration/feelings	5% (0% I; 7% E)	22% (21% I; 22% E)
Meeting/communication	20% (38% I; 13% E)	21% (28% I; 18% E)
Creativity/brainstorming	16% (13% I; 17% E)	16% (17% I; 15% E)
Virtual aspect	11% (2% I; 11% E)	5% (6% I; 4% E)
Topic of hackathon	11% (3% I; 13% E)	4% (2% I; 4% E)
Negative /neutral experience	9% (3% I; 9% E)	2% (0% I; 3% E)

Most citations concern multiculturalism and the diversity of teams. The students enjoy the internationality of the course: *"I enjoyed the multiculturalism of the team" (2019); "I enjoy meeting the Israeli students" (2019); "I enjoyed the possibility of working in a multicultural team" (2020).* The students appreciated the teamwork during the challenge: *"I learned a lot about team building, coordination, and togetherness" (2019).* Negative experience is related to poor involvement of teammates. Some students notice this problem, while others prefer saying, *"To be honest, nothing. None of the team members were involved" (2019)*. The use of different vocabulary between the two years was noticed: Students in the pre-COVID-19 course (2019) wrote: *"It's interesting to share ideas with colleagues from different countries"*; *"I enjoyed working on a project with problems which are around us"; "I mostly enjoyed the diversity of my team members"*. Students in the post-COVID-19 course (2020) wrote: *"They were so engaging and wonderful"; "One of the best things that happened during this period was that I met new friends"*; *"Conquering the unknown (people I've never met before)"*; *"I had a lovely team, cooperation, all opinions were flooded"*. To investigate this aspect further, the two levels of emotions presented by Camacho-Morles et al. (2021) were used (See Appendix 1: Codification of Emotion). The answers were divided into groups: answers with positive, negative, and neutral emotions. In positive emotions answers, some students have expressed satisfaction about more than one item: *"I enjoyed that we got to meet and work with people from different cultures".* In this case, two instances were counted: one for teammates (*"I enjoyed … got to meet"*) and one for teamwork ("I *enjoyed…work with people from different cultures*"). At the end of the analysis, a total of 122 citations in 2019 and 151 in 2020 were found. Table 8 represents the numbers and percentage of positive citations. For example, in 2019, three citations with high positive emotions about teamwork were found, representing 2% of the total citations, while in 2020, students expressed 10% high satisfaction. In

2019, 14% of instances expressed a high level of satisfaction and 38% in 2020. Neutral emotions were similar - 30% in 2019 and 29% in 2020. Negative outcomes: 7% were encountered in 2019, and only 1% in 2020: "*Not really enjoyed"; "To be honest, nothing"; "I did not enjoy"*.

Table 8. Instances of emotions of *Enjoyment* in students' answers (differences between zones)

Outcome/Retrospective	**Joy/Pride/gratitude**		**Contentment/Relief**	
Years	**2019**	**2020**	**2019**	**2020**
Teamwork	3 (2%) (6% I; 1% E)	15 (10%) (8% I; 11% E)	18 (15%) (24% I; 11% E)	12 (8%) (10% I; 7% E)
Teammates	5 (4%) (6% I; 3% E)	31 (21%) (23% I; 19% E)	8 (7%) (6% I; 7% E)	25 (17%) (23% I; 13% E)
Communication with team	4 (3%) (both zones)	3 (2%) (both zones)	21 (17%) (27% I; 13% E)	12 (8%) (4% I; 10% E)
Program	5 (4%) (0% I; 6% E)	9 (6%) (8% I; 5% E)	13 (11%) (9% I; 11% E)	13 (9%) (10% I; 8% E)
Total	**14%** **(15% I; 13% E)**	**38%** **(40% I; 37% E)**	**49%** **(67% I; 43% E)**	**41%** **(46% I; 38% E)**

Students' perception about what could be improved

Table 9 presents the principal codes found to explore issues students ask to improve.

Table 9. Main codes used to explore data for *Improvement*

Main code	**Keywords (separated by ;)**
Schedule/times	More time; Change dates; More than one week
Organization of the course	More instruction; Same instructions for all; Clearance; Coordination between instructors; Example; Video to explain; More eLearning
Communication between students	Students didn't answer; Communication was difficult.
Teamwork failures	Freeriding; Lack of involvement
Meeting	Face-to-face meetings; More global meetings; Team meetings
Topic of hackathon	Choosing our topic
Evaluation process	Same evaluation for all; Mentor evaluation
Neutral experience	I don't know
Positive experience	Don't change anything

After analyzing them using the TXM platform, the usage percentage of the keywords in each course was calculated and presented in Table 10. The percentages do not sum to 100 because students could avoid mentioning a citation or could reference more than one citation.

Table 10. Description of codes used by course for *Improvement* (differences between zones)

Main code	**% of students who cited pre COVID-19 (2019)**	**% of students who cited post COVID-19 (2020)**
Schedule/times	26% (13% I; 32% E)	26% (17% I; 30% E)
Organization of the course	16% (9% I; 18% E)	26% (32% I; 23% E)
Communication between students	11% (6% I; 12% E)	3% (6% I; 4% E)
Teamwork failures	19% (22% I; 18% E)	9% (both zones)
Meeting	2% (both zones)	2% (both zones)
Topic of hackathon	2% (both zones)	3% (both zones)
Evaluation process	6% (3% I; 7% E)	4% (both zones)
Technical aspects	8% (13% I; 6% E)	5% (both zones)
Neutral experience	9% (both zones)	6% (both zones)
Positive experience	3% (both zones)	13% (6% I; 16% E)

The two levels of emotions presented by Camacho-Morles et al. (2021) were used to investigate this aspect (Table 11). We proceeded the same way as in the Enjoyment question. Answers with neutral emotions were found: 46% in 2019 and 50% in 2020. Six positive (5%) citations were found in 2019 and 22 (16%) in 2020, for example: *"Keep it as it is. Thank you very much for giving us this unique opportunity*" (2020). In 2019, negative feelings were associated with time pressure and poor instructions. In 2020, the same associations were found, but the students insisted more on the clarity of the instructions. As can be seen, 3% of the students in 2019 and 13% percent of the students in 2020 didn't identify anything to be improved.

Table 11. Instances of emotions in the *Improvement* found in students' answers (differences between zones)

Outcome/Retrospective	**Shame /Anger**		**Sadness / Disappointment**	
Year	**2019 (N=118)**	**2020 (N =141)**	**2019 (N=118)**	**2020 (N = 141)**
Teamwork	11 (9%) (both zones)	0 (both zones)	9 (8%) (9% I; 7% E)	11 (8%) (6% I; 9% E)
Teammates (personal evaluation)	2 (2%) (both zones)	0 (both zones)	2 (2%) (both zones)	1 (1%) (both zones)
Communication	1 (1%) (both zones)	0 (both zones)	8 (7%) (9% I; 6% E)	3 (2%) (0% I; 3% E)
Program	4 (3%) (0% I; 5% E)	2 (1%) (both zones)	21 (18%) (both zones)	33 (23%) (34% I; 17% E)
Total	**15% (9% I; 18% E)**	**1% (both zones)**	**34% (36% I; 33% E)**	**33% (43% I;2 9% E)**

Discussion

Same content but better appreciation in 2020 - Research on distance education has pointed out the difficulties faced by students during the COVID-19 crisis (Bozkurt & Sharma, 2020; Leiba & Gafni, 2021). These difficulties largely stemmed from courses constructed in emergency mode and a generalized context of improvisation. The course studied in this article was not constructed in an emergency mode but meticulously planned. The course was created and tested before the COVID-19 crisis (2016 and 2017 academic years). Throughout the years, the course has been run by the same instructors from each academic institution who taught it. The course has undergone modifications and improvements until the 2018 academic year. After that, the course's structure and organization have not changed. Therefore, the courses were identical in 2019 and 2020, which is this research's subject. The changes that have been observed do not come from the instructional design. In both years, the same proportion of students asked for more clarity and precision in the instructions. Consistent with previous research (Isotani et al., 2013; Teng et al., 2012), comments about the program are at the top of the list of suggestions for improvement. Nevertheless, unlike those research studies, this dimension does not affect the students' positive experience in 2020. This indicates that the environmental context can influence students' perception of the course content; despite this positive experience and contrary to the results of Iglesias-Pradas et al. (2021), which indicate that students who have undergone the COVID-19 crisis perform well academically, the results find no significant difference between the two subgroups in terms of grades.

Stronger sense of community - The results suggest that students may have developed a stronger sense of community in 2020, as Abedin et al. (2010) and Swartz and Shrivastava (2021) described. Students demonstrate a more positive attitude towards teamwork and their peers (Tables 7, 10, and

11). The students of the post-COVID-19 course, conducted in 2020, personalize their preferences and express joy when talking about their peers. These attitudes can be linked to the results of Swartz and Shrivastava's study (2021). During the COVID-19 crisis, some teams became more cohesive, with students showing more empathy towards each other – the students appreciated the collaborative work. Contrary to the work of Hertel et al. (2005), the physical distance did not affect their motivation. This can be explained by the change that happened worldwide because of the pandemic, with enforced lockdowns and social distancing. Students were eager to meet and work with other students.

Changes in emotions - Camacho-Morles et al. (2019) highlight the importance of emotions of accomplishment in communication and collaboration skills in the 21st century. Pekrun and Stephens (2010) explain that *"The impact of task design and environments on achievement emotions is largely unexplored, with the exception of research on the antecedents of test anxiety" (p. 244).* This research brings a new perspective comparing two courses with the same instructions and design. The results showed that students learning after the outbreak of COVID-19 expressed more positive emotions than pre-pandemic students. When tasks and activities meet individual needs, positive activity-related emotions could increase. Pekrun and Stephens (2010) illustrate this with the example of cooperation in work environments, which fulfills the need for social relatedness. In this study, the change in the emotions expressed can be explained by several factors:

[1] The feeling of isolation usually highlighted in virtual teams and distance learning studies was amplified during the COVID-19 crisis. The GE course helped to break this isolation. Meet/meeting were the most frequently cited words by students in 2020.
[2] Since the course's inception in 2017, the instructors have become accustomed to enjoying presenting the course. They know and appreciate each other and take pleasure in running this type of course. During the COVID-19 crisis, the instructors continued to show positive emotions (joy at being together, joking, and encouragement), contributing to a favorable learning atmosphere in line with the work of Horovitz and Mayer (2021).
[3] Some students testify that they shared their experiences of confinement and suggest that conversations went beyond the course, implying that the course has increased interpersonal contacts. The results complement the work of Xu et al. (2021), who explored the dynamics created during a course between social support and emotional well-being. In our case, social and emotional support helped reduce emotional discomfort due to the pandemic.
[4] Students' teamwork played a new role and became more popular in 2020. The results indicate that the "anger and shame" dimension for teamwork is equal to zero in 2020. The words “new” and “different” were cited more in 2020. It can be hypothesized that the activity brings students joy and satisfaction, which aligns with traditional research (Croxton, 2014).
[5] Similarly to other research on COVID-19, sadness and anxiety due to the pandemic played a role. However, in this case, the "general" sadness helps to explain why students were so joyful during this course. Klonek et al. (2022) argue that the COVID-19 crisis has accelerated how well individuals collaborate during virtual activities. The findings illustrate an external aspect of organizational learning (Scipioni, 2021).
[6] The course is not a traditional one. The students developed know-how during the Hackathon and needed to exchange tacit knowledge between themselves or during mentoring sessions with their instructors to achieve the course objectives (Murumba et al., 2020).

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Changes in technology adoption - This study found fewer technical problems in 2020 than before. In the improvements' quotes, students suggest changing the layout of the platform pages or improving instructions. There are no complaints about the format of the course or difficulties connecting. This is consistent with the propositions of Klonek et al. (2022) and Swartz and Shrivastava (2021), explaining that new normalities emerged after the pandemic: remote work and virtual teams. In addition, good cohesion was noted in the 2020 group. These results follow the work of Al-Maroof et al. (2020). The authors demonstrate that technology adoption is enhanced during crises when students have no other choice. Similarly, students are also influenced by the reactions of their class. The cohesion noticed in 2020 may have played a role in this. These results confirm the reciprocal influence of digital competencies, social support, and student engagement during the crisis. These aspects have been highlighted by Oberländer and Bipp (2022).

Conclusions

Despite the detrimental effects of the COVID-19 pandemic on the world's population, the pandemic had some interesting benefits on technology adoption and digital transformation worldwide. The lockdowns and social distance isolation regulations stimulated a rapid move from all in-person, face-to-face activities to virtual ones using ICT. Although some populations had a prior recoil and fear of technology, the sudden situation forced everybody to change their habits and, thus, become used to technology. In this case, which is an example, students were used to working in face-to-face teams, having bad feelings about online virtual teams of the international team, and having troubles and constraints using the technology before the pandemic.

When the course began in November 2020, the main technical difficulties had been surmounted - the students had become used to following online learning courses. As a result, the students enhanced their digital skills, which may explain why the relational aspect was so important in the GE course. Indeed, through this course, the students have found (beyond the social networks they know) other students who share the same concerns in an anxiety-inducing environment. This virtual sharing of experiences may explain why everyone is so involved in the teams' activities and why the proposed activities are so satisfying, which is aligned with Nair and Solanki's (2023) suggestion that knowledge management among students during the COVID-19 pandemic was based, besides the ICT infrastructure and resources, on willingness, feelings of isolation, and boredom. The results suggest that technology adoption can be related to informal relations and peer support, leading to positive feelings.

Beyond these observations, the experience has led the instructors to reconsider the international GE course. The students have learned from their personal and academic experiences, and the instructors have also progressed in their knowledge of coordinating virtual teams. This kind of learning can be described as organizational learning because all the players are involved. Thus, it has influenced the effectiveness of overall knowledge management, especially referring, as Black Bernat et al. (2023) proposed, to culture, communication, ICT, methods, and organizational structures on the one hand and to the soft skills learned and experienced by the students such as collaboration, leadership, trust, and adaptation, on the other hand; all of them included in the GE course. Moreover, new routines emerged. For example, at the academic institution hosting the

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learning platform, the IT department has developed a new routine for registering foreign students who are not officially enrolled at the university.

Although this research does not concern the organization of a course, the results we have obtained lead us to consider how the course is run. The first step is to gain a better understanding of what makes a course attractive to students and, therefore, encourages positive feelings. According to Saeed et al. (2023), increasing knowledge sharing among the team members increases virtual teams' performance, especially when teams face cultural differences and schedule issues, which are relevant to the GE course.

- This course is based on students' experience: They have to organize themselves to produce a result. This is not a traditional course. The instructors within the involved academic institutions must give the students freedom to self-organize.
- The information and materials needed for the course are organized and accessible online, using a shared LMS, which is a critical factor for knowledge management and the success of the course (Nair & Solanki, 2023).
- The teaching team must be fully aware of the cultural differences between countries to prepare their students to confront these.

It is important to reflect on the interpersonal relationships that have been developed on the fringes of this course for both instructors and students, which affect the emotions of the students:

- It is imperative that the instructors know each other and that they have been able to meet physically before the start of such a course. This was the case in this example, as the instructors had participated in a European project that lasted several years. This helped to create bonds of friendship and trust. Over the years, the instructors have learned to work together, sharing their tasks and experiences.
- The relationships of trust established within the teaching team also foster the relationships of trust that will develop between the students. According to Saeed et al. (2023), team members share more knowledge if they trust each other.
- It is important for instructors to be aware of the interactions that exist outside the classroom. Team members with a strong willingness to connect would create a strong bond, which motivates them to communicate and share more knowledge with others (Saeed et al., 2023). In this case, the social relationships developed at a distance, outside the classroom, reinforced the feeling of belonging and the satisfaction of working differently in a difficult context.
- The informal context of a distance learning course becomes even more important than the formal context. Interactions between students (synchronous or asynchronous/self-organized) have as much, if not more, impact on learning than instructors' explanations.

Fulfilling these conditions can encourage a positive experience of the course (even if they are not sufficient). The information sharing within the virtual teams and the collaborative learning positively impacts the team's performance, leading to the successful completion of the project (Saeed et al., 2023; Santoso et al., 2024). These conditions enabled the instructors and students to overcome the critical situation of the pandemic.

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Limitations and Future Research

This research has some limitations. The COVID-19 pandemic outbreak could not be anticipated. This research has not been planned beforehand, and the post-survey was not intended to check the differences in the attitudes of the students before and after the pandemic. Instead, it was planned to be used for other course goals. After the instructors found the differences in the students' attitudes, the relevant questions from the survey were extracted and analyzed in that direction. If we could have imagined and predicted the outbreak of a pandemic, we could have defined a different and more specific survey.

Existing literature has shown the limitations and difficulties of distance learning during the COVID-19 period. Our case study shows exactly the opposite: the students did not experience any greater difficulties and rated the distance learning course positively during the confinement period. Analysis of the verbatim reports shows that informal social interaction played a more important role in team cohesion during the COVID-19 period. Interactions outside the course enabled students to retain the positive aspects of their experience. Future research avenues are as follows: Does the positive perception of the course persist after COVID-19? Are these positive perceptions linked to the attractive format of the course or to students' habit of collaborating at a distance (whether at the university or international level)? Can a change in the teaching team in charge of the course contribute to a change in positive perceptions of the course?

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Appendix 1: Codification of Emotion

Joy/Pride/gratitude (question Enjoy)		Contentment/Relief	
I enjoyed I really enjoyed Enjoyed so much Wonderful It was great, they were great One of the best things Nice working with Nice team Unique course Amazing people	Loved to meet... I was able to made friend Everything was so much easier with them Was a true pleasure I was pleased to meet It was exciting Was fun and interesting Working with amazing person	The experience Experiment Discovering Work in a different way Freedom to create Collaborate I learnt a lot Working on my English	Communicate Challenge my English Learned new things My teammates Meet new people, My team members Product innovation
Shame /Anger (question Improve)		**Sadness /Disappointment**	
Lack of commitment Not enough involved Awful Worst Not fair Free rider	Did not do anything, Extremely uncommitted We struggled In order to kick them out I don't want to pay for that	Not good It needs to give incitation More feasible Explain it better Making people more motivated It was unregulated	You need to improve communication Make sure everything is fine It was unclear More interesting Improve It was hard

Appendix 2: Post Survey – Relevant Parts

Please tell us how well the following met your expectations (1 = not at all; 5 = exceeded expectations)	Entrepreneurial content (video, slide decks, etc.) Team building Process Hackathon Problem-solving week Working with your team Communication with your team Communication with course mentors
Please tell us something you enjoyed about doing the Hackathon.	
Please tell us something we could improve within the Hackathon.	

Appendix 3: Linear Regression Results

ANOVAa,b

For 2020 Subgroup: The software indicates the message: No variables have been entered in the equation

Model		Sum of squares	ddl	Mean Square	F	Sig.
1	**Student**	10.067	1	10.067	12.231	.001c
	Regression	92.187	112	0.823		
	Total	102.254	113			

a Dependent Variable: Enjoy
b Subgroup = 19
c Predictors: (Constant), HPbsolv

Coefficients a,b

	B	Stand. error	Beta	T	Sig.
Constant	-1,22	0,234		-0,520	0,604
HPsolv	0,241	0,069	0,314	3,497	0,001**

a Dependent Variable: Enjoy
b Subgroup = 19

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ANOVAa,b						
For 2019 Subgroup : The software indicates the message : No variables have been entered in the equation						
Model		**Sum of Squares**	**ddl**	**Mean Square**	**F**	**Sig.**
1	**Student**	6.269	1	6.269	8.928	.003c
	Regression	97.603	139	0.702		
	Total	103.872	140			
2	**Student**	9.727	2	4.864	7.129	.001d
	Regression	94.145	138	0.682		
	Total	103.872	140			

a Dependent Variable: Improve
b Subgroup = 20
c Predictors: (Constant), Country
d Predictors: (Constant), Country, Enjoy

Coefficients a,b

	B	**Stand. error**	**Beta**	**T**	**Sig.**
Constant	0,158	0,189		0,838	0,404
Country	-0,266	0,082	-0,264	-3,239	0,002
Enjoy	0,193	0,086	0,183	2,251	0,026

a Dependent Variable: Improve
b Subgroup = 20