



## Emergency Remote Teaching during COVID-19: Lessons Learned

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### Abstract

The outbreak of COVID-19 pandemic has forced the shutdown of educational institution worldwide. Other alternatives of conventional face-to-face learning activities had to be found to make sure that students could complete the academic year. In this paper, we present our experience at the Information Technology Program at the Colleges of Applied Sciences in the Sultanate of Oman and how Emergency Remote Teaching (ERT) was conducted. We also compare results of this semester with previous semesters to determine if major changes have been witnessed. As the pandemic is still in full force the lockdown of colleges continues through fall 2020 which led to adopting online learning. Hence we studied our ERT approach to avoid the drawbacks and the pitfalls we faced in previous semester.

**Keywords:** distance assessments, distance learning, e-learning, emergency remote teaching.

### Introduction

The first case of confirmed COVID-19 infection in China could be traced back to November 17th, 2019 [5]. The virus spread to infect over 260 people before the end of the year and by 1st January 2020 the number of confirmed cases rose to 381. What has probably started in Hubei that month went on to become a pandemic that took the whole world by storm. As we finish writing this paper the number of confirmed cases all over the world is more than 100 million people with over 2 million deaths [25].

Trying to stop or at least control the spread of this pandemic, most countries took extreme measures that included complete shutdown of businesses, airports, sporting complexes, public activities and all educational institutions. Just as in almost every country across the globe, the Sultanate of Oman took precautionary measures to deal with the COVID19 pandemic. A committee called “Supreme Committee entrusted with studying scopes for a mechanism to handle developments resulting from coronavirus (COVID-19) pandemic” was created and given the task of deciding how the country would deal with this situation. One of the first decisions by the Supreme Committee decided was the suspension of face-to-face activities at all educational institutions for one month starting on 15th March, 2020 [21].

The academic institutions had to find alternatives for continuing with teaching and learning activities despite the suspensions of conventional classes. At this age of technology, the solution that everybody thought of was “e-learning”. It is well suited to distance learning in addition it can be used in conjunction with face-to-face teaching [18]. Moving to e-learning instructions provides flexibility with respect to time and place but converting conventional material to online in a very short period of time is a challenging task. E-learning is not

just converting traditional material into electronic lectures, labs, exams and so on. In this paper, we present how the Information Technology Program at the Colleges of Applied Sciences has dealt with the challenges of continuing the academic year despite the shutdown of campuses.

The rest of the paper is organized as follows: in the second section, we present the scope of the study, our institution, the programs offered with emphasis on Information Technology Program. In the section that follows we discuss e-learning, online learning, distance teaching and blended learning. The fourth section is dedicated to the results analysis. In section five, we discuss the change in results and how this change came about. The conclusion of the paper and our views on how to prepare for emergencies in future are presented in section six.

### Scope of study: Colleges of Applied Sciences

The Colleges of Applied Sciences (CAS) are a group of colleges delivering different academic programs under the umbrella of the Directorate General (DG) of the Colleges of Applied Sciences at the Ministry of Higher Education, Sultanate of Oman<sup>1</sup>. There are six colleges distributed over different Governorates in the Sultanate of Oman (Figure 1). Programs are unified across colleges and managed through the College Deanships, Directorate General, the Academic Council and the Board of Trustees.

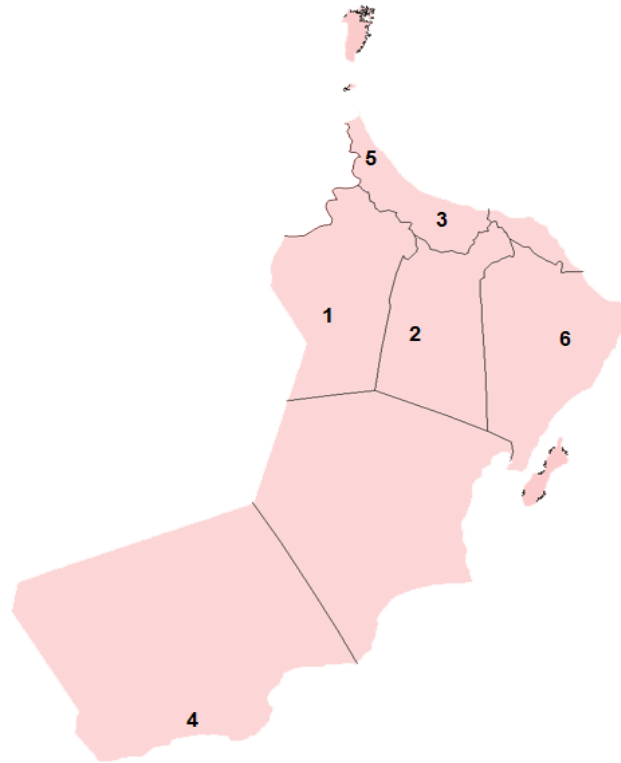


Figure. 1. Geographical Distribution of Colleges over the Country

At the undergraduate level, CAS offer 6 programs (Information Technology, Business Administration, Design, Mass Communication, Engineering, Applied Biotechnology, English Teacher Preparing Program and Mathematics and Science Teacher Preparing Program). Programs are offered based on the local job market need. Right now the programs offered are as follows:

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<sup>1</sup> The royal decree 76/2020 has, as of 20th August 2020, put the colleges of applied sciences under the affiliation of the University of Technology and Applied Sciences

1. Ibri Campus: Business Administration, Information Technology
2. Nizwa Campus: Business Administration, Design and Mass Communication
3. Rustaq Campus: Information Technology, Business Administration. The college has been transformed into College of Education with specific programs to prepare high school future teachers in different specializations (English Teacher preparing Program, Mathematics and Science Teacher Preparing Program).
4. Salalah Campus: Information Technology, Business Administration and Mass Communication.
5. Suhar Campus: Engineering, Information Technology.
6. Sur Campus: Applied Biotechnology, Information Technology and Mass Communication.

These programs are distributed across the Colleges of Applied Sciences. Programs, including the areas of specialization within the program are offered according to the capacity of each college and the needs of the local job market.

The syllabuses of all courses are unified across colleges. Each program has a Program Director PD who oversees the smooth running of the academic program across all colleges. In each college there is a head of the department HoD who oversees the daily activities in the department in coordination with the PD.

The disadvantages of this method are the difficulty of obtaining a matrix for sufficiently large values. A common drawback of methods for synthesizing Boolean functions based on orthogonal transformations is the essentially small number of SAC-functions that can be obtained within the framework of this approach. Combinatorial methods for obtaining Boolean functions are based on the separation of variables into sets over which special mathematical operations are performed [2].

For each course, a capable instructor is designated as System Wide Coordinator (Sysco). The Sysco is responsible for the preparation of the course material (outline, lecture slides, lab exercises, assignments, etc.) The material is prepared with cooperation of other faculty members from all colleges who contribute and/or revise proposed material. After completing the material preparation, the PD approves the material or suggests modifications. Approved material is disseminated to instructors of the course in colleges offering that course. In each college, there is a local coordinator for the course offered that semester. The main duty of the local coordinator is to communicate with the course Sysco and manage the course delivery in the college. Internal assessments are college based where students from different sections of the course sit for a unified midterm exams, practical test, assignments and all other types of assessments. However, the final exam is centralized. The Sysco prepares the final exam based on contributions from instructors from all colleges. After the students finish writing the exams, the exam papers are corrected by the courses teachers. In the case there is more than one instructor of the same course the students' exam papers are share-corrected by all instructors so that all students are judged fairly. The results are approved in the department then they are reviewed for discrepancies at the system level in a Board of Examiners meeting that is headed by the PD with membership of all Heads of IT departments across the colleges. After the approval of the board of examiners, the results are approved by the respective college councils. The approved results are forwarded then to the Academic Programs Department at the Directorate General of the colleges. The results of graduating students are also approved by the Academic Council and then by the Board of Trustees.

During the spring semester of the year 2020, classes were running as usual until the Supreme Committee decided that starting on 15th March, 2020 all face to face classes are suspended for one month with possibility of extending the suspension based on the situation of the pandemic. A plan for continuing classes had to be set up for the suspension period. In the first two weeks of the suspension, the main emphasis was on ensuring that students attain learning objectives of all courses and after that we researched how the assessments will be carried out. As the pandemic continued the supreme committee extended the lockdown of educational institutions and hence it was evident that students will not return to classes before the end of the semester and consequently a plan had to be made for the remainder of the semester. This necessitated converting in-person

classes into online, conceptualizing and offering alternative experiences, and re-defining student performance evaluation and assessments modes [16].

### **Distance learning**

Distance learning is basically transferring learning to the learner instead of transferring the learner to the educational institution; it is a way to deliver programs to off-campus students. Reference [17] defines distance learning as the effort of providing access to learning for those who are geographically distant. Distance learning has started with correspondence courses using printed material sent by the mail and communication by telephone [20]. Second generation of distance learning used audio recordings and radio and television broadcasts. Both of these modes of distance learning lacked the important factor of interactive communication between the learner and the instructor. Because of ICT progress, the third generation of distance learning systems, which included video interaction, emails and web technology, eliminated the drawback of lack of interaction between learners and instructors [10].

The term distance learning can be seen as an umbrella that covers different forms of learning such as online learning, e-Learning, online collaborative learning, virtual learning, web-based learning and so on. The common factor between these types of learning is that the teaching activities between the learner and the instructor are carried out at different times and/or places using different forms of instructional materials [4], [9]. It is important to stress that learning objectives, target audience, type of content and mode of delivery determine the design of the design of the learning environment [17]. It is also evident that distance learning generates different forms of interaction, support and assessment [15].

There are pros and cons of distance learning regardless of its form. According to [14],[24] one of the benefits of distance learning is enabling students to continue their studies while they are working and apply their learning directly the professional environment. Another benefit is that distance learning can be also beneficial to the institutions as it provides an element of flexibility in the learning process by the use of technologies, and interdisciplinary approaches to teaching and learning. Reference [14] adds reduction of cost as another advantage of distance learning. This is achieved by elimination of face-to-face training and development financial cost and in reducing productivity loss. However, there are several drawbacks of distance learning. Students may face problems in understanding scientific and technical course when delivered from distance. Distance education does not allow instructors to modify the lecture plans of the class based on the reaction or feedback of students. Reference [1] adds that distance learning may have a negative effect on communication and social skills of the learner. Whereas [14] points out the challenges that learners may face in connectivity and the access to the electronic resources.

**Emergency Remote Teaching.** Without looking into the advantages and disadvantages of distance learning, educational institutions worldwide had to adopt distance learning. Closure of schools and other educational establishments is one of the precautions used in case of outbreak of pandemics. By mid-April 2020, 94% per cent of learners in 200 countries worldwide representing 1.58 billion children and youth were affected by the pandemic [22]. Along with social distancing, this is called non-pharmaceutical interventions (NPI) [11], [7]. Converting from regular face-to-face classes to distance learning on a very short notice involved coordinating several activities and dealing with different factors on which the success of the move would depend.

As a response to the closure and suspension of face-to-face lectures, institutions had to find means of completing the semester from distance. Many universities worldwide adopted what was termed as Emergency Remote Teaching ERT [12]. This was the only option for institutions that did not have the right infrastructure for conversion to distance or online learning. There, certainly, are academic institutions that have embraced online education and prepared well developed plans about how to offer robust online programs. However, other institutions were forced by COVID-19 to offer online education without a planned durable learning programs [6].

Because of the urgency, the adopted strategy was teaching versus the usual strategy, learning. The first strategy, ERT aims at guaranteeing delivery of at least the minimum requirements of the courses with the available resources and the least changes to the traditionally prepared course material. Whereas, online learning is a long process that requires special infrastructure, software and course content specifically designed to be delivered online [12]. This in fact points out the difference between distance learning and distance education where learning is ability but education is an activity within the ability [23].

**Assessment and Grading.** Assessment is one of the basic aspects of conventional or online education [13]. This of course applies for conventional education and distant education. However there are major difficulties to conduct assessments because of the absence of face-to-face contact. Reference [3] lists five areas of concern that instructors cited, time management, student responsibility and initiative, structure of the online medium, complexity of content and informal assessment.

For ERT, the challenge is increased because of the sudden move to a different mode of teaching and assessment. Reference [19] defines 9 guidelines for assessment in light of Emergency Remote Teaching. The study focuses on health professions education however they can be applied to other disciplines. The guidelines are:

1. Evaluation of prerequisite for implementing online assessment.
2. Aligning assessment activities with stated learning objectives.
3. Addressing diversity of students' situations.
4. Maintaining a good balance of formative and summative assessments.
5. Stimulating student learning with online assessment.
6. Consideration of format, scheduling and timing of test.
7. Establishing clear communication to students regarding assessment matters.
8. Ensuring high quality feedback.
9. Addressing assessment validity threats.

Colleges and universities debated how to grade students during this semester. It was suggested to announce results as Pass/Fail rather than letter grade without including the semester in students' GPA [12]. This option may be helpful for students struggling with the transition, however students wishing to pursue postgraduate studies or to maintain their scholarships need to have letter grades. From the students' side, as an example, students at University of California Berkeley started a petition titled 'As for All'. The petition calls for assessing students on a scale of A+ to B+. Similar petitions were distributed at other universities including Harvard University [2].

**Tasks Associated with Emergency Remote Teaching.** Most of our students, if not all, have never experienced distance learning. They use the Blackboard, the official learning managements system, as a tool to obtain course material, submit assignments, and check their internal marks and other courses related activities. But they have never used the system to take lectures or conduct exams, except in very few cases. Therefore we and they were heading into uncharted territory. We had to conduct the following tasks and activities, answer continuous students' enquiries and maintain an acceptable level of quality keeping in mind that we worked in a centralized system:

*Communicating with Students.* The decision of the supreme committee was to stop classes immediately without giving faculty members a chance to inform the students and plan future actions to be taken. During regular classes, faculty members usually communicate directly with students during classes, through emails, LMS (Blackboard), etc. However, it is not guaranteed that all students will access their emails or the LMS during the suspension because of different reasons (e.g. there is no guarantee that all students had access to the internet). It is safe to say that all students had mobile phones and therefore the registration center sent text messages to all students' mobile phones about the next step in the semester. The students were informed that classes will be delivered online and that all communications with instructors must be through emails and Blackboard.

*Selecting Delivery Mode.* Online teaching can be administered synchronously or asynchronously. Since not having proper hardware, or good connection speeds, can prevent students from succeeding in class, the option was to go with asynchronous online teaching. The reasons for opting to this options were to avoid the possibility of students not being able to get access to the material due to connection problems, unavailability of students at lecture and/or lab time and the digital divide that may be experienced in some remote areas where some students live. It was agreed to record lectures in different forms and upload through the LMS. Based on a survey done by the colleges after the end of the semester, the majority of students think that the internet connection was not in optimal condition for ERT (Figure 2).

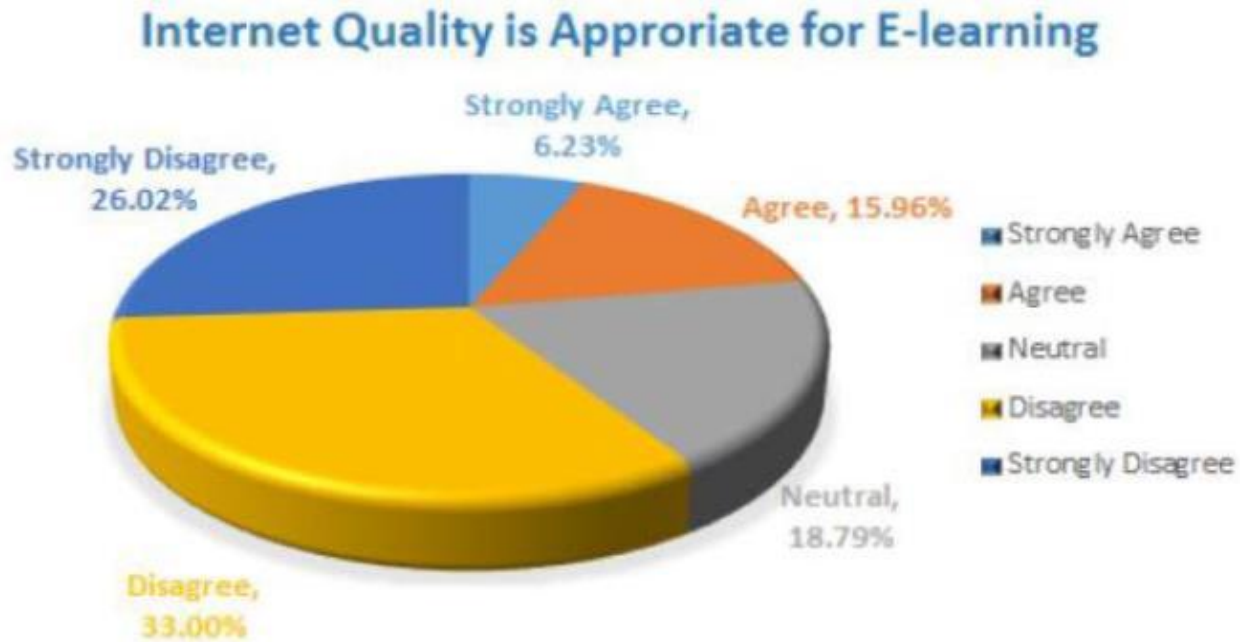


Figure 2. Students' view on internet connection

*Conducting Courses Remotely.* Based on the centralized nature of our institutions, contents of courses are unified across campuses. To transform face-to-face classes into distance learning mode, the logical way will be to deliver same lectures to students even for distance learning. It was decided that the course system coordinators prepare electronic lectures of their courses. The electronic material will be then sent to local coordinators to be uploaded to the Blackboard. Lectures were prepared as videos, demonstrations and Power Point slides with recorded audio of the system coordinator explaining the lectures. Even in normal situations, all course material: lectures, labs, assignments, projects, etc. are uploaded to the blackboard but other platforms can be used as a complement. In addition to material prepared by the Sysco, instructors can provide extra material in same or different form as the Sysco's. They can set up discussion forums on Blackboard or use Google Meet to discuss any issues with students who can connect in synchronous mode. Another issue that was crucial to the smooth running of the classes was the capacity of the Blackboard server to handle heavy usage of students. Students are supposed to use Blackboard during the semester but not all students access the Blackboard all the time. However, with the Blackboard being the main source of learning, all students would try to access it at any point in time. The heavy traffic on the server may cause it to slow down or even crash and hence students will not be able to access lectures. To overcome this possible obstacle and as a backup, videos were uploaded to YouTube, or to instructors' web pages and the links to the videos were sent to the students.

*Lab Activities.* Most of the IT program courses included practical components where students have at least 2 hours of lab per week. Some of the labs such as programming, databases, and web development can be delivered from distance but other labs which involve exercises on networks, security, Internet of Things (IoT) require specific hardware that students could not acquire. The solution to the latter problem was to use

simulation software wherever it was possible. The same problem faced students whose final year projects were in network, security and IoT.

*Assessments.* Courses have different forms of evaluation and different marks distribution. The assessments include quizzes, midterms, projects, presentations, practical exams and final exams. Usually the assessments are split into two components (internal marks and final exam). The assessments included (Figure 3): Quizzes, where 78% of courses had at least one quiz as a part of the assessment. Another mode of assessment used in 94% of the courses is midterms. As a part of preparing students to work either independently or in a group and to improve their communication skills, 78% of the courses had a project component and 52% had a presentation component. In the final two weeks of the semester, students sit for final exams for almost all courses. In spring 2020, out of the 54 courses offered, 51 had a final exam component (94% of the courses). The final exams usually weighs 40% or 50% of the total marks of the course. Final exams are administered as a 2-hour written exams with full invigilation.

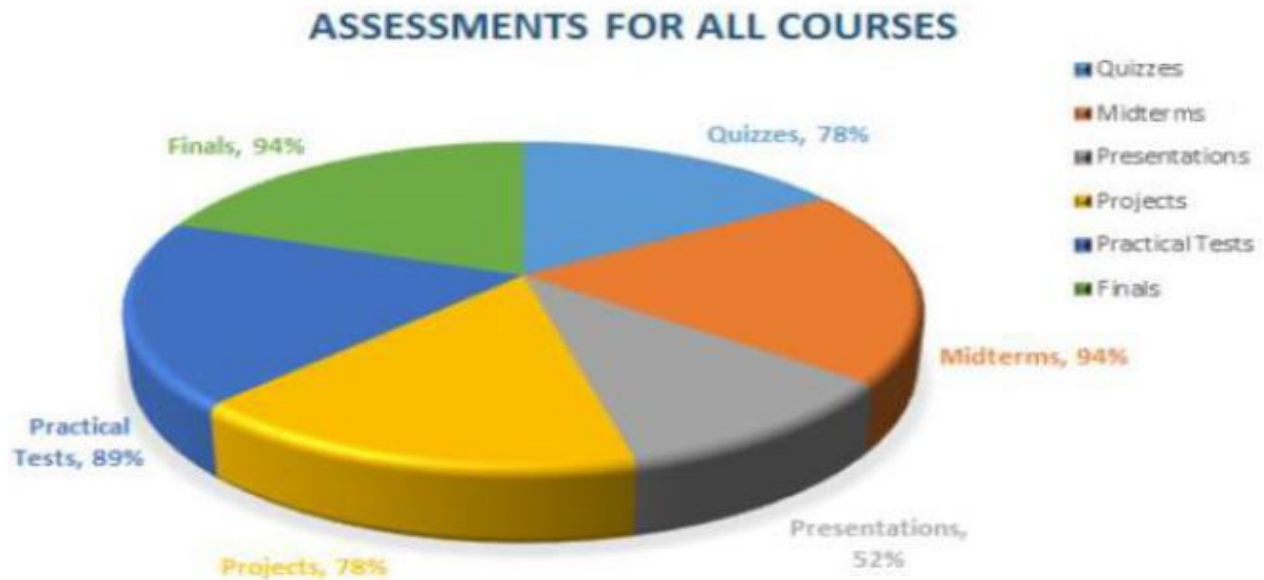


Figure. 3. Types of assessments

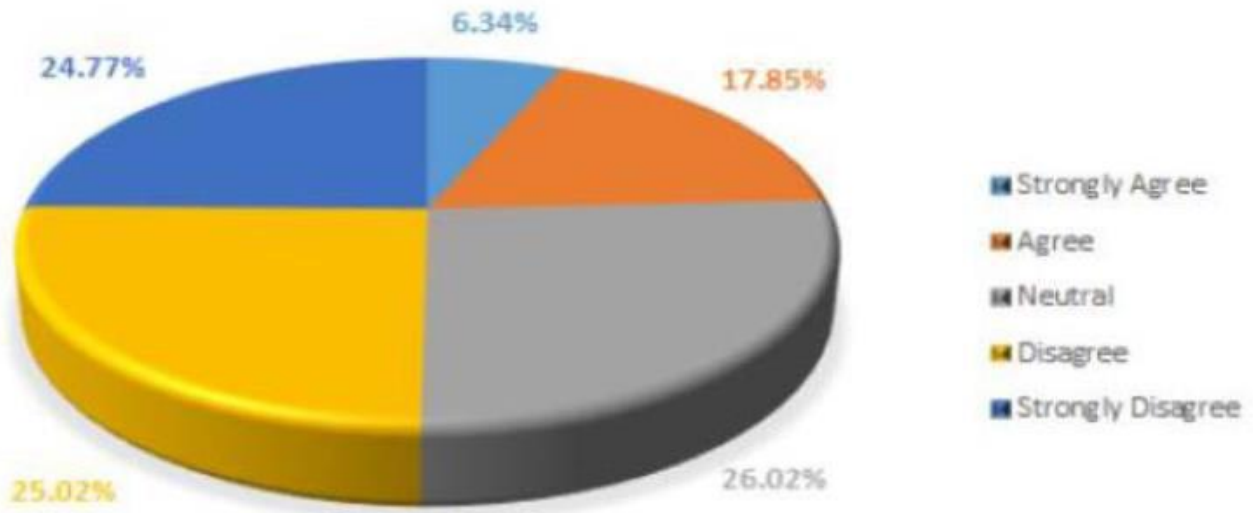
Most quizzes and midterms were conducted before the switching to Emergency Remote Teaching. The very few that were not already conducted were converted to either online quizzes or an assignment. Since most of the courses have a laboratory or practical component which counts for one credit, practical exams are one of assessment modes implemented. In fact, 88% of the courses had a practical test component where usually student answer a set of questions in the computer lab in defined time boundaries. Figure 3 shows the assessments of the 54 courses offered in spring 2020.

The Ministry of Higher Education issued a decree to regulate the online teaching and assessment for the semester. The regulations defined mode of teaching and internal/final marks split up, etc.

According to the decree, semester work weight was allotted 80% of the total marks and the final exam was allotted the remaining 20% of the total marks. All assessments during the closure were conducted from distance. For the final exams, the choices were: synchronous electronic exams, home exam with a limited time frame or an assignment. The first choice was excluded because of the possible technical issues that can face students. There are students who live in remote areas and cannot be guaranteed access to the exam at the specified time. Therefore, the choice was left to the instructors to choose between (home exam and assignment). In all colleges, 54 different courses were offered. Out of the 54 courses, 51 courses had a final exam component. The choices were 32 course would have a home open book exam, 18 would have an assignment and 4 courses did not have a

final exam. Two courses were final year projects which involved submission of reports and online presentation and a demo. The other two were foundation courses with only continuous assessment without a final exam. Based on the survey mentioned above, more than 25% of the students find that the duties assigned to students were appropriate in number and in content and did not present extra load (Figure 4).

### Assessment Put Extra Load on Students



#### Analysis of results

The different nature of delivering lectures, labs and conducting assessments surely affects students’ performance and results. To analyze the results, we compared the results of this semester (spring 2020) with the results of previous semesters (fall 2019, spring 2019). The number of courses offered in each college depends on number of eligible students, available staff members, laboratories and so on. Therefore there will be noticeable differences in number of courses offered from one semester to another. For this reason, we will be using percentage rather than number of students obtaining a specific grade.

In this section, we will compare the overall distribution of grades of all students in all colleges. From previous years, we notice that the results are usually bell shaped. A small number of students on the left side (A, A-, B+) and a similar number on the left side (D+, D, F) with the majority of students in the middle (Figure 5).

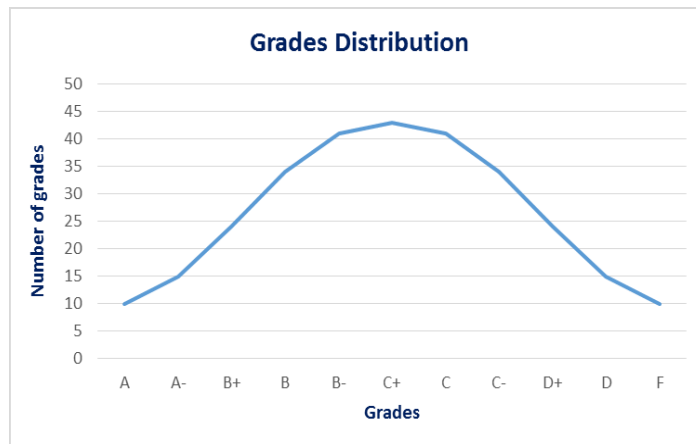


Figure 5. Normal Distribution of Grades



In spring 2019, the number of grades was 4250 distributed as shown in the graph below (Figure 6). The graph does not completely represent a normal distribution because of the high percentage of students obtaining grade “D”. On the other hand, in fall 2019 the distribution is more normal with highest percentage of students obtaining grades between “C-” and “C+”. The number of grades in this semester was 3492.

If we compare the above two results with those of spring 2020 where Emergency Remote Teaching was implemented we see a clear difference. There is a shift to the left with more students scoring “B+” and “B” out of the 3663 grades. Only 1% of the students failed compared 6% in both previous semesters. It should be noted that the percentage is rounded for readability.

As Figure 6 shows, it is safe to remark that overall, students’ grades improved during spring 2020 semester.

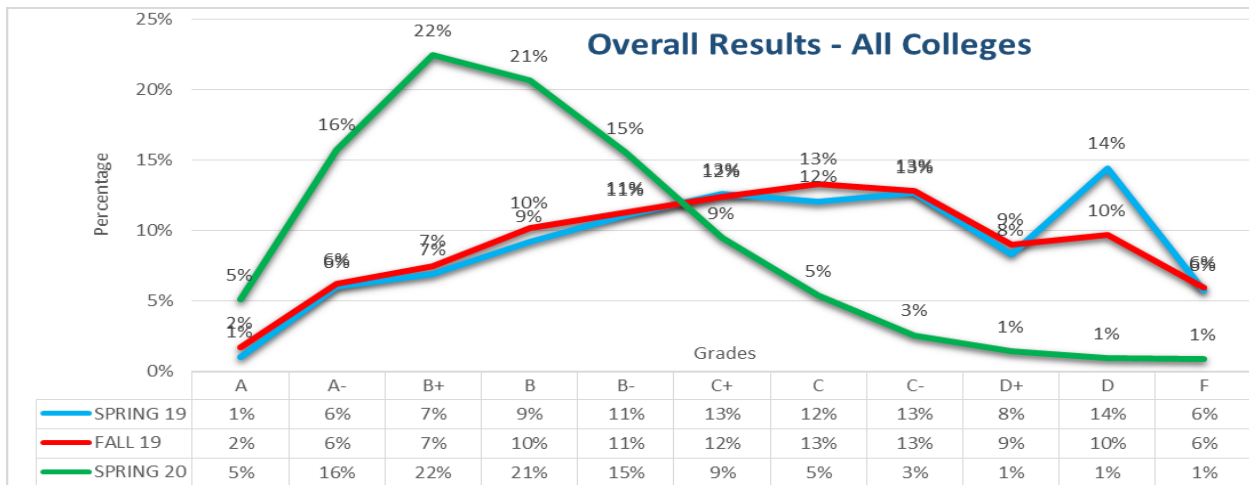


Figure 6. Overall results distribution

According to the degree plan of the program, courses are divided into years or levels. Students select a major after they complete some of the college requirements courses and the department requirement course (about 60 credits hours or the equivalent of credits completed in 5 full-time semesters). Therefore by the end of the fifth semester each student will have selected a major (Software Development, Data Management, Compute Networks and Information Technology Security). For the first and second year we will compare results of all students to discover if there has been any change in the results based on the year in which the student is registered. Regularly, students tend to perform better as they advance in their studies. In their final year, more grades will be on the left side of the graph and less grades on the right side. In the first year it is usually the opposite.

It is important for the program to analyze the third and fourth year results to find out if there is big difference in results from one major to another. The comparison for the first and second year will be for all students, however for third and fourth year we will compare results by year and major.

### Results Analysis by Year (Level)

*First Year (Level 1).* In spring 2019, as Figure 7 shows, out of 832 grades 0.24% (0%) was “A” and 13% of the grades were “F” with the highest percentage at grade “D”. In fall 2019, out of 792 grades only 1% of the grades was “A” and 14% of the grades were “F” with very similar results to spring 2019. The major change happened in spring 2020 where out of 1010 grades, a shift to the left by more than 4 grades can be witnessed. Moreover, only 2% of the grades were “F” and 5% of the grades were “A”. The highest percentage of grades is in the “B” and “B+” region.

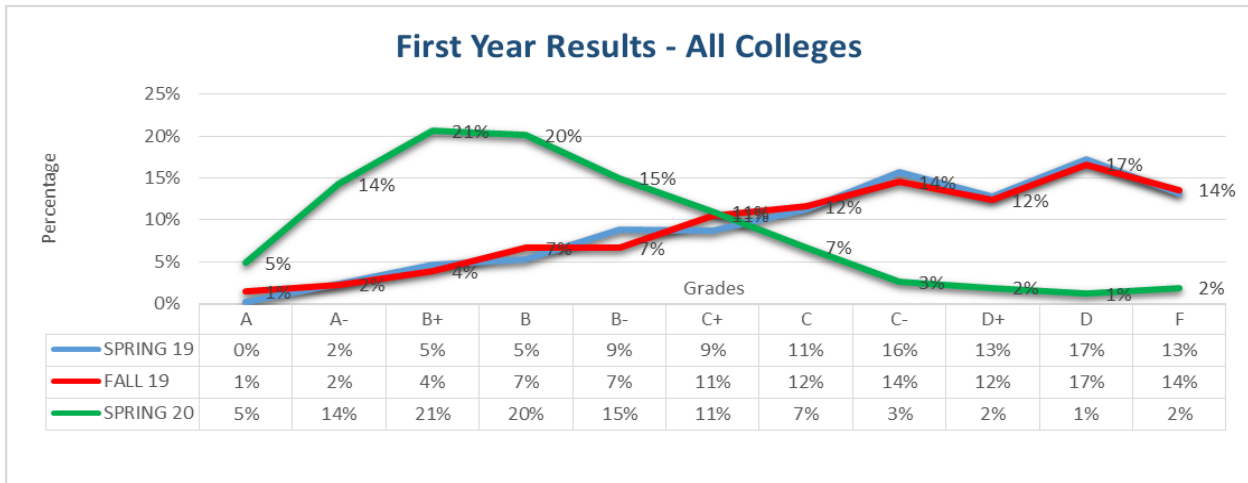


Figure 7. First year results distribution

*Second Year (Level 2).* The same trend can be seen in the second year as shown in Figure 8. Out of 888 grades in spring 2019, 5% of the grades are “F”, 0.11 or 0% of the grades is “A” with the highest percentage at grade “C”. Results are similar in fall 2019. Out of 994 grades, 1% is “A”, 6% is “F” and the highest percentage is “C” with “C+” and “C-” very close. It can be also noted that the distribution is normal in both semesters. The results of the second year students in spring 2020 is similar to that of the first year of the same semester. Out of 793 grades, 3% is “A”, 1% is “F” and the highest percentage is “B” followed by “B+”.

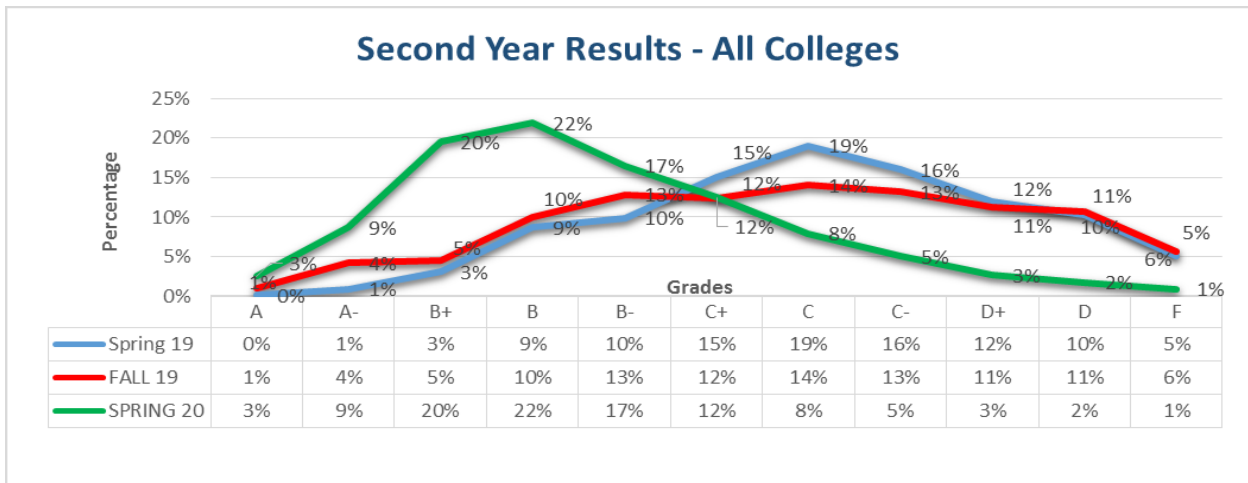


Figure 8. Second year results distribution

This function is balanced and corresponds to the criterion of a strict avalanche effect. For  $k_1 = 1$ ,  $k_2 = 0$ , the synthesized function  $g$  is transformed into another balanced SAC function from six variables:

*Third Year (Level 3)*

*A. Software Development Major.* The number of students who select this major is usually very small compared with other majors. Students find programming more challenging than other courses and they believe that their chances of obtaining higher grades are very low and hence they tend to go to other majors.

The results of Third Year SW Development Major students in spring 2019 and fall 2019 show that out of 63 and 54 grades respectively, students in general score in the region between “C-” and “B-” with low percentage of failures. If we examine Third Year SW Development Major results in spring 2020 we do not notice a big

difference in the distribution. Out of 37 grades the highest percentage is grade “C” and 5% of the grades are “A”. There is an improvement in performance but it is small nonetheless (Figure 9).

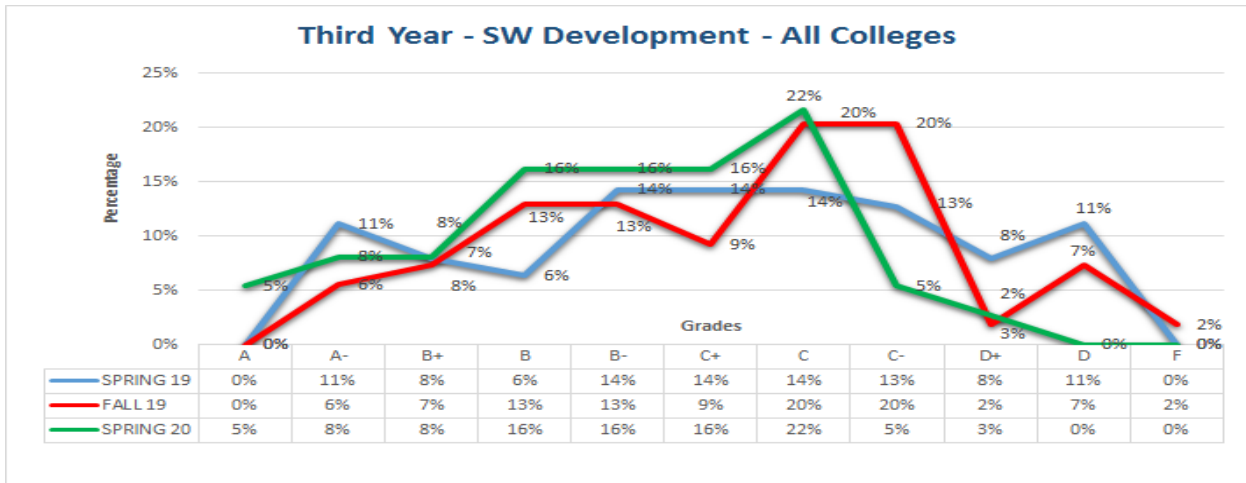


Figure 9. Third Year – Software Development Major Results Distribution

**B. Data Management Major.** The number of students in this major is larger than those in Software Development Major but it is still relatively small for the same reasons. The results of this level in spring 2019 show that out of 87 grades the highest percentages of students obtained “C” with relatively low percentage for “A” and “F”. As for fall 2019, out of 17 students, there were no “F” grades nor “A” grades. However due to the small number of grades, a reliable conclusion cannot be drawn. The results of spring 2020 for the same level, show that out of 83 students, the most frequent grade is “A-” with 28% followed by “B+” with 22% (Figure 10).

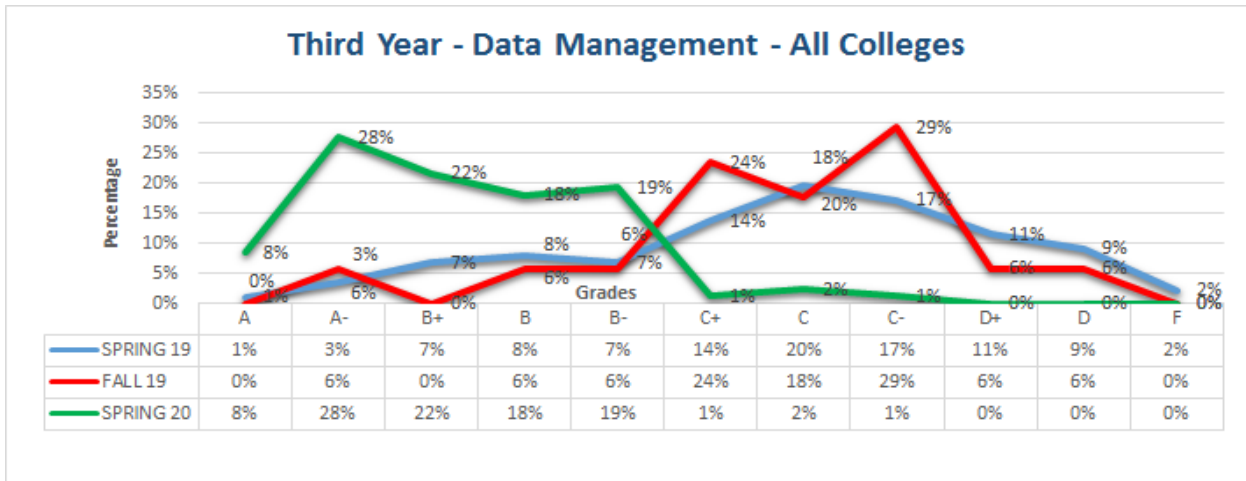


Figure 10. Third Year – Data Management Major Results Distribution

**C. Computer Networks Major.** Computer Networks major. This is the major with highest number of students. The results show (Figure 11) that in spring 2019, out of 112 grades, the most frequent grades are “C” and “C-” which is similar to the results in fall 2019 where out of 139, “C” and “C-” grades are the most common. The comparison with results of spring 2020 shows a different pattern. Out of 142 grades, the highest percentage is “B” with 24% followed by “B-” with 23%. There are no failures and the percentage of “A” grade is 3% compared with 0% in spring 2019 and fall 2019.

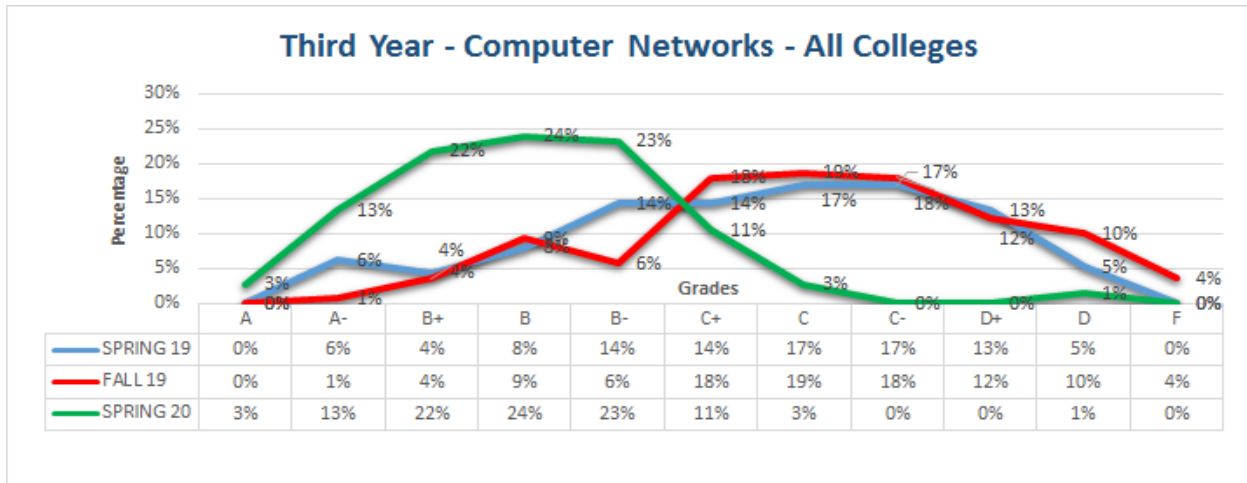


Figure 11. Third Year – Computer Network Major Results Distribution

*D. Information Security Major.* This is the major with second highest number of students after Computer Networks. The results of third year IT Security Major in spring 2019 and fall 2019 for this level are not similar. Out of 99 grades in spring 2019, the failure percentage is 14% with “C-” representing the grade with highest percentage. Whereas in fall 2019, out of 28 grades 7% failed and grade “D” has the highest percentage. Overall, the performance in both semesters is quite poor. The results of spring 2020 exhibit a good improvement. Out of 71 grades, the lowest grade is “C-” and the grade with the highest percentage is “B” with 30% (Figure 12).

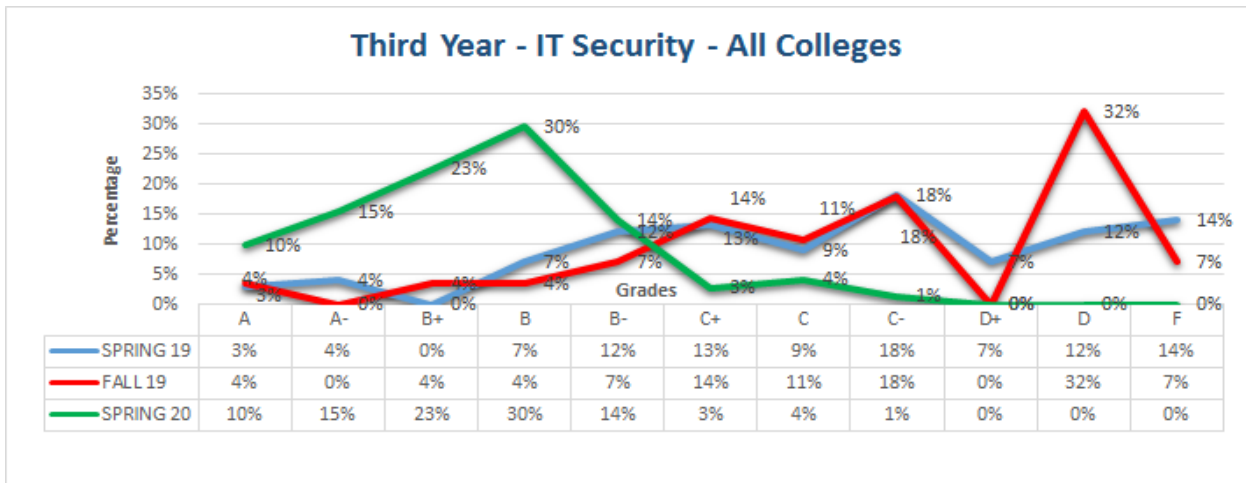


Figure 12. Third Year – Information Security Major Results Distribution

**Fourth Year (Level 4)**

Students in fourth year usually perform well with very low percentage of failure. The same pattern continues with ERT.

*A. Software Development Major.* In spring 2019, out 252 grades only 1 grade was “F” representing 0.4% the highest percentage of grades was 18% for grade “C+”. Similar results were exhibited in fall 2019 where out of 139 grades, again only 1 or 0.72% grade was “F”. The highest percentage was 18% for grade “B”. In spring 2019, 3% of the grades were “A” while in fall 2019, 4% were “A”. Results of fourth year students in SW Development major in spring 2020 show that out of 173 grades 15% of are “A”. The highest frequency was for “B+” at 24% and 0% for grades “D” and “F” (Figure 13).

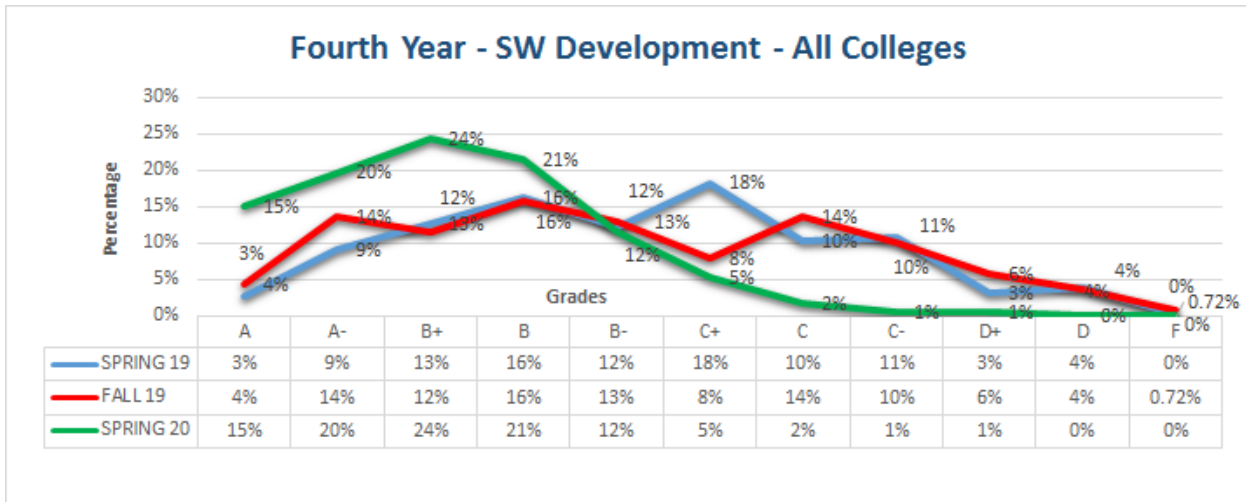


Figure 13. Fourth Year – Software Development Major Results Distribution

*B. Data Management Major.* In spring 2019, the distribution was almost normal except for the relatively high percentage of grade “D”. Out of 193 grades, the highest frequency was at grades “B-” and “B” with 19% each. As for fall 19, the number of students is less therefore only 84 grades are available for analysis. Out of this small number 1% of the grades is “F” which is the same percentage of previous semester. Between grades “A-” and “A” in both semesters the percentage is almost the same, 13% and 12%. Same remark can be seen on the right side of the graph with 8% and 7% for grades “D” and “F”. This indicates that the batches are similar (Figure 14). The similarity exhibited between spring 2019 and fall 2020 cannot be seen in spring 20. In this semester, out of 73 grades, 15% were at “A” which is higher than the percentage in previous semesters for both “A” and “A-”.

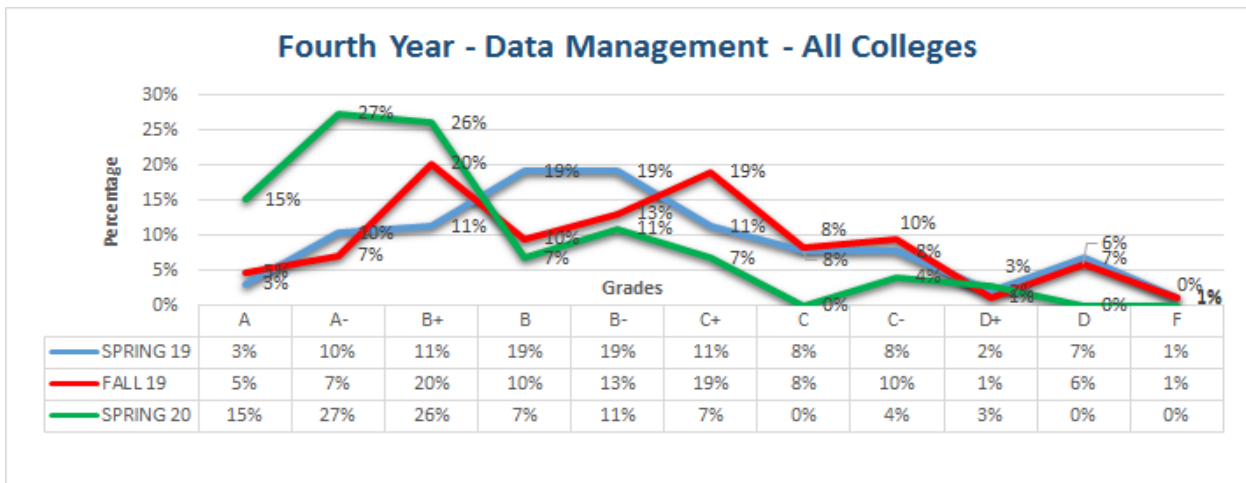


Figure 14. Fourth Year – Data Management Major Results Distribution

*C. Computer Network Major.* The results of spring 19 for fourth year students in Computer Networks major are normally distributed. The grade with highest percentage is “C+” at 22%. Out of 274 grades only one grade is “F” representing 0.36%. The results of fall 2019 for the same level of students is not as clearly normally distributed as the previous semester but most of the grades lie in the middle of the graph. Out of 225 grades, there were no failures. In spring 20, the results are distributed normally but with a shift to the left. The highest frequency is usually for grades in the “C+” region. Here it is shifted to the “B” region with no failures for 215 students (Figure 15).

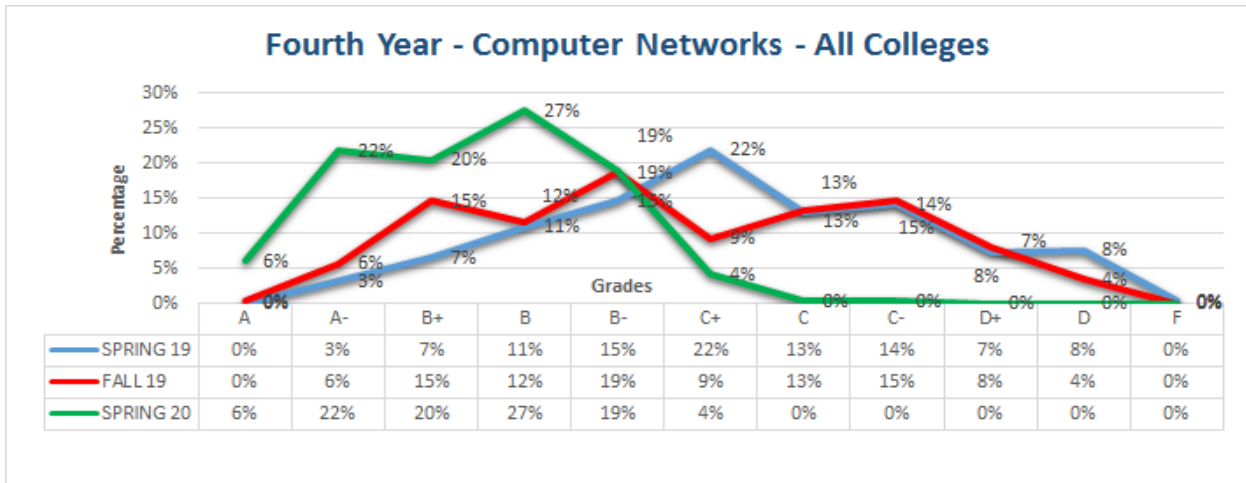


Figure 15. Fourth Year – Computer Network Major Results Distribution

*D. Information Technology Security Major.* The graph shows that most of the grades lie in the region between “C+” and “B” with 42% out of 159 total grades. The distribution is almost normal except for the high percentage of “A-” due to high grades scored in final year projects. Normal distribution is exhibited in fall 19 results for fourth year students of IT Security major with out of 206 grades, 20% of the grades lie at “C+”. In spring 20, the distribution is normal but shifted to the left. Out of 195 grades, 25% is at “B+” with no grades at the extreme right side of the graph (Figure 16).

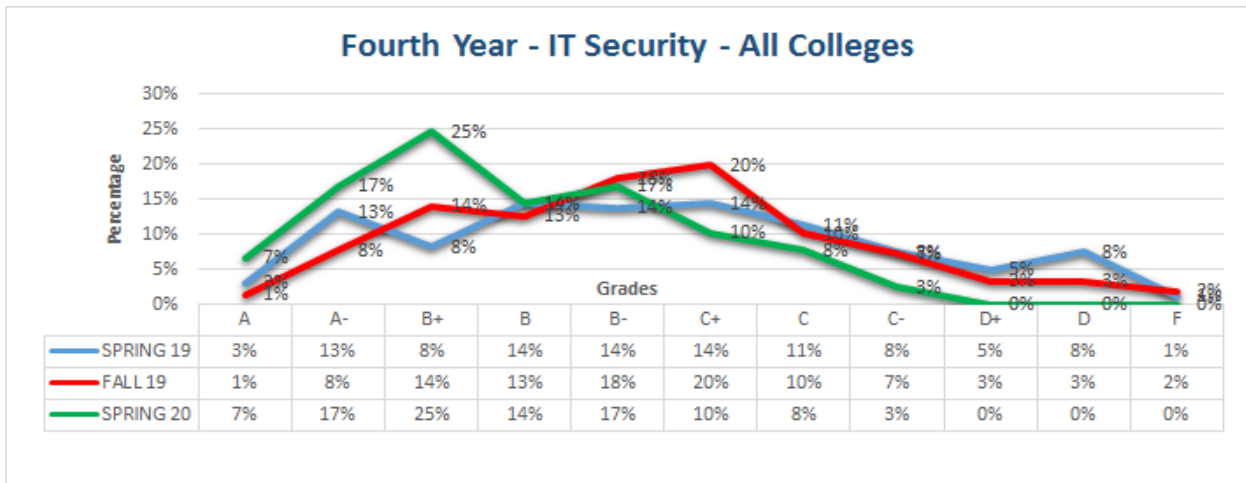


Figure 16. Fourth Year – Information Security Major Results Distribution

**Results Analysis by Course**

In order to draw more conclusions, we selected 4 different courses (one from each year). The selection was based on finding courses in which similar number of students registered during the last 3 semesters.

*A. First Year Course.* The first year course selected is ITDR1104 Programming Fundamentals. This course presents a major challenge to some of the students and it determines if the can continue in the program or not. Therefore it was important to discover if distant learning, doing assignments/ projects independently, different assessment mode and marks distribution have made a difference in students’ performance.

In spring 2019, most of the grades were on the right side of the graph. Out of 174 students, 14 students failed representing 8% of the students taking the course. None of the 174 students managed to obtain an “A”. In fact, most of the grades were in the region between “D+” and “C” representing almost 50% of the students. These

numbers indicate the presence of problems that have to be addressed. Similar distribution is exhibited in fall 2019 results. In fall semesters the number of students registered in this course is usually less. Out of 96 students, 15% failed the course (i.e. 14 students). Again none of the students obtained an “A” grade. Overall, the performance in fall 2019 was worse than it was in the previous semester. In spring 2020, the results shifted to the left with a normal distribution centered at “B” grade. Out of 242 students only 2 students failed representing 1%. On the left side of the graph, 6% or 15 students obtained an “A” compared with 0% in the previous two semesters. The performance has clearly improved (Figure 17).

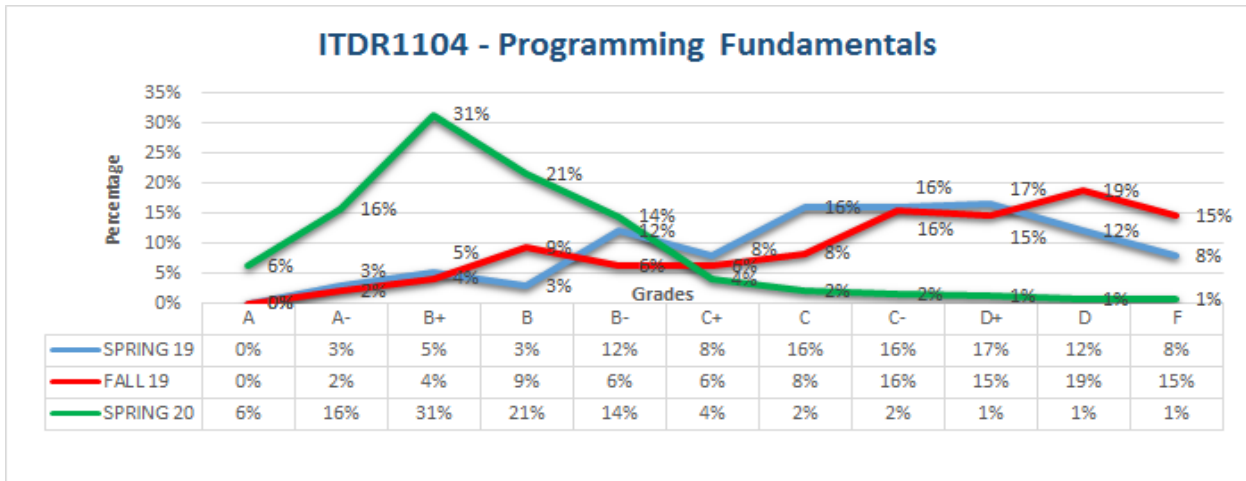


Figure 17. “ITDR1104 – Programming Fundamentals” results distribution.

*B. Second Year Course.* The second year course selected is *ITDR2106 Introduction to Databases*, (Figure 18). The results of this course for spring 19 show an almost normal distribution skewed to right. Out of 174 students, the highest percentage 21% obtained “C-” with no “A” grades and 6% or 10 students failing the course. The results in fall 19 for the same course show similar distribution to that of spring 19. Out of 48 students, the highest percentage 19% obtained “C” with no “A” or “A-” grades and 2% or 1 student failed the course. In spring 20, there is an overall improvement with the graph shifted to the left but without normal distribution. Out of 154 students, the highest percentage, 19%, obtained “B+” or “B”, one student (0.65%) obtained an “A” and no failures for the first time in 3 semesters.

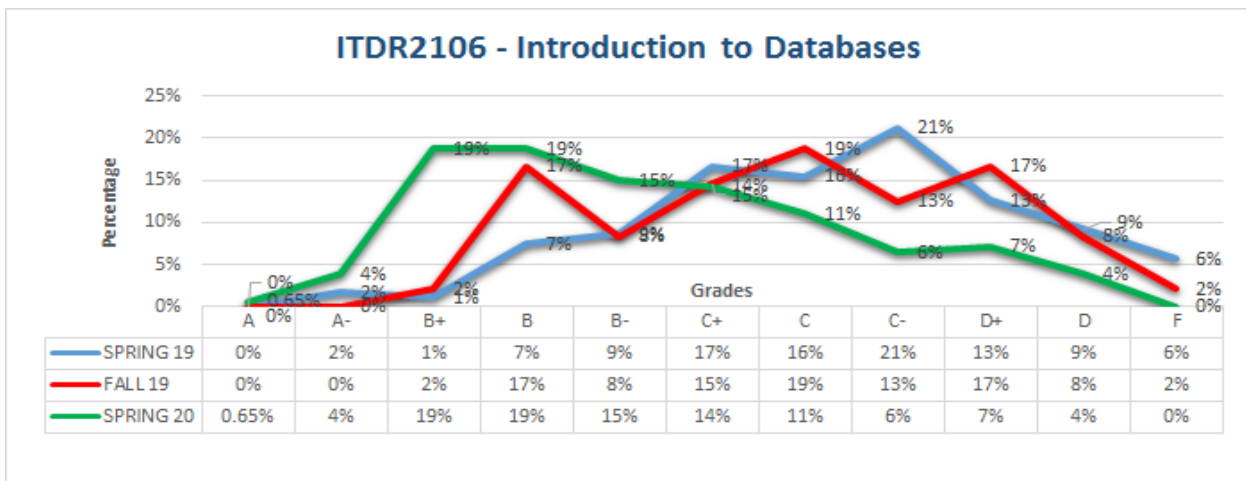


Figure 18. “ITDR2106 – Introduction to Databases” results distribution.

*C. Third Year Course.* The third year course selected for comparison is ITDR3101 Systems Analysis and Design. This is a department requirement third year course that all students must complete before selecting a major. The distribution of grades was not normal in spring 2019. As Figure 19 shows, the graph is tilted to the right with majority of students obtaining grade “C”. In fact out of 33 students, all students secured a “C” grade or higher. With a higher number of students in fall 2019, the distribution is normal. Out of 163 students, 24% obtained “C+” followed by 23% with “C” and 16% obtained a “B” grade. The results for the same course in spring 2020 exhibit normal distribution with a shift to the left. Out of 40 students, 48% or 19 students secured “B” grade. It is well noted that there have no failures during the last 3 semesters.

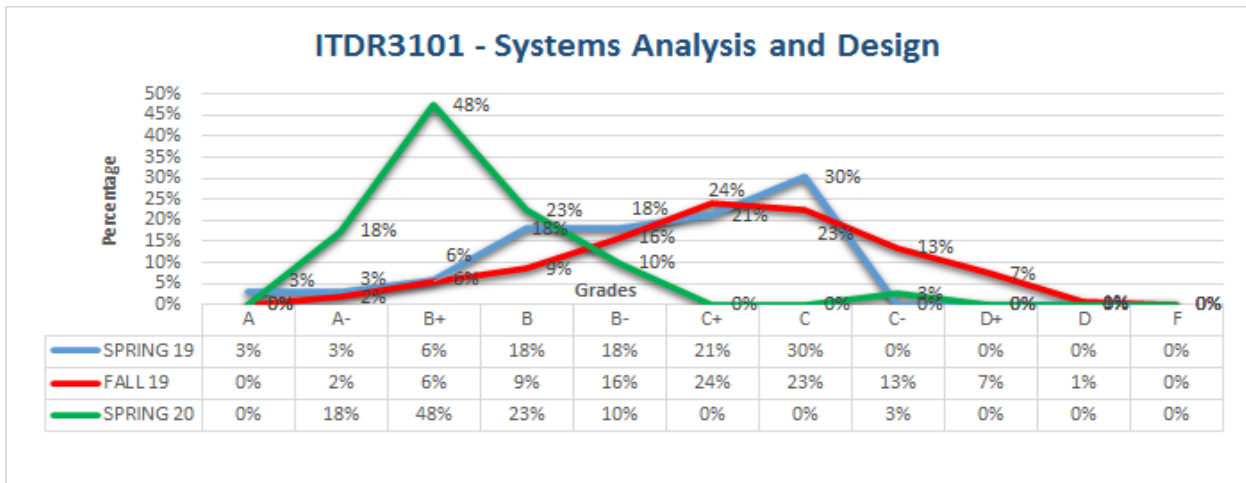


Figure 19. “ITDR3101 – Systems Analysis and Design” results distribution.

*D. Fourth Year Course.* The fourth year course selected is ITNW4112 Advanced Routing and Switching (Figure 20). This is mandatory and open only to Computer Networks major students as a part of Bachelor degree requirements. The number of registered students is always quite low. In spring 2019, the number of students was 19. The distribution shows that almost 50% of the students scored “C+” or less while the other 50% scored “B-” or more. In fall 2019, the number of students was 26. The highest frequency was for grade “B-” with 31% or 8 students while the remaining students scored almost equally on both sides of the graph (8 students to the right of the center and 10 students to the left). Finally, in spring 2020, 17 students registered for the course. Out of the 17 students, 6 students or 35% obtained “B-” and only one students scored “C+”. The remaining have obtained a “B” grade or higher.

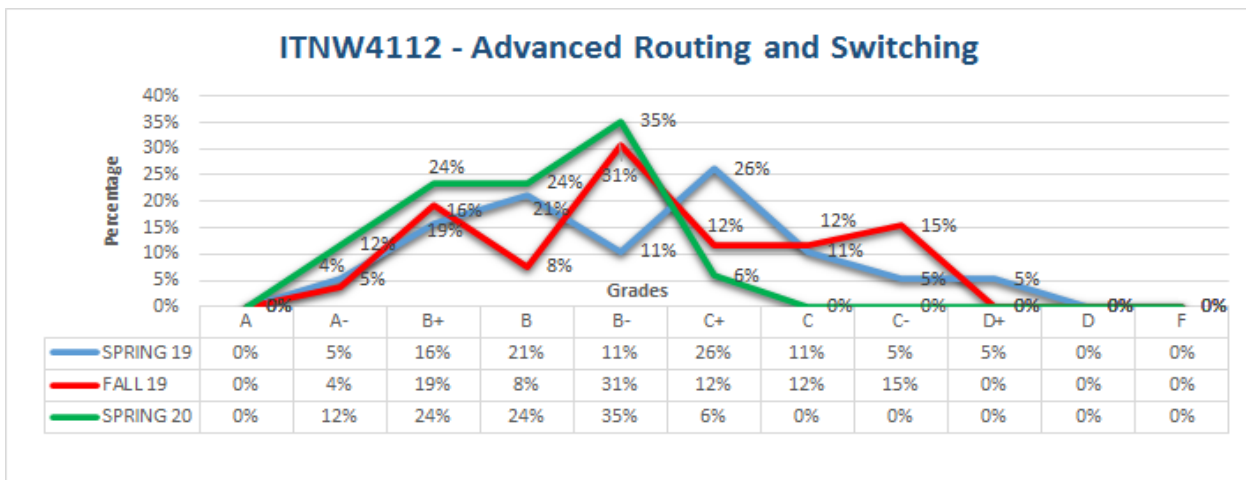


Figure 20. “ITNW4112 – Advanced Routing and Switching” results distribution.



## Discussion

As days went by during the closure of colleges and with the follow up with students it was expected that the grades will be inflated. One cannot safely declare that students actually mastered the courses nor that the learning objectives and outcomes of all course have been attained. However as the analysis in previous section shows, a noticeable rise in numbers of high grades and decline in lower grades is witnessed. This can be attributed to the following reasons:

1. *Different forms and weight of final exam.* Most students lose marks in the final exam due to the pressure of exams, quantity of material covered and in some cases the psychological fear of exams causes even good students to perform poorly. During the semester students manage to accumulate marks step by step all the way to the final. Midterms usually cover 5, 6 or 7 units from the course and assignments are given enough time to complete. With the modification assessment weights, students guaranteed a better score in semester work and the final exam pressure and anxiety were lifted because of its lower weight of and the nature of the exam.
2. *Practical Assessments.* The practical assessment were – as other assessments - conducted from distance (online). The weight for this component was higher than usual. Students were assigned duties with specific scope and time constraints. Again with more time, open resources and less exam tension, students performed better than before.
3. *Quizzes and Midterms.* Even though, these types of assessments had different formats, more difficult and analytical oriented questions, students performed outstandingly since they were given adequate time and resources to complete the tasks.
4. *Projects and Assignments.* With students freed from attending classes, they had more available time to work on projects and assignments. Presenting their work online was also advantageous for students who suffer from speech anxiety. After submitting the projects, students presented, individually, their work either through video conference session or by submitting a recorded presentation in case they could not present synchronously.
5. *Availability of Material.* Lectures and labs were available in recorded forms which offered more opportunities for students to review courses at their own pace and time.
6. *External help.* There is possibility that some students obtained help and may have been involved in plagiarism but were not discovered. Plagiarism could be discovered and was discovered and students were penalized in a number of cases. But if students were helped by an extra party it is not possible to prove it happened without doubt and consequently suspected students cannot be punished without concrete evidence.

## Conclusions

Despite the sudden move from one form of teaching to another without any notice, all courses were delivered and assessed without any problems. However the results were inflated and do not indicate the true level of students, nor do they indicate the achievement of the course objectives. Despite the presence of outstanding students, the results of this semester show that all students are at a high level and there are only very few students at a modest level which is not true.

Having witnessed the grades inflation and the false sense of outstanding performance and since all fall 2020 courses are delivered online, we had to take major changes in delivery mode, assessment mode and marks distribution. In total there are 53 courses offered across all college in fall 2020. The delivery mode was a mixture of synchronous lectures and labs and asynchronous lectures and labs. The synchronous lectures or labs are being conducted according to their regular timetable using Google Meet or MS Teams. Asynchronous lectures and labs are recorded and made available to students through the official LMS. Moreover, the synchronous lectures and labs are also recorded and made available to students who may miss the synchronous

sessions and for reviewing purposes. Marks distribution is left to the course instructor or coordinator to decide on number of assessments, type of assessment, weight of assessment, time constraints and mode of conducting it. In addition to online assessment, the students have to validate their answers through answering direct oral question, presentations, demos,..etc. Plagiarism detection and submitted work authenticity will be more rigorous than in the previous semester.

As we approach the end of the semester and final exams, it is evident that students have become accustomed to online learning. The attendance in synchronous lectures and labs is above the usual average. The interaction with students is improved. However, the grades are not expected to be as inflated as in spring 2020. We will analyze this the results of the current semester and compare them with results of spring 2020 to determine if the measures taken were appropriate and gave more realistic results.

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