L-Università ta' Malta
Faculty of Engineering

BLISS

Erasmus +: BLISS

Blended Learning Implementation for reSilient, acceSsible and efficient higher education

Project 2021-1-SE01-KA220-HED-000023166

Project Result 1

Deliverable 1.1.1, Database of Analysed document

Deliverable 1.1.2, A set of requirements for completing the information from each institution

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Document heading

Project title:	Blended Learning Implementation for reSilient, acceSsible and efficient higher education
Project result:	**1**
Leading org.:	University of Malta
Output title:	Mapping of the Covid-19 impact on the adoption of blended learning strategies
Authors:	University of Malta with input from the entire consortium

Project Result 1 Summary

The Covid-19 pandemic forced Higher Education Institutions (HEIs) worldwide to rapidly rethink their learning strategies. This sudden acceleration in the integration of online tools into teaching, particularly in digital technologies, has created a unique global experiment in the implementation of blended learning strategies.

The BLISS consortium comprises universities from different parts of Europe, each experiencing varying degrees of pandemic severity and government responses. For example, Bergamo, Italy, was one of the hardest-hit locations in Europe, while Sweden and Malta implemented comparatively less restrictive measures. While the education system successfully adapted to maintain continuity, the diverse responses across institutions led to different learning strategies at various stages of the pandemic. Each participating university has conducted an independent analysis of its response to Covid-19 responses, generating a valuable dataset for assessing blended learning implementation in HEIs. This provides an opportunity to examine its potential, identify challenges, and establish best practices for more effective adoption.

Although the BLISS consortium primarily focused on engineering curricula, the findings are expected to have broad significance for the entire higher education community.

List of Overall Tasks

Task 1.1 – Analysis of Institutional Reports

- Collect and review documents from all partner institutions regarding their Covid-19 response.
- Identify best practices and gaps in information.
- Compile a standardized dataset.

Task 1.2 – Development of the Survey Questionnaire

- Design a questionnaire based on insights from **Task 1.1**.
- Include both quantitative (e.g., multiple-choice, scaled questions) and qualitative (e.g., open-ended) sections.
- Establish the best methodology for data collection.

Task 1.3 – Conducting the Survey

- Distribute the questionnaire to educators in **engineering education** at partner institutions.
- Gather responses and build a database for analysis.

Task 1.4 – Data Analysis & Conclusions

- Analyze survey data to identify **patterns and trends** in pandemic responses.
- Evaluate the **effectiveness of different blended learning approaches**.
- Synthesize findings into a research paper.

Project Result Implementation

Division of work

Activity Leadership and Planning The University of Malta led this activity and organized the related work as planned.

The University of Malta (UM) lead this initiative, with active participation from all partner institutions. Each institution has already, to varying degrees, assessed the impact of Covid-19 on its academic activities. This activity benchmarked existing evaluation approaches and enhance the analysis through a structured survey. The joint evaluation of different institutional experiences will serve as a foundation for further development.

1 Task 1.1 – Analysis of Institutional Reports

The first step involves reviewing the documents produced by each institution in response to Covid-19. Partners will share and compile available information, and a dedicated team—led by UM and including representatives from all institutions—will analyze these materials. The goal is to identify best practices, highlight gaps in the data, and ensure a consistent and comprehensive dataset across all institutions.

Deliverables:

- **(1.1.1)** Database of analyzed documents.
- **(1.1.2)** Set of requirements for completing missing information from each institution.

The University of Malta was mainly responsible for Task 1.1.1, by compiling the database and analysing the documents. All project partners were responsed for Task 1.1.2. by compiling a set of documents and information from each institution.

Project Deviation

The duration of the activity was extended and conducted concurrently with PR2, since after discussions during the kick off meeting the BLISS consortium decided that there was a lack of necessity to complete PR1 prior to the initiation of PR2. This decision to prolong the timeline proved to be beneficial, as it allowed for a more thorough and detailed examination of the documentation provided by the participating universities. Initially, the documents were found to be inconsistent across institutions, which presented challenges in standardizing the data. The additional time granted the research team the opportunity to review and analyze these materials more carefully, ensuring that all relevant information was captured and assessed effectively.

In addition to the extended timeline, a questionnaire was developed and distributed to enhance the data collection process. The extended timeframe allowed for a longer data collection period, enabling the team to gather more comprehensive and diverse data from the various institutions. This, in turn, contributed to a more accurate and robust dataset. The combined effect of both the prolonged activity and extended data collection period allowed for a more complete and detailed analysis. This ultimately resulted in higher-quality findings, offering deeper insights into the impact of Covid-19 on the higher education landscape, particularly in the context of engineering education.

Project Result 1 in the context of the Project

PR1

- Conducted a comprehensive analysis of the diverse responses to the Covid-19 pandemic across different Higher Education Institutions (HEIs) within the consortium.
- Compiled and benchmarked the reactive measures implemented by various institutions to tackle the pandemic's impact on education

PR2

- Analyzed existing literature and Covid-19 experiences to identify successful blended learning strategies.
- Developed a research diary to highlight trends and define requirements for improving curricula through blended learning.

PR3

- Selected and developed at least three educational units based on identified requirements for blended learning.
- Created detailed syllabi for the selected educational units, ensuring alignment with pedagogical approaches.

PR4

- Implemented the new educational units and assessed their effectiveness in improving learning outcomes.
- Evaluated and documented the organizational impact of blended learning courses on the education system.

PR5

- Facilitated the exchange and implementation of developed educational units across consortium partners.
- Conducted a cross-evaluation of the educational units to propose environment-specific modifications for better applicability.

Result of Activities

Review of Literature

The notion of blended learning (BL) brings together two opposing ends of the spectrum; the in-person traditional approach towards learning and the online counterpart. This allows for exploiting the advantages of both approaches simultaneously and is most prominent within Higher Educational Institutions (HEIs) [1]. Bhagat et al. list four criteria deemed essential for the formulation of study units following a BL approach; “context”, “pedagogical framework”, “instructor competency” and “technical issues” [2] . Having said that, Garrison and Kanuka implore on the importance of employing the online counterpart on the onset of study unit design; as opposed to merely adding online material once the study unit is already established via in-person teaching [3]. The need to comprehend this suggestion came forth clearly during Covid-19; whereby remote tutoring was the only viable option, and replacements for otherwise in-person lectures were necessitated. This grasping of the situation may thus be exemplified by introducing three major phases (Phase 1 - 3) that establish different instances within the Covid-19 pandemic, as presented in Figure 1. Phase 0 is added to note the existence of blended learning prior to the start of the pandemic.

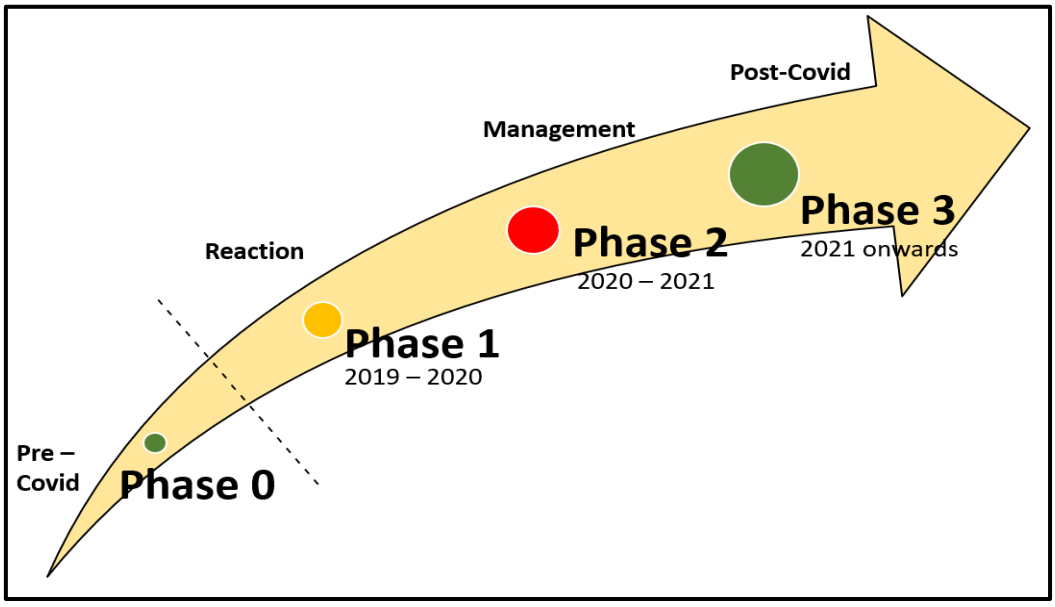

Figure 1 - Classification of the three major phases of the Covid-19 pandemic

Over the course of the Covid-19 pandemic, about one and a half billion learners had to undergo the effects of universities shifting to online teaching [4]. Subsequently, as we are emerging from the pandemic, UNESCO has launched the initiative of #LearningNeverStops. Such a motto instigates the drive to adopt all lessons learnt during these past three years and ensure that future learning is improved to meet these new needs and overcome obstacles. This section aspires to present a brief state-of-the-art regarding the evolution of education (in particular, engineering) during the pandemic and moving forward.

Most of the work in literature acknowledge the toll that the pandemic rendered on both the students and equally, their professors; underscoring themes such as motivation [5], the state of “thriving” as well as caring for “students traditionally minoritized” [6] or “under-privileged” [7] to ensure a more inclusive experience. Despite the influx of emerging themes correlated to psychology, only few literature works shed light on the

universities' input to assist their students' needs. This is most commonly limited to providing practice exams for self-assessment, in addition to reducing course difficulty and expectations.

Krishnakumar et al. urges engineering faculties to prioritise paralleling practical engineering examples and careers in study units; as well as to allow students ample time to orient themselves to the resources at hand [6]. Such significant suggestions are to be taken on board when study units are either redesigned to allow for blended modality, or new modules are designed from scratch. This reiterates the proposals set by Guppy et al. who note that design of the study units (social aspect, delivery mode and pedagogy) are aspects whose importance emerged through the Covid pandemic and challenges encountered [7], [8]. Similarly, Hung et al. owe the success of remote learning to ease of self-assessment, network quality and the student's ability to manage their studies [5].

An observed exclusivity is vivid in the majority of the research works, whereby interviews, questionnaires and surveys focus on students, lecturers or both [6], [7], [9], [10], [11], [12]. Other research works broaden the sample population to incorporate administrative staff and design specialists [8]. Having said that, Asgari et al. draw attention to the faculty administration and how the allotted budget for each scholastic year had to be amended to cater for the unprecedented transition [7]. Although this is a step in the right direction, there are no research works that devote time to express how the universities' work paralleled that of the national government during the Covid pandemic; or whether any efforts were rendered by the Universities to assist the national Covid situation.

Butnaru et al. test eight different hypotheses, ranging from the efficacy of face-to-face learning in motivating students' attendance; the significant role played by technology in enhancing online learning and the influence of institutional management in ensuring a smooth transition [9]. The study would have been amplified had the authors simultaneously considered the lecturers' views based on the same variable criteria. The BLISS project acknowledges this imbalance and shall consider both ends of the spectrum (students and lecturers) when testing its hypothesis and conceptualising blended study units. Another observation is that the majority of data collection through available literature was attained through interviews or surveys; and thus the potential exploitation of reviewing internal correspondence issued during Covid was overlooked. This is hence strongly recommended due to the reputability of such documentation, reflecting the course of action adopted by universities and how lecturers were advised to transition online.

Notwithstanding, moving forward from the Covid pandemic demands attention concerning the future of engineering education, namely upcoming amendments to curricula to include blended learning modalities [10] . Some authors have recommended that a reshuffle of how technology is infiltrated within study units' structure should be prioritised, yet fail to exemplify, through practical study modules, how this can be achieved [9],[10]. Subsequently, one must also bear in mind that diverse courses demand individual attention upon restructuring. For instance, Yu et al. simulate the time window in which online facilities should be implemented within an in-person safety system engineering lecture, so as to heighten attention span and maximise on the hybrid modality's advantages [10]. This may thus vary depending on both the topic taught and the receiving audience.

Guppy et al. assess the predicted influence of the shift towards remote modality, the newly-formed opinion on employing blended learning post Covid and the lecturers' view on the post-Covid reform. Six criteria were employed by the authors [8] in attempt to anticipate forthcoming scenarios "two or three years" following Covid; resulting in blended learning being the most voted by participants (out of 281 staff members and 4243 students), followed by fully online courses envisaged as the way forward. In spite of this, the authors [8] ascertain that there is yet no concrete evidence to sustain the concept of "University 4.0" [13].

Following this detailed review, a segregation of research works can be applied based on four separate stages in the Covid-19 timeline. Table 1 summarises these four phases and attributes the research works to each phase.

Table 1 - Phases of the Covid-19 timeline and related papers

Phase Name	Timeline of Events	Paper Title	Author
Phase 0	Pre Covid-19	Learner readiness for online learning: Scale development and student perceptions	Hung et al.
Phase 1	Reaction to Covid-19 (2019 - 2020)	Using workplace thriving theory to investigate first-year engineering students' abilities to thrive during the transition to online learning due to Covid-19	Krishnakumar et al.
		An observational study of engineering online education during the COVID-19 pandemic	Asgari et al.
		The Effectiveness of Online Education during Covid 19 Pandemic—A Comparative Analysis between the Perceptions of Academic Students and High School Students from Romania	Butnaru et al.
		An exploration of engineering instructors' pedagogical adaptations early in the COVID -19 pandemic	Manierre et al.
		Engineering education amid a global pandemic	Grodotzki et al.
Phase 2	Management of Covid-19 (2020 - 2021)	An observational study of engineering online education during the COVID-19 pandemic	Asgari et al.
Phase 3	Post Covid-19 (2021 onwards)	The post COVID-19 future of digital learning in higher education: Views from educators, students, and other professionals in six countries	Guppy et al.
		Research on the Mixed Education Mode for the Safety Engineering Major during the Coronavirus (COVID-19) Epidemic	Yu et al.

	Educational trends post COVID-19 in engineering: Virtual laboratories	Vergara et al.
	Higher Education in the First Year of COVID-19: Thoughts and Perspectives for the Future	Cesco et al.

The research work also seeks to comprehend whether the incline towards blended learning is generic across all students, or whether the trends change based on criteria such as age, course and personal preference [8]. Novel hypothesis could assess the forecasted ratio of classes held on campus to those held remotely; the modality of teaching as well as how practical engineering skills would be best imparted under this new modality [13]. This is not an entirely easy feat, and Yu et al. conform by commenting that to test pilot-project study units, real-time teaching would have to be disturbed. Simulation is hence advocated for here [10].

Vergara et al. and Asgari et al. have already attempted to grasp the situation by unveiling the benefits of virtual engineering laboratories (such as manufacturing laboratories in the case of [14]) utilising Virtual Reality (VR) and present room for improvements. Whilst this new concept of teaching engineering laboratories is not frowned upon, Vergara et al. comment on how students still deem in-person laboratories as imperative throughout their engineering education (Vergara et al., 2022). Asgari et al. note the possibility of imbalance between students who lack practical hands-on engineering experience [7]. This final comment sets the scene for the upcoming stages of the BLISS project, whereby new engineering study modules should avoid have a situation where one pedagogy (example online learning) overpowers another.

Methodology – Towards an Analysis of Documents obtained from the Partner Institutes

This section of the report shall recount the experiences of the Faculties of Engineering in six European universities who partake in the Erasmus+ project BLISS (Blended Learning Implementation for reSilient, acceSsible and efficient higher education). The goal of this project is to raise awareness on the applicability and effectiveness of blended learning in higher educational institutions (HEIs), by developing study units that cater for a fresh approach towards engineering education in HEIs and back this up through implementation of a blended learning methodological structure. The member universities are ‘Universita’ degli studi di Bergamo’ in Italy, ‘Sveučilište U Rijeci’ in Crotia, ‘Politecnico di Torino’ in Italy, ‘KTH Royal Institute of Technology’ in Sweden, the University of Malta and Univerza V Ljubljani in Slovenia. The BLISS team comprises almost twenty-five members of staff of diverse faculties of engineering.

The choice of participants in this study owes itself to the disparate approaches by distinct governments across the European continent during the pandemic, leading to the identification of extremities in handling the situation. For instance, Sweden was one of the few countries who progressed through Covid without issuing lockdowns, as opposed to Italy who implemented one of the first national lockdowns, as well as the enforcement of vaccination through the Green Pass. These opposing ends of the spectrum were essential to be analysed and compared to understand the impact of governmental choices on HEIs, and subsequently, on the knowledge transfer. The

same concept can be applied for Malta, an island in the Mediterranean, and was thus self-contained during the years governed by the pandemic.

Requirements for Document Compilation per Partner

This report shall adopt the methodology presented in Figure 2, which commences upon issuing a call for descriptive documents. Each BLISS partner was requested to submit numerous documents corresponding to Covid-19 within a shared database. As showcased in Section 3.1 (Document Analysis), this database pooled together university correspondence, guidelines issued from the government as well as results for internally conducted questionnaires. A spreadsheet was then coined to input all the data for the documents and accompanying discussions were then held with members of the Faculty of Engineering within the BLISS project to support the results issued from the documentation. Ultimately, the data was thoroughly analysed, and a detailed analysis ensues in this work.

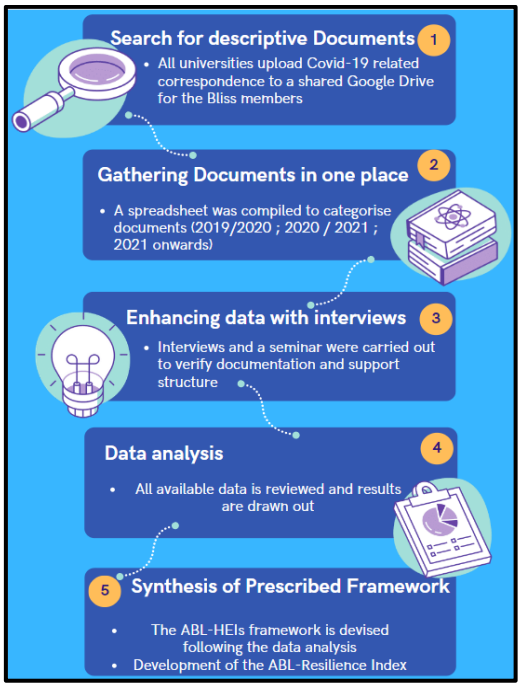

Figure 2 - Pictorial representation of proposed Research Methodology

Data Collection Methods

Prior to conducting this research, each university was appointed its own “BLISS Covid-19 Diary”; which comprised of a detailed spread sheet consisting of three major columns. These columns were strategically appointed to be representative of the three phases that Covid-19 can be segregated into. As presented in Section 2; Phase 1 (2019-2020) focuses on the initial response to the pandemic, Phase 2 (2020-2021) recalls the midst of the pandemic and Phase 3 (2021 onwards) discusses the next stages moving forward from Covid. To clarify what was sought through each phase, Figure 6 summarises all the queries that were asked for through the BLISS Covid-19 Diary; the results of which will be elaborated in the ‘Research Findings’ section.

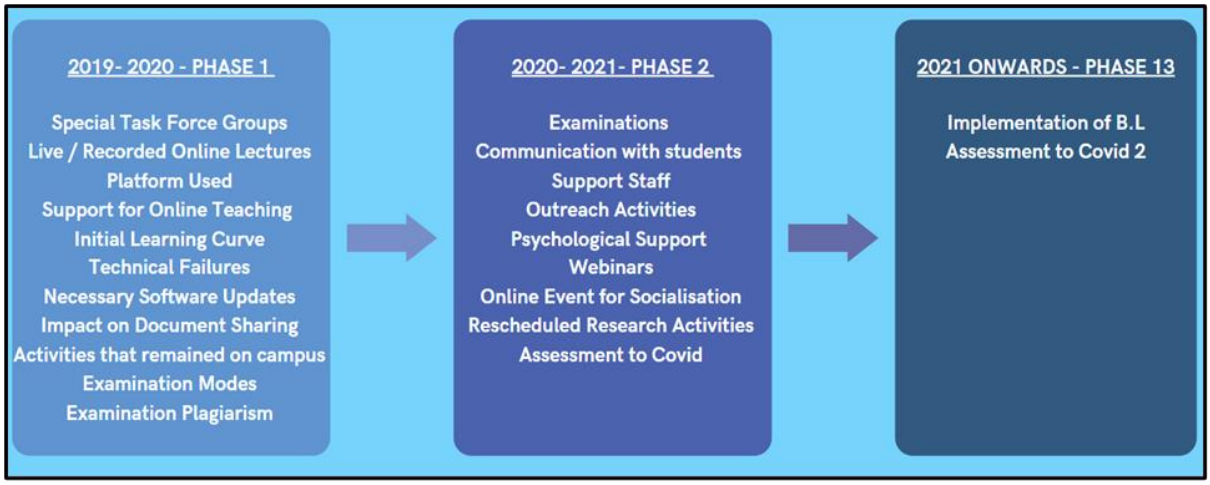

Figure 3 - A summary of what was sought through the BLISS Covid-19 Diary

At the starting-point of this research study, the universities introduced in Section 3 were asked to upload any Covid-19 associated documentation to a shared Google Drive. The universities had the liberty of uploading a plethora of correspondence ranging from guidelines to questionnaires as deemed suitable by them. Detailed analysis of this critical material can be found in Section 7. The research team proceeded to evaluate the contents of such correspondence by appointing them to the appropriate cells within the BLISS Covid-19 Diary and thus ,initially, the entries within each BLISS Covid-19 Diary retained exclusivity for the documents and links shared by the six universities.

Main Findings from compiled Partner Documentation

Quantitative Overview on the Documents presented per Partner

This section will direct the major findings extracted through a systematic review of the six BLISS Covid-19 Diaries. A total of one-hundred and forty-seven documents (147) linked to Covid were gathered between the member universities and made available through the shared Google Drive. Figure 3 presents a simplified distribution between the documents and their issue date; whereas Figure 4, alternatively, highlights the percentages of documents belonging to each of the six respective universities. In order to preserve the anonymity of these six universities, a pseudonym will be assigned to each university randomly. The vast majority of documents were issued in 2020 (onset of the pandemic). This in itself is a reflection of the haste in which the universities responded to the global crisis and shifted attention towards safeguarding both students and staff. Indeed, only eleven percent of all the available documentation was published during 2022; indicative that an ease of control measures was being employed. Having said that, the absence of documentation in 2022 might embody a lack of planning ahead (post Covid), solidifying the relevance of the BLISS project. The latter project aspires to acquire an in-depth grasp of how Covid-19 influenced teaching pedagogies in HEIs and thus be able to provide this “roadmap” ahead for universities to abide by.

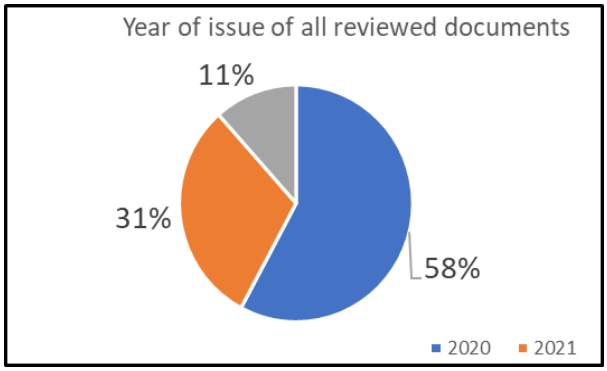

Figure 4 - Year of issue of all available documents

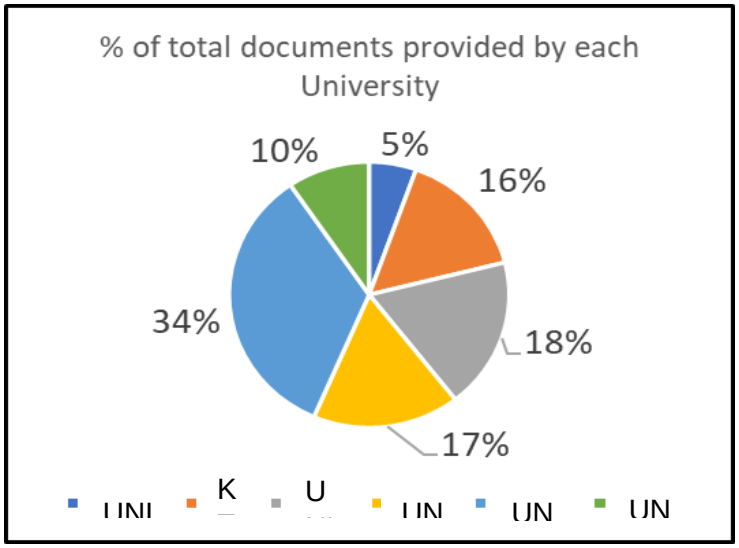

Figure 5 - Percentage of documents issued by each university.

Subsequently, the documents were attributed to diverse categories based on their contents; as depicted in Figure 5. The quantity of guidelines that was issued by the respective university exceed one hundred and twenty; yet on the other hand less than ten documents pertained solely and specifically to the Faculties of Engineering; suggesting more possible future work in this direction. The BLISS project will attend to this need through the proposal of individual modules that can simultaneously cater for engineering education at HEIs. On the other hand, only five documents were strictly questionnaires issued by the universities to students and staff; and broadly dealt with the adaptation of the new teaching methods.

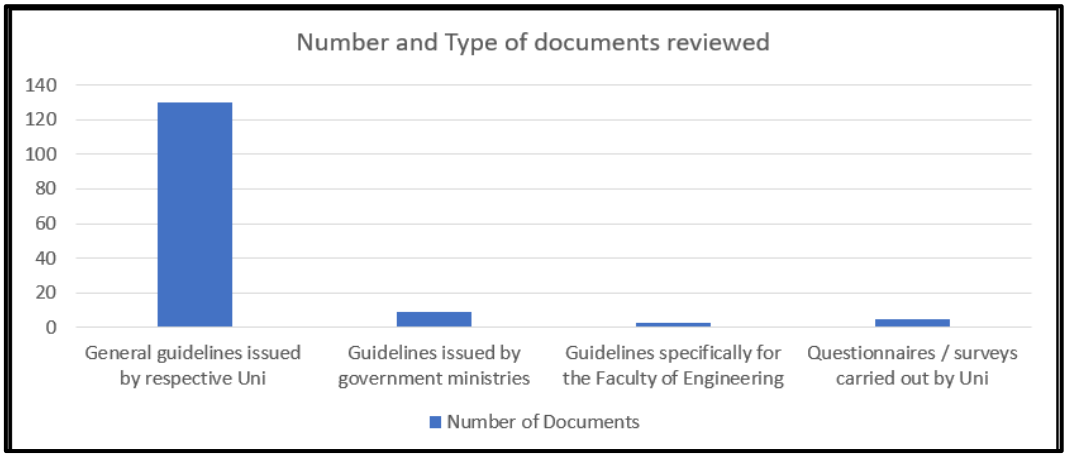

Figure 6 - Comparison of document contents

Analysis of the BLISS Covid-19 Diary

This section will discuss and constructively compare the findings drawn from each BLISS Covid-19 Diary; in order to identify which phases (Phase 1, 2 or 3) were the most saturated and which phases warrant further investigation.

Phase 1 - 2019 / 2020 – The beginning of the pandemic

- Special Task Force Groups and Date of Closure

The majority of the universities immediately established a general task force yet at the start of 2020, Table 2; and allowed individual faculties to occupy autonomy on their quotidian tasks as well. In summary, a general task force comprises of a group of people who would undertake all Covid-19 matters, issue the necessary documentation and ensure that all anti-epidemic measures were strictly adhered to. On the other hand, POLITO retained the same organisation team as that prior to Covid-19 and simply resorted to using Microsoft Teams. Having said that, POLITO also appointed a university Covid-19 control person to take charge on Covid-related affairs. Table 3 summarises the efforts made by universities in this domain.

Table 2 - Date of closure of all universities (Phase 1)

FEBRUARY 2020	POLITO
	UNIBG
MARCH 2020	KTH
	UNIRI
	UNILJ
	UNIMA

Table 3 - Set up of a general Covid-19 task force within the universities

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
General task force / committee to issue Covid guidelines for all faculties.	✓	✓				✓

General task force but faculties still had autonomy to make decisions.			✓	✓	✓	
Appointment of a University Covid Control Person		✓				

- Live / Recorded Online Lectures

An implementation of a mixture of live and recorded remote lectures was reported by the six BLISS member universities; Table 4, immediately after first cases of Covid were announced in the country. These were made possible with the careful choice and enactment of software platforms such as Zoom. Consequently, five out of six universities opted directly for a mixture of synchronous and asynchronous teaching approaches, as shown in Table 5. UNILJ initially commenced with solely synchronous mode and then shifted to having both synchronous and asynchronous.

Table 4 - Commencement of live and recorded remote lectures

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Live Remote Lectures Only			✓			
Recorded Remote Lectures Only						
Both Live and Recorded Remote	✓	✓		✓	✓	✓

Table 5 - Mode of teaching - synchronous vs asynchronous

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Synchronous Only			✓		✓	
Asynchronous Only						
Both Synchronous and Asynchronous	✓	✓	✓	✓		✓

- Platform Used

In order to be able to swiftly adjust to the new normality at a fast pace and without compromising on valuable learning time; universities and higher educational institutes (HEIs) had to resort to online video conferencing software. A unanimous answer was brought up in response to the enquiry of platforms chosen. All universities used more than one platform; Table 6, exemplifying how diverse platforms were timely provided and all universities sought assistance from different platforms. The most common adopted platforms included Zoom and Teams; with the majority of universities commending the ease of use and versatility of the latter two.

A query that followed focused solely on the functions available on Zoom; attempting to understand better how far lecturers attempted to try and make remote lectures as engaging and interesting as possible, Table 7. For instance, the one-minute question feature introduced on Zoom was used by lecturers at the Faculty of Engineering in UNIRI and UNIBG for mid-term exams to ask simple questions; and to write a certain code in the given time. Similarly, the same two universities also employed the Zoom Polling feature through Allocation of 10 minutes to assess via polls whether the students had understood a topic; and gather instantaneous feedback from the students. UNIMA, UNIRI and UNIBG made use of the Interrogation function by randomly picking students to see whether the topic had been understood.

Table 6 - Selection of preferred online platforms

To	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
GoToMeeting			✓			
Cisco Webex			✓			
Zoom	✓	✓	✓		✓	
Merlin				✓		
Moodle			✓	✓	✓	✓
Canvas	✓			✓		
Skype	✓	✓				✓

BBB		✓		✓		
Teams	✓	✓			✓	✓
Panopto					✓	
Google Meets					✓	✓

Table 7 - Exploring different Zoom functions

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
One-minute questions	****	****	****	✓	****	✓
Polling	****	****	****	✓	****	✓
Interrogation	****	****	****	✓	✓	****
Punchlines	****	****	****	****	****	****

- Support for Online Teaching

It must be recalled that Covid-19 opened a new window for expanding pedagogies, yet remote learning was still unchartered territory. Hence, it was essential that support was given to lecturers in order to facilitate the transition between physical and remote learning, as presented in Table 8.

A hundred percent of the BLISS member universities provided training for both technical and academic staff to ease the transition between physical to remote lectures. Four out of the six universities provided software licenses for online platforms that were not in place before Covid-19 struck. On the other hand, all universities provided IT equipment to staff members; as well as some going even further to provide IT equipment also to students. This showcases that six out of six universities provided more than one means of support; pointing towards the right direction.

Table 8 - Understanding of various support mechanisms offered

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG

Provision of licenses + reimbursements of licenses	✓	✓	✓			✓
Provision of IT equipment to students		✓		✓	✓	✓
Provision of IT equipment to teachers	✓	✓	✓	✓	✓	✓
Training for Technical + Academic Staff	✓	✓	✓	✓	✓	✓

- Initial Learning Curve

Without a doubt, all of the aforementioned hurdles (new platforms, need for online support) took a toll on the way students and lecturers alike perceived and responded to learning and teaching methods. This for sure induced an unpredicted stump in the learning curve, displayed in Table 9.KTH and UNIRI reported similar experiences encountered during the initial adjustment to remote learning (such as difficulties in comprehending how the new modality (remote learning) would influence the way that learning content is presented to students; the frequency of uploading material on the platform; whether any supplementary material would assist in making the most out of the remote experience).

Table 9 - Initial challenges faced

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Difficulty to adapt to the new modality		✓			✓	✓
Difficulty in scheduling timetables	✓			✓		
Difficulty in creating online material	✓			✓		
Difficulty in maintaining frequency to uploading such material	✓			✓		

Students who viewed from home did not have privacy	✓			✓	✓	✓
Students noticed an overlapping of leisure time with academic time	✓			✓		✓
Initial reluctance by professors to switch to remote teaching			✓			

- Technical Failures

Aside from the omnipresent learning curve addressed in the previous heading; the usage of continuous online technology provoked an increase in the technical failures encountered. A problem that recurred for all 6 universities was that of having poor connectivity and this impacted the whole remote learning experience; Table 10, especially the examinations sessions – mentioned also by the more than half of the universities. Although this issue was partially-resolved in the following semesters; a demand for a new structure catering for blended learning might be in place moving forward from the pandemic; especially with all the technological resources available to us at the tips of our fingers.

Table 10 - Technical Failures

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Technical failures during online examination session	✓	✓			✓	✓
Connectivity issues due to overloaded servers + internet traffic	✓	✓	✓	✓	✓	✓
Audio-video material circulating without control (Intellectual Property)						✓
Difficulty of downloading recorded lectures due to long videos						✓

- Necessary Software Updates

In attempt to omit technical failures as much as possible, and to ensure the best possible remote learning experience; certain improvements had to be made to the teaching infrastructure employed at the date. Four out of the six BLISS member universities upgraded the way information was being disseminated; such as opting for specific software to carry out a focused group of tasks. For instance, in order to be able to draw curves and graphs, a particular software such as GeoGebra was opted for. Similarly, in order to host exams on a safe, specialised software, some of the universities chose Wiseflow. Having said that, not many universities undertook major software upgrades and it was only POLITO who implemented two extensive software undertakings: a digital certificate and a digital twin, as is indicated in Table 11.

Table 11- Additional software updates necessary

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Adding a digital certificate + authentication code to access portal		✓				
Creation of a twin remote teaching system on cloud just in case main server goes down		✓				
Specific tasks shifted online with specific software such as Merlin GeoGebra or Wiseflow	✓			✓	✓	✓

- Impact on Document Sharing:

As stated in the previous findings; shifting rapidly into remote learning required more than just the selection of the appropriate platform; affecting other aspects such as that of document sharing. Given that all group assignments had to be transitioned remotely as well, dissemination of information was not as straightforward as before, and this is revealed through Table 12. Despite the initial query on document distribution, three out of the six BLISS member universities claimed to have not found any issues in sharing documents; and instead retained the same manner as was done prior to Covid. For instance, members from the Faculty of Engineering at UNIMA commented on how the use of same online virtual learning environment (VLE) was continued throughout the entirety of Covid in order to access notes, recorded lectures, lecture links and even have remote exams on. The remaining three universities adhered to the same concept by creating secondary platforms (such as an intranet or a cloud) for sharing of documents; or opted for proprietary software that would still do the job.

Table 12 - Changes to document sharing as a result of the pandemic

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
No effect on document sharing (same platform was maintained)		✓			✓	✓
Creation of cloud sharing platform like “KTH Box” or e-classroom	✓		✓			
Opted for specific software to share all kinds of docs like “Merlin”				✓		

- Activities that remained on campus

The majority of the BLISS member universities mentioned laboratory sessions as the number one activity that could not be held remotely. Understanding how lab sessions were held during Covid-19 is of extreme relevance, especially recalling that the members of the BLISS project are members of Faculties of Engineering from six universities (and thus practical lab sessions are a foundation for any Engineering module). The universities noted how they managed to circumvent this issue by either organising lab sessions on campus or adopting a blended learning approach (a percentage of the lessons held online and the rest maintained on campus). It was noted how the lab sessions that were indeed held on campus were carried out under very strict supervision and adherence to all sanitary measures; Table 13.

Once again, since the BLISS consortium comprises of individuals from the field of engineering, another hurdle encountered due to Covid was the assortment of Bachelor’s, Master’s or doctoral theses. This proved to be even more challenging when the particular thesis was of a practical nature and required the use of apparatus available on campus. Some universities thus allowed thesis students to work on campus; depending on the difficulty and effort of work needed, the degree undertaken and the professor in charge.

A similar question with a widespread answer, Table 14, was related to how the universities responded to closure and restricted access to campus buildings. Some universities entirely prohibited gatherings in all campus buildings; whilst others implemented strict schedules and time slots to permit only a limited number of students within buildings (such as within libraries). Other rooms (such as classes allocated to design classes in POLITO) were enhanced with multimedia facilities to permit ease of remote connection even when the lecture was held in-person. KTH and UNILJ did not ban access to campus buildings, but rather reduced the number of permitted students in one session and allowed for social distance to be practiced at all times.

Table 13 - List of activities that could not be transferred remotely

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Lab Sessions	✓	✓	✓	✓	✓	✓
Bachelors' thesis research permitted on campus when possible	✓	✓	✓		✓	
Art / Design classes that could not be held remotely		✓				

Table 14 - Changes to campus buildings during Covid-19

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Libraries (a specific schedule was created to allow students in certain time slots; or allowed a certain loan duration)			✓	✓		
Rooms for design courses – enhanced with multimedia services		✓				
Reducing the number of students allowed in class (ex by half)	✓		✓			
Prohibition of gathering in all buildings (including dorms)			✓		✓	

- Examination Modes

One of the most demanding academic aspects that had to be dealt with during the pandemic was the debate of whether or not to hold examination sessions as per usual; and if in the affirmative, how would such assessments materialise. The platforms introduced previously provided this opportunity to the six BLISS member universities. During Phase 1, all six universities successfully held examinations in a remote manner; Table 15, yet the approach, presentation and the structure of the exams differed from

one university to the next. Some universities opted for exams that consisted mainly of a multiple choice structure; whereas other online exams demanded a lengthier, essay-structured answer. Depending on the study unit in context, some exams had been substituted by projects and presentations of the yearly coursework. All online exams were held through one or more of the platforms mentioned earlier, with the majority of Universities utilising Zoom as the main hosting software for exams.

Table 15 - Initial examination sessions during Phase 1 of Covid-19

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Online exams through specific test platform	✓	✓	✓	✓	✓	✓
Online tests with multiple choice				✓		
Online tests with longer essay-type answers				✓	✓	
Projects / presentations	✓			✓	✓	
E-Portfolio where students would log their yearly coursework and get assessed on it (excluding the normal VLE)				✓		

Phase 2 - 2020 / 2021 – Midway through the pandemic

- Examinations (Phase 2)

During the second phase of the pandemic, progress was being made by all six universities in terms of selecting the most appropriate examination methods, Table 16. The latter decision was influenced by both internal factors (such as capacity and availability to carry out exams on campus), as well as external factors (pressure from governmental entities, stakeholders and the current Covid situation within the country). It was also noted that the experience with remote examinations in Phase 1 mapped out an improved strategy for conducting exams in Phase 2, with some of the universities advancing the approach to how exams were to be held throughout the year.

Table 16 - Examination session held in Phase 2 of the Covid-19

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG

Online / remote written exams	✓	✓	✓	✓	✓	✓
Online oral exams	✓		✓	✓		✓
50 % online / 50% campus (Autumn Exams)	✓					
In person (example – up to 10 people allowed in April 2021)			✓	✓		✓

- Communication with students

All BLISS member universities maintained incessant communication using email correspondence and live remote meetings with their students, established in Table 17. KTH took it a step further and decided to cater for first year students by organising virtual tours of the university and carried out phone calls to welcome students. Similarly, POLITO also launched a website dedicated to Covid-19; whereas UNIRI provided an email address entirely dedicated to provision of Covid support and feedback.

Table 17 - Means of communication with students during Covid-19

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Phone calls to first year students who could not be physically present due to Covid	✓					
Emails			✓		✓	✓
Website dedicated entirely to Covid		✓				
Virtual tours for first year students	✓					

Live meetings and streaming	✓	✓		✓	✓	✓

- Support Staff

Within the second phase of Covid-19; that is, in the midst of the pandemic, it was essential to have a reinforced support mechanism in place, as proven in Table 18. This manifested in three major ways; with half of the universities launching a dedicated website solely for Covid-19 education and sustained by PDF documents (such as guidelines). As mentioned earlier (in Phase 1), half of the universities continued to make use of staff groups devoted to managing Covid-19 within campus; and more than half of the member universities provided the option of hosting mock online examinations prior to the actual exam.

Table 18 - Assistance provided by support staff throughout Covid-19

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Website / PDF documents dedicated to Covid		✓			✓	✓
Dedicated teams and departments were available	✓				✓	✓
Provision of trial exam before online exams		✓		✓	✓	✓

- Online Event for Socialisation

A strong sentiment of student loneliness and solitude emerged from more than a single research work; and thus it was imperative to assess whether remote social events had been organised by the different universities; Table 19. The definition of remote social events would thus point towards events held through an online platform (such as Zoom) in order to provide a space for classmates to socialise; and without any academic purpose. A wide range of answers were obtained for this finding. Half of the member universities did not host such online socialisation; “E-Buddy”, meetings since in this day and age, the majority of students are still connected through social media and thus there was a reliance on technology. Having said that, KTH, POLITO and UNIRI planned similar events to remote socialisation in order to keep students engaged.

Table 19 - Remote socialisation activities held by universities

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Alternatives were held; such as periodic meetings for feedback from students were held				✓		
Such online events were not targeted since students have easy access to social media and can communicate between them			✓		✓	✓
Dedicated channel for social, entertainment and educational purposes	✓	✓				

- Rescheduled Research Activities

All six universities attempted to facilitate research (especially at higher levels) for their students; mainly by providing a window of delay, shifting the research objectives to suit a remote thesis and also develop assignments specifically for remote researching. This was of extreme importance especially for students within the engineering faculties, whose research comprised of a laboratory or practical component and thus needed to have adjustments made to cater for the unplanned circumstances, Table 20.

Table 20 - Amendments to research activities during the pandemic

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Request for deadline extensions and compensations	✓	✓	✓		✓	✓
Possibility of carrying out research online + defences online		✓	✓	✓		✓
Development of new model assignments and thesis defence models				✓	✓	

- Assessment to Covid (Phase 2)

After almost two years and four academic semesters later, a review of how Covid-19 was indeed handled by the universities was an important aspect to address, Table 21. This would thus lay the framework for the upcoming years. Four out of the six universities issued questionnaires to both students and members of staff so as to assess the overall experience; with the remaining two universities enquiring for Covid-19 feedback with the general feedback issued after each study unit. For other universities, assessment of the reaction to the Covid-19 pandemic had been already ongoing, with email accounts dedicated to Covid-19 assistance and feedback; as well as tools to monitor each remote lecture.

Table 21 - Assessing the Covid-19 situation during Phase 2

	KTH	POLITO	UNILJ	UNIRI	UNIMA	UNIBG
Tools to monitor the instantaneous quality of the remote lecture (such as quality of connection)		✓				
Questionnaires and surveys to students and teachers	✓	✓		✓		✓
Email dedicated specifically for Covid, in order to allow students to submit feedback				✓		
General feedback submitted at the end of modules			✓		✓	

Summary of Results

Table 22 groups together some of the major results exhibited in the previous section in preparation for the ABL- Resilience Index. The summarised data abides by Garrison et al.'s Community of Inquiry (CoI) model which introduces the educational experience triad; Social Presence, Cognitive Presence and Teaching Presence [15]. The University of Denver explores different means of how each can be achieved to ensure fruitful educational outcomes [16]. For instance, social presence can be obtained by clear communication between all stakeholders (lecturers and students) such that a community of interactiveness can thrive. In the case of the second aspect of the CoI, that is the teaching presence, proper course design (ideally with mixed methods of teaching) must ensure fulfilment in students' learning journey. Ultimately, the cognitive presence concerns the well-being of students and their engagement with the study units, implementation of knowledge and timely problem identification and solving. Thus, the CoI will be of asset for classifying the response of the BLISS member partner universities.

Table 22 - Summary of the results that fall in line with Garrison's CoI framework [15] :

Community of Inquiry Criteria	2019-2020 - Phase 1	2020-2021 - Phase 2
Social Presence	NIL	Means of communication with students during Covid-19 (Table 17) Assistance provided by support staff throughout Covid-19 (Table 18)
Cognitive Presence	Exploring different Zoom functions (Table 7) Initial examination sessions during Phase 1 of Covid-19 (Table 15)	Means of communication with students during Covid-19 (Table 17)
Teaching Presence	Selection of preferred online platforms (Table 6) Exploring different Zoom functions (Table 7) Changes to document sharing as a result of the pandemic (Table 12) Initial examination sessions during Phase 1 of Covid-19 (Table 15)	Means of communication with students during Covid-19 (Table 17) Webinars

Discussion

Although there are several papers which based their studies on surveys and questionnaires involving both students and lecturers; no prior research work has delved deeper into the archives of universities and faculties of engineering alike to retrieve documentation. Although documentation related to Covid-19 management is oftentimes perceived as momentarily and short-lived; it is a most credible source and a simultaneous direct reflection of how events unfolded and the course of action taken in due time. This discussion shall thus highlight the major concerns from the Findings; depending on either Phase 1,2 or 3.

Phase 1

1.1.1 Introduction of novel platforms and support measures.

The majority of BLISS member universities used up to four different platforms, showcasing that more than one platform was actually needed to cater for all the new different needs that occurred when switching to remote learning. This suggests that a future comprehensive platform could also be developed; uniting all of the advantages of each platform into one. It can be commented that Zoom does lay ground for a multidimensional platform through a variety of available functions.

Apart from the three BLISS member universities who responded with certainty regarding using Zoom platforms, the remaining respondents claimed how the use of Zoom features was dependent on the personal preferences and knowledge of each individual lecturer. Although this is true, it is recommended that moving forward, all lecturers are at least made aware of such functions and how their subjects could benefit from different functions to bring out certain aspects and objectives. This suggestion should also be taken on board when revising syllabi or creating new blended learning study units (aim of the BLISS project) so that the available functions can specifically be used to enhance the overall learning experience and engagement of students.

Having said that, despite the provision of support measures acting as an extreme asset during the initial Covid stages; it would have been of much more value had the curriculum always been designed to adapt easily to unforeseen circumstances by upholding blended learning (intentionally). Thus, moving forward, the curriculum should now incorporate educational modules that cater for all the above addressed needs; this is an evident gap that is indeed the scope of the BLISS project.

1.1.2 Learning curve and hurdles encountered

This section evokes an interesting viewpoint on the perception of the initial reaction to the new modality. The learning curve is an exciting process to review since difficulties were not solely limited to technical difficulties but also psychological and social.

Internal questionnaires and surveys carried out by some of the BLISS member universities acknowledged that some students could not make the most of the online teaching experience due to not having enough privacy. An additional trend that was observed was the sentiment of struggle imparted by the students in being able to keep their leisure time and study time separate. This could trail back to certain study units; that did not change enough (reduce outcome objectives and work load etc) to suit the new norm; and thus failed to consider how working from home could impact the fine line between work and leisure.

Another challenge faced related to study units concerned units with laboratory components and practical research. Knowledge of how the universities went about planning lab sessions and engineering theses would be of essential importance for BLISS's ultimate goal; that of striking the perfect balance between remote and in person learning (i.e. blended learning). However, this is not an easy task to achieve and thus each existing module should be evaluated with the influence of the location vis-a-vis the learning outcomes kept in mind.

A third, and possibly one of the more severe hurdles included the alarming issue of plagiarism during remote examinations (especially in Phase 1). Although not asked for in the BLISS Covid-19 diary; all universities mentioned plagiarism during the discussions held; thus another row was added to specifically focus on how universities dealt with an unseen form of plagiarism; the remote plagiarism. Despite the benefits and the commodity that was achieved through having online exams; one of the riskiest element entailed was having to deal with potential issues of cheating, plagiarism and even having students helping each other remotely. In fact, all six universities were unanimously aware of this situation, and tried to devise ways to curb it. For instance, UNIRI implemented four different means to annihilate plagiarism; namely random question allocation, strict time stamps per question, live remote oral exams as well as

having students keep their laptop camera switched on during exam as a means of supervision.

An interesting point to comment on was regarding the video conferencing which was simultaneously ongoing whilst the online exam was being held. This method basically involved having a lecturer or an administrator supervise the students using video conferencing, to ensure that no illicit activity was ongoing in the background. Many universities commented on possible student privacy invasion in this manner and even issues of data protection. This point is not only valid for the Covid period but should be acknowledged come the need for remote exams in the future; thus, finding a solution that can cater for both risks of plagiarism (provision of live supervision), without infringing any data protection issues is a must.

Phase 2

1.1.3 Evolution of exam sessions in the middle of the pandemic

Despite remote written exams and online oral exams still being the modality of choice by all six universities; some universities re-introduced certain examinations on campus. For instance, KTH commenced its autumn exams by opting for a 50-50 mode (that is, 50% of the coursework was to be tested in campus, whilst the other half could be easily carried out online). This hints towards the desired direction; that of having Blended Learning established as the new norm within engineering studies in HEIs. Similarly, three other universities re-established campus examinations, yet restricted the number of students permitted in the examination venue at a single time. Provision of practice examination exams was a crucial step in the direction of moral and academic support. Mock examinations in a period of trial and tribulation could be viewed also as a pilot study in itself to test both the academic success rate of the examination; as well as to observe the reception of changes made to the traditional exam modality. This is thus a step of paramount importance even for the BLISS consortium to assess the examination components of the proposed blended learning BLISS study units.

Conclusion

In conclusion, the initial analysis of the documents produced by each institution in response to Covid-19 has provided valuable insights into the diverse strategies implemented across the partner institutions. Through collaboration and data sharing, a comprehensive dataset was compiled, enabling the identification of best practices and the recognition of gaps in the available information. The efforts led by the University of Malta (UM), along with input from all partner institutions, ensured a thorough and consistent analysis, contributing to a deeper understanding of the varied responses to the pandemic. This work serves as a solid foundation for further analysis and reflection on the effectiveness of different approaches in higher education. By identifying key patterns and opportunities for improvement, these findings offer critical guidance for enhancing institutional resilience and shaping future strategies in response to similar challenges. The continued collaboration and data-driven approach will be essential as the project moves forward, helping to refine and optimize the strategies employed by higher education institutions in the evolving landscape of digital and blended learning.

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Suggested Readings

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