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NEW OPTIMIZATION/AUTOMATION MODELS FOR HEI MANAGERIAL WORK: GRADING, REGISTERING ATTENDANCE, EXAMINATION SCHEDULING, ARCHIVING, AND TIMETABLING

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Abstract

The purpose of the present study is to introduce novel optimization and/or automation models for Higher Education Institution (HEI) managers in certain academic processes like grade entry, registering online class attendance, identifying examination schedule clashes, setting-up a central filing system (data archiving), and developing timetable techniques. The study used advanced MS Excel functions and various techniques such as conditional formatting, inserting pivot tables (matrices) and charts, removing duplicates, and filters. Moreover, the study also used MS Teams, Google Sheets, and simulations to introduce novel techniques for other processes. It was found that converting raw scores to grades and generating module grade statistics for every module can be easily automated using MS Excel functions and charts, examination schedule clashes can be easily identified using pivot tables, and online class attendance can be easily and adequately monitored through the power of MS Excel functions. Additionally, the study revealed that HEI leaders and staff can effectively and efficiently collaborate as well as access and share files through MS Teams. Furthermore, the study found that collaborative scheduling along with various techniques in timetabling such as using dummies, group coding, re-arrangement of commitments, and rescheduling of classes can enhance the feasibility, speed, and accuracy of timetable management in any HEIs regardless of software programs used. HEIs are advised to apply these techniques with minor alterations depending on their objectives, constraints, and resources.

Keywords: Higher Education Institution, Central Filing System, Grade Analysis, Timetables, Examination Clashes

1. INTRODUCTION

Working in Higher Education Institutions (HEIs) is both rewarding and challenging. There are multiple positive features in this work and one of the most rewarding aspects is the chance to make a difference in the lives of students; whether it is by making it certain that exams are scheduled efficiently and fairly, allocating qualified lecturers, allocating tutors to students who require extra support, determining accurate remaining modules to advise students and ensure their progress, automating grade entries to deliver quick feedback to students, and efficient timetabling to ensure that resource allocation is optimized and that students and lecturers are not disadvantaged, and many more. In all of these areas, institutional leaders play a vital role in supporting students, and their work can directly and considerably impact the students' educational experience and can aid in terms of ensuring that they have the maximum support and proper resources needed to succeed.

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The opportunity to work with intellectuals from various backgrounds is also another positive aspect working in HEI's operations management providing leaders and managers the chance not just to collaborate and enhance positive relationships with some of the most passionate and brilliant individuals but to learn from some of the best minds in the academia. Moreover, the industry's dynamic nature is also a rewarding aspect making it a fulfilling and worthwhile career choice as it provides opportunities for professional growth and development and the chance to be part of ever-changing and exciting environment. However, being dynamical makes it constantly evolving and operations managers within the field need to be able to adapt to fundamental needs and changing circumstances and be able to think creatively and critically to solve complex problems. Their work can then demand a considerable degree of analytical and strategic thought patterns. This is mainly due to the fact that the main area of higher education lies in the complexity and intellectual stimulation of the work (Kaloudis et al, 2019).

In the light of the foregoing discussions, higher education institutions face multiple problems in relation to operations management encompassing module grade entry and analysis (Ibe et al, 2020), identifying students' remaining modules (Nicoletti, 2019), scheduling of examinations (Dener & Calp, 2018), tutor allocation (Caselli et al, 2022), timetabling (Ceschia et al, 2022), and many more. These challenges are common in most colleges and/or universities around the world and can be more complex in educational institutions with multi-faceted programmes and thousands of students, faculty members, and staff. Particularly, it is very common in the Sultanate of Oman where most of the colleges and universities have course offerings which are awarded by universities from different countries. The awarding universities amongst others are mainly from United Kingdom, USA, Malaysia, Jordan, UAE, and Egypt (Diwan of Royal Court, 2023). Their situations become complex because these national institutions need to follow the academic procedures and processes imposed by these awarding institutions. A case in point is Majan University College (MUC) whose awarding body is the University of Bedfordshire, United Kingdom (MUC, 2023). MUC is located in the country's capital, Muscat, where the main author of this work is affiliated with.

In conjunction with these current challenges and issues, this paper presents a novel approach in terms of providing automated platforms and solutions using Advanced MS Excel and other tools to enhance, optimize and/or automate the grade entry list and its corresponding statistics, online class attendance entries, clashes in examination schedule identification, central filing system, and develop timetabling techniques. Although implemented for five areas, other approaches can also be developed and maybe be applied to more scenarios/processes using other techniques which may deem fit according to the requirements of any HEIs.

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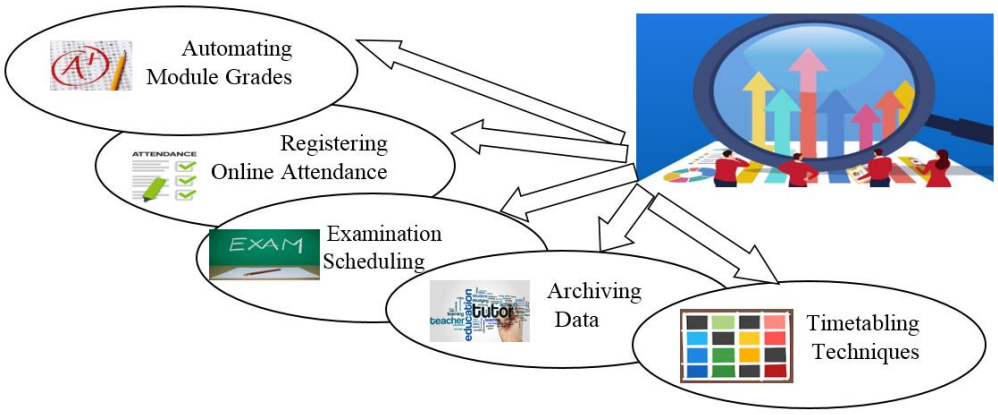

Figure 1: Five HEI Academic Processes to be Optimized/Automated

2. RELATED WORK

Institutions in higher education are tasked with providing the necessary quality education to students whilst making it certain that operational efficiency is upheld. One of the largest challenges encountered by HEI managers is the automation and/or optimization of various academic processes like module's grade/result statistics and analysis, attendance registration, examination scheduling, central filing, and timetabling. Traditional approaches to these procedures and processes are most often time-consuming as these are performed manually leading to inefficiencies and errors. Nevertheless, recent advances pertinent to optimization and/or automation models present formidable and promising solutions to battle these challenges. This literature review section explores the extant literature on new optimization/automation models used by managers and/or leaders in various higher education organizations to enhance the efficiency and effectiveness of various academic processes.

2.1. Grade Entry

Grading is a crucial academic process in higher education institutions. It involves the assessment of student performance and assigning grades that reflect their level of understanding and mastery of the course materials. In essence, Sam (2023) defines it as a process where a student's work is assigned a rank of performance. Similarly, Kumari (2022) says that grading is a process whereby numerical marks are converted to grades, possibly a letter. These definitions imply that grading regardless of total marks assigned to a certain subject is objective in nature. However, converting numerical marks to grades poses a challenge as the process is affected by the lack of consistency in terms of the grading scale used (Haladyna, 2019) leading to inconsistencies in the grading process amongst many HEIs. Another issue is the know-how of the educators on how to use technological tools to speed up the process and the limitations to their access to the same. Many educators around the world have either limited access to these tools or do not have automation techniques which according to Rollwitz (2022) cause additional workload and burnouts amongst these teachers.

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There are a number of studies which have explored automation models to speed up and/or improve the process of grading students. For instance, Ren et al (2020) developed an Excel-based automated grading system for automating the grading method for activity-on-node calculations. The method proposed showed 100% accuracy whilst reducing manual grading tasks. This study has some positive aspects which can be applied in other assessments; however, it focuses on grading particular projects and not on converting numerical marks to grades and extracting information and providing analysis on students' performance. In addition, related studies have also been conducted in terms of grading and some of these are the ones performed by Huang and Wu (2021) who proposed an automated grading system for a subject in a Computer Science utilizing a rubric-based evaluation. Both revealed that their system can automatically grade assignments and produce feedback to students using their own grading scale. Similarly, Kim et al (2020) designed an automatic grading system for assignment using machine learning which can automate the calculation of grades of students' assignments based on how they perform. Their studies have helped teachers within their organization reduce their workloads. Other studies have also provided considerable aid in their respective places, e.g., Al Mamun et al (2019) who used artificial neural network to automate grades for exam sheets; Tan et al (2018) who developed an automated grading system using Excel VBA designed for Engineering students. Like Huang and Wu, their system can automatically grade assignments and produce feedback to students.

Overall, looking at the results of the studies above, it can be generalized that most of the studies focused on generating models that would be able to score students' performances on the questions provided on the assessments such as assignments (essay types), option-based exams (Multiple-Choice), and other types of assessments. Most of these focused on automating the scoring per question using a rubric or marking scheme and not on automating grade entries and providing automated analysis using automated charts. It should be noted that the main purpose of this study is to help every module lecturer automatically convert the scores of the students into its corresponding grades and display statistical measures along with its pertinent charts. This is to easily generate the module analysis and generate the overall performance by looking at the pass rates, failure rates, averages, counts, and other measures which is needed in most universities in Oman before publishing the results as most universities in the country follows a UK system where every module may contain students of various status, i.e., Normal, Retake, Referral Students. There is then a need to produce an automated system that would produce automatic conversions of scores obtained by students in every module which will also automatically display all other measures mentioned above and corresponding graphs. Note that the task of the Module Coordinator is just to mark all the papers based on the marking scheme and once all the marks are finalized, it should then be entered into a 'Mark Entry Sheet' that has readily available formulas and techniques whereby outputs can then be generated at an instant. The main goal is speed and accuracy using MS Excel techniques and formulas and this is the gap that this study is going to fill.

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2.2. Registering Online Class Attendance

Shifting to online classes during the pandemic (COVID-19) has paved the way for new challenges in taking attendance during virtual sessions. Accordingly, there has been a growing enthusiasm for instituting automated attendance systems that can accurately register the attendance of attendees without the manual input by the lecturers. Entering attendance in most colleges/universities in Oman whether offline or online is a must as most of the students are sponsored by the ministry and it requires reports from these institutions from time to time. In addition, attendance is believed by many higher education lecturers to be the main aspect for positive academic performance especially in modules/subjects with considerable practical activities (Ancheta et al, 2021). This implies that students should attend maximum number of classes in order to progress in their modules successfully and obtain positive outcomes. There have been significant number of studies conducted in terms of the importance of attendance aside from the one performed by Ancheta et al. For example, Bergin (2019) stated that attendance improves performance, and it is an early indicator of success. In addition, Woody Allen cited in Tomforde (2023) said that “80% of success is showing.” This idea about the importance of attendance is also supported by Montauban (2023) and Swanepoel et al (2021).

Several research works have proposed multiple automated attendance systems for online classes. For instance, Chiu et al (2021) developed an automated attendance system for online sessions using a facial recognition technology to register attendance automatically. They asserted that their system was able to reduce teachers’ workloads in terms of attendance entry during online classes. Similarly, Wang and Kim (2021) created an automated system which also utilizes a facial recognition technology and revealed that their system is highly accurate. Furthermore, other alternatives were also proposed by other authors for registering attendance during online set-ups. Nguyen and Le (2020) developed a system that utilizes a unique identifier for each student to enter attendance. Their method has been used in certain modules at the outset and applied in others as well with the passage of time with very high accuracy. Another method was the one proposed by Nagpal and Singh (2019) which uses machine learning algorithms to identify and/or recognize attendees’ faces and register attendance. In the light of the above discussion, it can be observed that the development of automated attendance systems for online sessions has been an emerging but uncertain area of research that has a great potential or capacity to enhance the efficiency and accuracy of attendance registers during virtual sessions. Nevertheless, further research is required to address the issues pertinent to privacy and security and to explore ways and means in terms of taking attendance during online set-ups. For instance, the use of facial recognition technology raises concerns over the collection and use of students’ biometric data. This is a very important aspect to consider especially in Oman, a Muslim country, where this research is conducted. This gap is to be addressed in this study by developing advanced formulas using MS Excel that would use entries from MS Teams to automatically generate attendance of students using other functions such as VLOOKUP to match the entries with the attendance sheet acquired from the college’s database. Refer to the results section for this.

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2.3. Identifying Clashes in Examination Schedules

Scheduling examinations is a complicated academic process and demands proper and careful planning to make it certain that there are no clashes or conflicts in the schedule. Nonetheless, with the increasing number of students and courses, it has become challenging to schedule examinations and other types of assessments without any clashes. Hence, the use of technology to determine these conflicts in the schedule of examinations has become a very important aspect to consider. The University of British Columbia (2023) defines an examination clash as an event where a student has more than 1 examination happening on the same day and at the same time, or when there is an overlap on the allotted timings for scheduled formal assessments, particularly a written exam. Clashes in the examination timetable are impossible to avoid entirely due to the size and complexity of the timetable considering the number of students and the subjects they are taking within a particular semester (Leather, 2023). Nevertheless, many individuals have developed various techniques to resolve this particular issue. The most recent studies are elaborated hereunder.

Several studies have presented various approaches to determining conflicts in the schedule of examination. Most of these approaches were able to demonstrate its effectiveness in terms of reducing clashes and improving student satisfaction; however, most of the models and/or techniques proposed in these research works are complex and difficult to maintain especially for normal workers in higher education without a thorough knowledge on programming or coding or some other advanced IT skills, e.g., heuristic algorithm aimed at resolving examination timetable conflicts by Smith et al (2019); integer linear programming by Lee et al (2018); efficient algorithms by Nguyen et al (2018) and Kim et al (2018); a hybrid algorithm (graph theory and constraint programming) by Wang et al (2019) and a multi-objective approach by Chen et al (2020).

Looking at the above-mentioned models proposed for clash identification, it can be observed that these available models are difficult to manage as they demand necessary software programs that necessitate individuals who are well verse of the same. This is the gap that this study is going to fill by introducing an easy technique using a readily available software program, MS Excel. Advanced features such as advanced filtering, conditional formatting, and removing duplicates will be used in addition to some other techniques which will be elaborated in the subsequent section. It is aimed at equipping various HEI leaders such as the Programme Managers (PMs), Directors of Studies (DoS), and Head of Registry with a user-friendly toolkit for identifying examination clashes without further delay and hassle.

2.4. Archiving Data (Establishing a Central Filing System)

There is huge challenge and complexity in terms of managing records and documents in higher education institutions (Touray, 2021). Many of the HEIs still depend on manual record-keeping methods, which can be error-prone and time-consuming. Furthermore, the decentralized nature of many academic departments can make it complex and challenging to make it certain that records are consistent and easily accessible across

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the organization. The lack of a centralized filing system in HEI can result to several issues. For instance, records maybe duplicated, lost, or misplaced, that can lead to delays and inefficiencies in various academic and administrative processes and procedures. This can lead also to difficulties in academic progress tracking, student record management, and in terms of ensuring compliance with the regulatory requirements (Assaf et al, 2022). Additionally, decentralized record-keeping can make it difficult for various sections and/or departments to easily share information and collaborate effectively, which can in turn hamper academic and research initiatives (The New South Wales, 2023; Carballo, 2022). Hence, there is a pressing demand for HEIs to implement centralized filing systems to enhance data or information security, improve record-keeping, and facilitate adequate academic and administrative processes. Such initiative would provide a singular and reliable source of information, making it certain that there are accurate records, which are up-to-date, and easily accessible to authorized staff members. Also, the centralized filing system would support collaboration across departments resulting in increased efficiency, enhanced research capacities, and better outcomes for students.

Data archiving in HEI is an important challenge that has received a considerable attention in recent years which is mainly due to the ever-increasing volume of data generated within the industry. Several studies have explored the challenges and corresponding advantages of data archiving in higher education. For instance, Fathema et al (2020) proposed a framework to archive digital student work such as artifacts, assignments, presentations, and research paper. Using a combination of curation, preservation, and management of data, students' works were properly preserved and archived. Similarly, Khan et al (2021) also used a framework for preserving records of college students in Pakistan using a cloud-based approach and their model has demonstrated the effectiveness in terms of security and reliable storage. In addition to these studies, there have been also other research works that used different methods, e.g., Kozak (2018) who implemented a centralized storage system for electronic documents in a university environment which included the utilization of appropriate file formats, access controls, and backup procedures; Elgazzar (2019) who studied the digital preservation practices of the American University in Cairo, Egypt emphasizing the relevance of institutional policies, training, and collaboration between stakeholders.

In all the studies reviewed, the models or frameworks implemented by the researcher are indeed revolutionary solving a lot of issues in terms of central filing system within the HEIs. Although, some of them used a cloud-based network, none of them demonstrated the use of MS Teams which is the most recent cloud-based app or feature of Microsoft that can be used for digital storage. This might be because of the fact that the maximum usage of MS Teams started only during the COVID-19. To bring forth a new approach of data archiving in higher education, this study will fill the gap by using this Microsoft feature in terms of instituting a central filing system in his own department, the Faculty of IT to ensure that academic files are properly archived and that his colleagues can easily access, share, and collaborate.

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2.5. Developing Timetabling Techniques

Timetabling is a crucial and challenging task that HEIs must perform to make it certain that examinations, courses, and other events happen without clashes (Burke et al, 2019). It also plays a vital role in terms of the optimization of the use of resources like classrooms, staff, and faculty members. Developing effective timetabling techniques can aid in terms of improving efficiency, reducing costs, and enhancing student satisfaction. In many cases, the old methods of timetabling have been inefficient and prone to errors resulting to dissatisfaction amongst students, higher costs, and decreased productivity. Mousavi and Behrouzfar (2018) demonstrated that the timetabling problem in HEIs is considerably complex and can be further compounded by other factors such as constraints and varying student preferences. Similarly, Al-Anzi et al (2019) stated that the manual methods of timetabling are not only a waste of time but can also result to clashes and errors which can in turn dissatisfy students and highly impact the operations in HEIs. Additionally, Wang and Qian (2020) revealed that using an automated timetabling system can lead to considerable enhancements in the efficiency and accuracy, as well as better student satisfaction. This idea is supported by Gonzalez et al (2021) who asserted that HEIs should adopt modern techniques of timetabling, specifically using Artificial Intelligence (AI) and optimization algorithms to resolve the issue.

Furthermore, there have been several studies conducted pertinent to timetabling techniques. One of the most common ones is the one used by Schaerf (2019) which is the heuristics algorithm which depend on the rules of thumb or common sense to aid timetabling process. These algorithms are specifically useful for big colleges/universities which timetable a voluminous number of events and courses. Significant research has demonstrated that heuristics algorithms can produce efficient and effective timetables; however, they may not always be optimal. Another technique used is the one that uses Mathematical optimization models, i.e., the one used by Yeoh and Ng (2019). Their models are used to identify an optimal solution to a given problem related to timetabling. Mathematical optimization models have the competitive advantage of being able to consider a large number of variables simultaneously and can provide optimal solutions. Nonetheless, these models require considerable computing resources and can be time-consuming to implement. Recent research has also explored the use of AI techniques in timetabling such as those presented by Li et al (2019). AI techniques like machine learning and neural networks can be utilized to learn from past scheduling data and predict future scheduling patterns which can reduce the time requirement and improve the overall efficiency and effectiveness.

In addition to the studies mentioned above, Garcia-Sanchez et al (2020) emphasized that there is a need for the higher education industry to use modern techniques in timetabling using AI and Machine Learning (ML) in order to solve various issues such as clashes. These can be used to optimize timetables based on real-time data, as well as forecast student demands and varying preferences. Similar to this, others have also introduced the most recent methods; e.g., multi-objective approach by Zhang et al (2019) which minimizes clashes and enhances student satisfaction, Gursel et al (2021) who

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implemented a cloud-based software which allows students to view their timetables in real-time, and Shams et al (2021) who developed a deep learning model to forecast the availability of rooms and resources based on past timetables.

Looking at the above elaborations, it can be generalized that most of the common platforms and techniques used to battle the complexities of timetabling are those that involved optimization, Mathematical models, neural networks, deep learning, machine learning, and/or with the use of AI. Nevertheless, it all still depends on the policies, procedures, and constraints faced by the institution. Moreover, the software program to be developed and implemented should comply with all the variables, constraints, and objective of this organization, otherwise, a lot of challenges and issues will be encountered. Since, the college under study has already a developed system which is called Integrated System for Registration (ISFR), this study is going to fill the gap of all the research works reviewed by introducing timetable techniques in a general sense, meaning techniques for HEIs who have already a digital platform which may prove useful with simple modifications in their various platforms. Techniques such as how to avoid conflicts in students' classes, how to resolve issues pertinent to counteracting overflowing number of students (swapping/transferring rooms), how to assign groups, or how to transfer students and teachers which will be introduced in the later sections.

3. THEORETICAL AND CONCEPTUAL FRAMEWORK

The researchers were guided by several concepts and theories related to their study that were derived from their readings of extant and relevant literatures. This section then provides structure and guidance necessary to comprehend the theoretical underpinnings of the research questions, design appropriate methods, and analyze data rigorously and meaningfully.

3.1. Grade Entry

The grading slab of the college under study follows a UK system where the lowest grade is equivalent to (G = 0) and with a passing grade of 40 (D-). Refer to table 1 for additional information. This is entirely different from other colleges/universities around the world where grading scales follow different bases and passing grades. It should be noted that the "G" grade in this table means that the student has either obtained a mark which is 0/100 or absent during the assessment or examination. The cut-off grade to pass is 35 (E) provided that the mark in the other assessment is higher and the total outcome is 40 or more. For instance, if a student obtains 35 in the first exam which is 60% and obtains 48 in the final examination which is 40% of the total grade, the student will pass overall, (i.e., 35 x 60% + 48 x 40% = 40.2). If by any chance, the student obtains any grade lower than 35 (E), the student has to retake the examination during the re-sit examination as scheduled, which is usually during the next semester. For example, Student X obtains a mark equivalent to 20/100 (F) in the first assessment and 90/100 (A+) in the final assessment, his overall outcome will be RA meaning referral in the first exam. He has to retake the first examination next semester in this regard. Similarly, if he obtains 90/100 (A+) in the first exam and 20/100 (F) in the final examination, his overall outcome will be

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RE meaning referral in the final examination where he has to retake the final examination next semester. In the UK system and as followed by the college under study, there is no failure in the first attempt of the subject. Re-takers of the subject will not be either awarded a 'fail' in their overall outcomes. For clarity, refer to the definitions below.

Normal Students – Students who are registered in the module/subject for the first time. Any student whose status is 'normal' will not be awarded a 'fail'. If a student, for example, fails or is absent in any examination, he will be given a referral (re-sit) chance next semester. If he does not pass in any of the referral examinations during a re-sit, then he will be awarded a ''failure''.

Retake Students – Students who are retaking the module more than once. K1 = Retake 1, K2 = Retake 2, and so on. Similar to normal students, they will be given referral chances if they fail or are absent in any of the assessments.

Referral Students - These are the normal/retake students in the previous semesters who had grades lower than 35 (E) and whose overall outcomes are lower than 40 (D-). They will automatically fail the module if they do not pass any of the re-sit assessments.

All the information above is clearly stipulated in the college's Online Student Handbook (MUC, 2023). Table 1 below shows the grading slab of the college under review.

Table 1: MUC Grading Slab (MUC, 2023)

Grade Letter	Mark Band %	Grade Descriptor	
A+	80-100	Outstanding	PASS
A	75-79	Excellent	
A-	70-74		
B+	67-69	Commendable	
B	64-66		
B-	60-63		
C+	57-59	Good	
C	54-56		
C-	50-53		
D+	47-49	Satisfactory	
D	44-46		
D-	40-43		
E	35-39	Marginal Fail	FAIL
F	25-34	Fail	
F-	01-24	Fail	
G	0	Non-Submission	

In the light of the grading slab above, generating a report that includes exam statistics is necessary. It is then crucial to comprehend the importance of the numbers in the report, as they will inform the lecturer's decision pertinent to not just the exam's quality but student learning (BCM, 2019). Additionally, Hill (2020) stated that studying students' prior examination performance is aimed at improving student outcomes and learning what

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specifically they struggle. Accordingly, with the outcomes of the analysis of the results, curriculum can then be adjusted, or teachers can then provide remedial classes wherever necessary, which could improve students' achievement, Hill further asserted. Moreover, Oermann and Gaberson (2019) also demonstrated the importance of organizing and presenting all the students' raw scores of a particular subject's examination into frequency distributions, histogram or frequency polygon. This can be used accordingly to interpret the results and utilize them to make decisions on grading, selection, placement, and other considerations. This information is crucial for the preparation of posttest discussions with students and/or improving the examination.

In relation to the preceding paragraphs and in compliance with the UK standards, this paper presents the automation module examination results' statistics using various measures as illustrated in fig. 2 below.

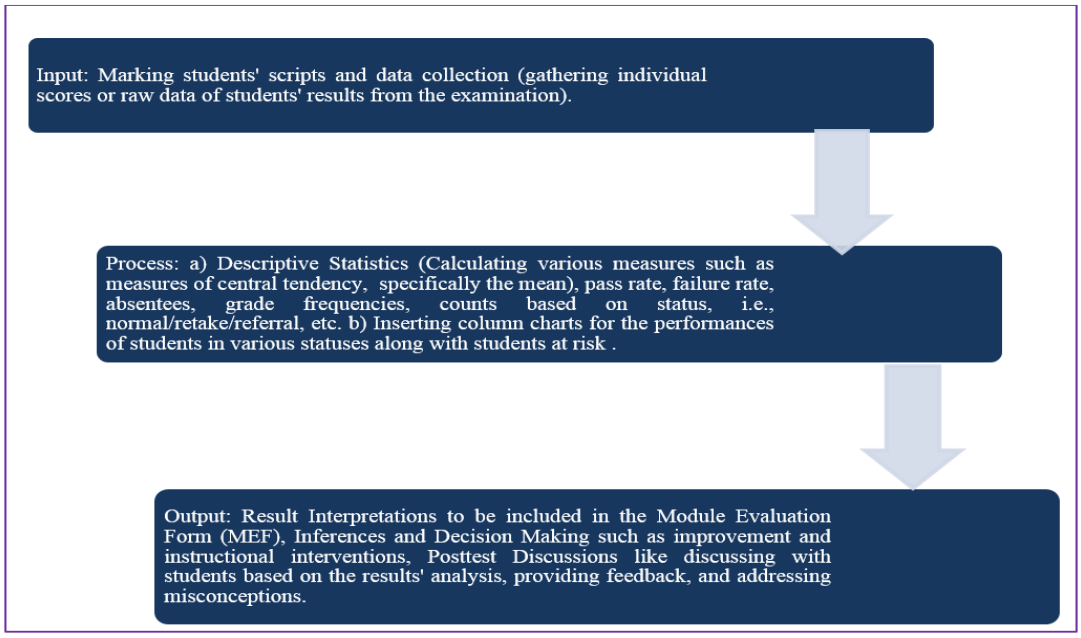

Figure 2: Schematic Diagram: Module Result/Grade Statistics

Analyzing students' module results using the above schematic is related to performance measurement which can be linked to investigating the reliability and validity of student performance (Petra and Aziz, 2020). However, performance measurement is not just focused on the academic process as it is considerably applied in assessing employees or entire organizations against set goals or benchmarks. Similarly, it can be used to evaluate business performance, like analyzing sales figures, customer satisfaction, or staff performance metrics (Vaidya, 2023; Valamis, 2023). Furthermore, evaluating grades of students is related to an operational or business concept which is data analysis, specifically student data analysis (Rowley, 2021), decision making in higher education (Posselt et al, 2019), decision making in business (Bornet, 2023), and continuous improvement process as elaborated by Nizinski (2023) who stated that the idea behind

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continuous improvement is the incremental and ongoing process of changes which can result in efficient business processes, better goods/services, and superior customer services.

3.2. Registering Online Attendance

Considering various related theories can offer different perspectives on the factors affecting students' class attendance and by looking at these theories, teachers and other levels of educators and/or researchers can acquire some insights into the underlying factors that affect attendance behaviors and implement strategies which are entirely effective to promote regular class attendance. The attribution theory, for instance, which was started by Fritz Heider in 1958, is a social psychology that focuses on how people relate and make sense of the social world (Gordon, 2022). Gordon stated that this theory is concerned with how individuals translate the events happening within their environments and how these translations influence their behavior and thought patterns. In terms of attendance, students may attribute their non-attendance or attendance to factors like personal motivation, perceived class importance, or external circumstances such as issues on transportation, financial issues, etc. Understanding the attributions students make can provide insights into attendance patterns and use strategies to increase attendance percentages of students. Another theory is the Theory of Planned Behavior which is explained by Sansom (2023) saying that individual behavior is resulting from intentions, which are mainly influenced and/or affected by attitudes, perceived behavioral control, and subjective norms. In the context of attendance, students' intentions to join their classes might be shaped by their attitude toward attending, for example, valuing education and the like, by subjective norms (societal or peer expectations), and by their perceived control over attending, i.e., having a proper timetable, or positive transportation options.

Other theories are also related to class attendance such as self-determination theory mentioned by Ackerman (2018) which is the "ability or process of making one's own choices and controlling one's own life" which can imply in terms of attendance that students will more likely to attend classes if they have this feeling of a sense of autonomy in their educational choices, positive relationships with peers/instructors, or perceiving themselves as competent in the classroom. Additionally, expectancy-value theory (Renninger and Hidi, 2022) which proposes that people's motivation is affected by expectations of success and the value they place on a particular activity can also be related to attendance as students, who believe that joining classes will lead to better comprehension and academic progress and/or success will be more likely to value attendance.

In the light of the foregoing discussion, students' class attendance can be influenced by multiple factors ranging from external to personal matters. For this very reason, the college under study requires every staff member to enter attendance and monitor students' performances. Furthermore, the college ensures that this is done with utmost care as the Ministry who sponsors most of its students' fees requires a record from time to time. Since, Microsoft (MS) Teams or Google Meet offers services with relative ease

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of use, accessibility, and integration with other educational tools, the institution requires the staff to use these apps with more preference to MS Teams due to its recording facility and other options. Most of the college presentations are still currently done online for recording purposes. In addition, many of its support/revision classes are still conducted online. However, this app is not directly linked to its database where attendance entries are made. In this regard, an automated feature is needed to easily extract absentees from the downloaded list generated by MS Teams and import the same to the college database. To act on this process, the schematic illustration, is presented below, fig. 3.

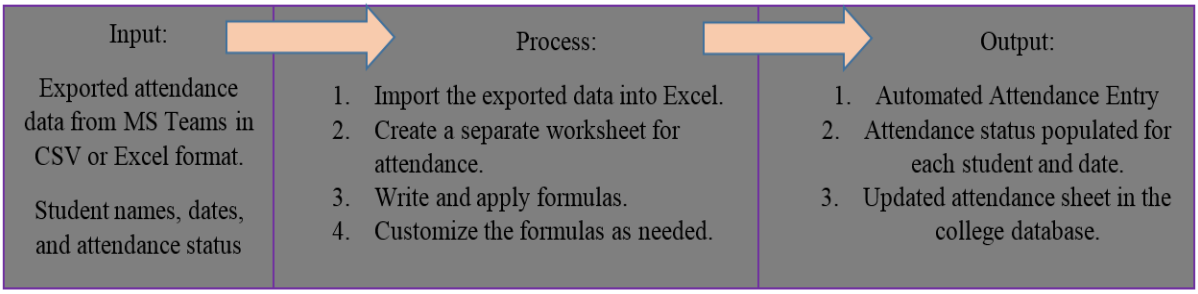

Figure 3: Schematic Diagram for Extracting Online Attendance Entries for the College Database

3.3. Examination Clashes, Timetabling Techniques, and Archiving Data

Preparing timetables for students be it for examinations and/or classes can be a very tedious task depending on the availability of resources. Multiple software programs are currently used by many HEIs to finalize their timetables intended for both the staff and students. Timetabling has its roots in graph theory which is a branch of Mathematics concerned with networks of points and their connections. (Carlson, 2023). Timetabling techniques mainly involves defining variables pertinent to exams/classes, etc., domains (possible time slots), and constraints such as clashes and limited resources to implement and/or develop efficient and effective timetabling techniques and strategies. This relates to the concept called “Constraint Satisfaction Problem” or CSP theory which provides a framework for modeling and solving scheduling problem (Grohe, 2019). Additionally, it is also related to Operations Research and OR techniques such as linear programming and optimization which can be utilized to develop mathematical models and algorithms for solving complex timetabling problem, considering all other factors involved such as resource limitations, preferences of students and staffs, and the objectives of the optimization (Vidhya, 2023; Korstanje, 2020).

Aside from timetabling and identifying clashes, a very important academic process performed in HEIs is the data archiving. It relates to various theories such as Records Management Theory (Robertson, 2019) which uses the principles/practices for systematically managing records throughout their lifecycle, Preservation Theory (Adams and Caro, 2019; Skinner and Schultz, 2018) which deals with strategies and/or techniques to make it certain that there is a long-term accessibility and usability of archived data, and Information Governance (Ball, 2018) which relates to the set of

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policies, processes, and controls used to manage information assets within the company. Moreover, data and/or digital archiving also relates to archival science, long-term digital preservation, and Information Lifecycle Management (ILM).

The foregoing discussions clearly emphasizes that timetabling issues can be handled with paramount success using modeling and other optimization techniques implemented through a software which are currently readily available. Since, the college under study intensively uses Advanced MS Excel, methods can be explored to develop models that can detect clashes and develop timetabling techniques which can be initially applied in Excel and finally incorporated in the college database. Since, the main author of this paper is well-verse in Advanced MS Excel techniques and formulas; this will be instituted in this study with proper elaborations on how it is to be implemented.

In terms of data archiving, similar to what is proposed in preservation theory, this study is aimed at establishing a central filing system that can ensure that faculty members have systems to manage records and that they are able to reap the benefits of having a long-term accessibility and usability of archived data.

These features can aid the institution in terms of augmenting its ability to efficiently and effectively manage its core academic processes which in its entirety affect students' progress and satisfaction. This will also help lecturers save significant amount of time searching for information, timetabling classes, identifying conflicts/clashes within examination schedules. Overall, the main aim is speed and accuracy by optimizing and/or automating these processes and/or providing techniques that are far much better than manual methods. To have an overview of how the steps are implemented, refer to the Methodology section.

4. SIGNIFICANCE OF THE STUDY

In terms of module grade entry analysis, this study can provide benefits to HEIs in terms of improved data accuracy, quality assurance in education, curriculum enhancement, student support and intervention, institutional decision-making, and continuous improvement. For the automation of the attendance entry for online classes, it offers multiple benefits encompassing time saving, increased accuracy, real-time monitoring, data analysis capabilities, targeted student support, and enhanced accountability. In terms of determining examination conflicts/clashes and developing timetable techniques, this study can help HEIs in matters like efficient examination scheduling, fairness and equity, academic performance, student experience and satisfaction, optimal resource allocation, staff workload management, and timely completion of exams. Additionally, in developing techniques for data/digital archiving, HEIs can benefit in matters such as preservation of knowledge, compliance and legal requirements, data security and integrity, cost efficiency, business continuity and disaster recovery, and many more.

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5. METHODOLOGY

5.1. Module Grade Entry Analysis

In automating the module grade statistics and analysis, quantitative approach will be used since all scores of students in every module are numerical. It should be noted that after correcting the question papers, the module coordinator will enter the students' scores of a particular module in MS Excel provided by the Faculty Administrator. This sheet is then sent to the Programme Manager (PM) for final entry. However, the database will display only the counts of grades and other measures and graphs are not available. This study will then focus on creating automated formulas and techniques that will automatically provide the values and graphs of a particular assessment. Using other formulas, the module consolidated statistics along with the overall charts will also be presented.

In terms of population and locale, the population consists of all the modules in the Faculty of IT (53 Modules) and using a purposive sampling, only 1 module will be selected that will serve as a template for all. Only 1 is enough as using the formulas and other techniques, it can be used for all modules. Since this is the case, purposive sampling is suitable. Purposive sampling is a type of non-probability sampling in which items are selected because they have features and/or characteristics which a researcher needs in the sample (Nikolopoulou, 2022; Thomas, 2022). Since Mathematics 101, the module coordinated by the main author of this paper has one of the modules having the highest number of students in the college which can showcase all statuses required; this will be selected and used as a sample for the automation. All other modules' grades can then be analyzed using this template after finalizing all the formulas and techniques. The module contains 244 raw scores, as this is the total number of students registered in the module.

In terms of data gathering tools and procedures, the Head of Faculty will be informed that students' data will be analyzed in a particular module as mentioned in the preceding paragraph to meet the objectives of the study which will provide benefits to all the staff members. After receiving the go signal, data will then be downloaded from the college database in PDF format and then imported to MS Excel. The main author will then use various functions and techniques along with conditional formatting to set-up the module statistics. Refer to simulation and results section for this.

5.2. Registering Online Attendance

To automate the process of extracting the attendance from MS Teams, an exploratory-sequential approach will be used where qualitative data is extracted first, i.e., the emails of students to be followed by the generation of models and formulas to generate the numerical values. Creswell and Creswell (2018) noted that exploratory-sequential approach starts with collecting qualitative data first and then proceed to quantitative observation. Similar to the automation of module grade statistics as detailed in section 5.1, this academic process will use purposive sampling as one module attendance entry template can be used for all modules using the same population (53 FoIT modules) as mentioned above and 1 module as a sample. However, a different sample will be selected as the data to be used is coming from the repositories pertinent to COVID era where

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actual online classes happen, year 2021. It should be noted that the same data gathering procedures mentioned in 5.1 will be applied. The only difference is that data will be exported from MS Teams in CSV format which will then be imported to MS Excel. Refer to simulation and results for the formulas to be used and other techniques.

5.3. Identifying Clashes in Examination Schedule and Developing Timetabling Techniques

Similar to 5.2, this section will use an exploratory-sequential approach where qualitative data is extracted first, i.e., the modules and details of students to be followed by the generation of models and formulas to generate the numerical values. The population consists of all students of the college being considered. However, since the models can be applied by other PMs and/or DoS in other Departments, a single-stage cluster sampling is used where all modules in 1 department is selected, the FoIT. The data (Current Semester – Feb to Jun 2023) will then be downloaded from the college database, filtering the FoIT and excluding the Faculty of Business Management and Faculty of English Language Studies registered students. It will be downloaded in PDF format and then imported to MS Excel. Formulas and other techniques will then be implemented which is shown in the subsequent section, the simulations and results section. It should be noted that the same gathering procedures implemented above will be instituted.

5.4. Data Archiving Using a Central Filing System

Mixed methods will be used in this stage, as this academic process will involve trial and error as well as algorithm approach to establish a central filing system in MS Teams along with the Google Sheets. The trial and error phase will involve trying some sheets and documents to be archived in various folders and setting conditions in order for the techniques to work. The algorithm phase will implement all the steps necessary to be followed by the staff for archiving. The researcher will carefully study, explore, and set-up all the technical requirements. Purposive sampling will be used which is similar to 5.1 as the files to be tested and/or included depends on the purpose of the filing as well as the judgement of the researcher. The population consists of all the files in FoIT; however, the samples will include some sheets, documents, and other relevant files which will be selected for trials. To gain a thorough understanding of the process, refer to the final simulations and results as shown in the subsequent pages. Kindly note that all data gathering procedures followed in the preceding sections will also be applied in this process.

6. SIMULATIONS, RESULTS, AND DISCUSSIONS

6.1. Module Grade Statistics Automation

In the proposed scenario, the total number of students is N. This total number should become green when the total of K3:K18 is matched, meaning there are no mistakes in terms of counting the number of normal, retake, and referral students' grades. This is set up by clicking the conditional formatting in MS Excel, and then by clicking 'Highlight Cells Rules and "Equal to" the desired value. The problem is to minimize the time finding the

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frequency distribution of grades in terms of status (All, Normal/Regular, Retake, and Referral students), solving for other calculations such as totals, pass & failure rates, non-attempt rate, average of the module, and showing the graphs of the overall performance. This requires referring back to the grading slabs, setting up lower bounds, and inserting additional columns, which naturally lead us to the following Equations and/or Functions.

$$Total\ No.\ of\ Students = COUNTA\ (B:\ B)-1 \quad \text{(fxn 1)}$$

$$GPA = IF\ (E2<>"",\ VLOOKUP\ (E2,\ \$H\$3:\$J\$18,\ 3,\ 1),"") \quad \text{(fxn 2)}$$

$$All = COUNTIF\ (\$F:\ \$F,\ J3) \quad \text{(fxn 3)}$$

$$Normal = COUNTIFS\ (\$D:\ \$D,"NORMAL",\ \$F:\ \$F,\ J3) \quad \text{(fxn 4)}$$

$$Retake = COUNTIFS\ (\$D:\ \$D,"RETAKE",\ \$F:\ \$F,\ J3) \quad \text{(fxn 5)}$$

$$Referral = COUNTIFS\ (\$D:\ \$D,"REFERRAL",\ \$F:\ \$F,\ J3) \quad \text{(fxn 6)}$$

$$Total = SUM\ (K3:K18);\ SUM\ (L3:L18);\ SUM\ (M3:M18);\ SUM\ (N3:N18) \quad \text{(fxn 7)}$$

Where,

E2 is the first student number

<> is less than, greater than which means NOT

J3 is the grade criterion

*""*is a blank cell

*$*is used to lock the cells, generated by pressing F4; *3* means third column from the lower bound; *1* means TRUE which is used for intervals, e.g. 80% - 100% (VLOOKUP)

Normal is a student who is taking the module for the first time

Retake is a student who is retaking the module and who failed last semester

Referral is a student who is not attending the class and is taking the assessments only

Note that Programme Managers (PMs) from other educational institutions may have a different grading slab which is different to the system applied herein which is based in UK. They have to then adjust the lower bound values (Column H) depending on their own grading system.

The problem has been formulated in such a way that PMs can easily verify the grade entries submitted by the Module Coordinators and look at the overall performance at a glance to either approve the grades to be published or return the grades to the latter for certain actions such as revisiting files due to borderline cases or re-checking the attendance sheets for the absentees, or take other necessary actions as required. Users of this Automated Grade Entry Result Statistics should follow the following steps in order to be successful.

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(1) The PM of the Faculty/Department has to create one excel workbook with two (2) primary sheets: Frequency distribution for grade letters and statuses such as all, normal, retake, and referral as shown in fig. 4 and module statistics as shown in fig. 5.

(2) All formulas above, fxn 1 to fxn 7 should then be pre-defined. After setting-up the formulas, this sheet should then be duplicated depending on the number of subjects offered within the Department. These sheets will then be renamed as per the names of the subjects and can be used by other coordinators.

SI	STN	NAME	Status	Score	GPA
1	STN1	N1	Normal	47	D+
2	STN2	N2	Normal	41	D-
3	STN3	N3	Normal	44	D
4	STN4	N4	Normal	20	F
5	STN5	N5	Normal	80	A+
6	STN6	N6	Retake	0	G
7	STN7	N7	Retake	0	G
8	STN8	N8	Retake	30	F
9	STN9	N9	Retake	40	D-
10	STN10	N10	Retake	0	G
11	STN11	N11	Retake	55	C
12	STN12	N12	Retake	40	D-
13	STN13	N13	Retake	71	A-
14	STN14	N14	Retake	56	C
15	STN15	N15	Retake	8	F-
16	STN16	N16	Retake	22	F
17	STN17	N17	Retake	43	D-
18	STN18	N18	Retake	40	D-

TOTAL NO. OF STUDENTS (N)					244
Lower %	Percentage	GRADE	ALL	Normal	Retake	Referral
0.00	0	G	8	2	6	0
1.00	1%-19%	F-	15	5	9	1
20.00	20%-34%	F	22	13	7	2
35.00	35%-39%	E	21	15	6	0
40.00	40%-43%	D-	23	14	7	2
44.00	44%-46%	D	10	9	1	0
47.00	47%-49%	D+	9	7	2	0
50.00	50%-53%	C-	20	13	6	1
54.00	54%-56%	C	8	5	3	0
57.00	57%-59%	C+	12	7	5	0
60.00	60%-63%	B-	15	10	5	0
64.00	64%-65%	B	10	8	2	0
67.00	67%-69%	B+	3	3	0	0
70.00	70%-75%	A-	16	13	3	0
75.00	75%-80%	A	11	10	1	0
80.00	80%-100%	A+	41	40	1	0
Total			244	174	64	6

Figure 4: Frequency Distribution: Grades, All, Normal, Retake, and Referral Students (Sheet 1 of the Workbook) – Calculated Using the Formulas Shown in the Preceding Page

There are 244 students (normal/retake/referral) in this simulation of results; however, for simplicity only 18 students were shown above. The task of the Module Coordinator is just to enter the details for columns A, B, C, D, and E. The purple columns (F, K, L, M, and N) along with the totals will be automatically calculated and/or updated once the data is entered. As mentioned earlier, Cell M1 (244 in green color) will automatically turn green if the calculations are correct. If some entries are wrong (e.g. 32.5 where 2 dots are entered instead of 32.5, or 2O.5 instead of 20.5), it will be easily detected) i.e. MS Excel showing the total of 244 without any color. This helps PMs and Coordinators to maintain consistency, accuracy, and in terms of saving a lot of time.

Moreover, fig. 5 below will also be automatically updated along with its calculations and graphs as the table is linked with the tables shown above, fig. 4. To automate the entries of this sheet, the following functions and/or techniques are applied.

1) Grades (Column B) – These are copied from sheet 1 and these are constant.

2) Columns C, D, and E – To get the normal count of G: = Sheet1! L3. This is to be followed to get the retake count of G, and referral count of G by changing the cells, i.e., M3 and N3 respectively.

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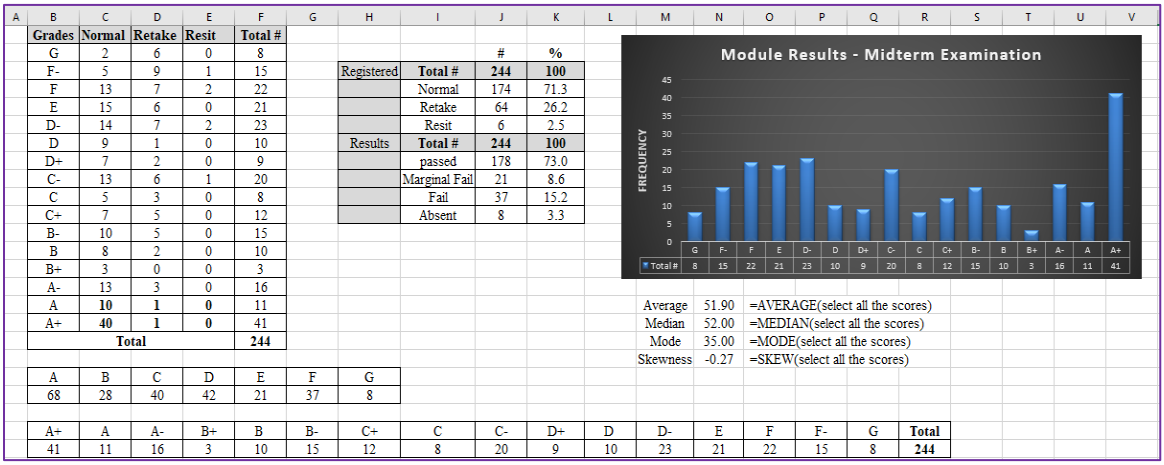
3) Total of Each Grade = SUM (Select the values in columns C, D, and E.)
4) Overall Total (244) = SUM (Select all values in column F.)
5) Passed = Count of all students from D- to A+
6) Marginal Fail = Count of all E's
7) Fail = Count of all F and F-
8) Absent = Count of all G's (Equivalent to 0)
9) Mean, Median, Mode, and Skewness – Refer to the formulas included along with fig. 5 below.



Grades	Normal	Retake	Resit	Total #
G	2	6	0	8
F-	5	9	1	15
F	13	7	2	22
E	15	6	0	21
D-	14	7	2	23
D	9	1	0	10
D+	7	2	0	9
C-	13	6	1	20
C	5	3	0	8
C+	7	5	0	12
B-	10	5	0	15
B	8	2	0	10
B+	3	0	0	3
A-	13	3	0	16
A	**10**	**1**	**0**	11
A+	**40**	**1**	**0**	41
Total				**244**

		#	%
Registered	**Total #**	**244**	**100**
	Normal	174	71.3
	Retake	64	26.2
	Resit	6	2.5
Results	**Total #**	**244**	**100**
	passed	178	73.0
	Marginal Fail	21	8.6
	Fail	37	15.2
	Absent	8	3.3

Average	51.90	=AVERAGE(select all the scores)
Median	52.00	=MEDIAN(select all the scores)
Mode	35.00	=MODE(select all the scores)
Skewness	-0.27	=SKEW(select all the scores)

A	B	C	D	E	F	G
68	28	40	42	21	37	8

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E	F	F-	G	Total
41	11	16	3	10	15	12	8	20	9	10	23	21	22	15	8	**244**

Figure 5: A Sample of Module Statistics (Sheet 2) – Midterm Examination of Math 101 (Used by the Authors Using the Raw Scores from Sheet 1)

Discussion

As can be seen above, using the formulas and techniques in MS Excel the module coordinators can then easily have an overview of the students' performance in a particular assessment of a module within a semester. Obviously, at the outset, the process looks tedious and time-consuming. However, this can save a lot of time for the coordinator for all other subsequent assessments, e.g., final examination and other examinations in the upcoming semesters. Additionally, other module coordinators can use the same template for their assessments within their own modules. All they need to do is just to change the first 5 columns of sheet 1 and these are the SI, STN, NAME, STATUS, and SCORE, and all relevant entries along with the chart will be automatically updated accordingly. Institutional leaders or whoever is the in-charge of grade entry checking can also use this template as real-time data using any platforms such as Google Sheet where Coordinators and other colleagues can collaborate with certain editing rights which can be configured significantly. The output generated in these simulations agree and/or similar with those presented by Ren et al (2020) and Tan et al (2018) who also used MS Excel to automate the process. Nonetheless, their findings are very specific to their own requirements as well as their own grading system. In addition, their studies revealed the module statistics

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using only 1 status. In this study, however, multiple statuses such as normal, retake, and referral are displayed using the COUNTIFS function.

6.2. Registering Online Attendance Entries

In the proposed scenario, the total number of students is N, which could be any number. In this sample, the module considered has 18 students as shown below, fig. 6. It should be noted that the number of students is without limit, i.e., from 0 to infinity. The problem is to minimize the time finding the students who were present or absent. The main target is #N/A which means 'Absent' and this is important as the first step the lecturer needs to take is to enter the attendance in the college database where all students are marked Present at the outset. Thereafter, he will then proceed looking for only those numbers in Column 'I' where its corresponding Column 'K' shows #N/A. Using a filter feature in MS Excel, he will then filter all these absentees and use the details to update the status from Present to Absent in the college database which consequently saves a lot of time. This automation and/or optimization leads to the following Equations and/or Functions.

Column D = LEFT (C3, FIND ("@", C3)-1) (fxn 1)

Column E = VALUE (D3) (fxn 2)

Column J = VLOOKUP (I3, E: F, 2, 0) (fxn 3)

A	B	C	D	E	F	G	H	I	J	K
Data Downloaded from MS Teams			STN - Extracted from E-mails (Column B)	STN - Expressed in Values	Present		Downloaded from the College Database			Present/Absent Generated Using a VLOOKUP
SN	Student	Email					SN	Student No.	Name	
1	Student Name(400500125)	400500125@ZEDRICHUNIVERSITY.EDU.OM	400500125	400500125	P		1	400500143	Student 19	#N/A
2	Student Name(400500126	400500126@ZEDRICHUNIVERSITY.EDU.OM	400500126	400500126	P		2	400500142	Student 18	#N/A
3	Student Name(400500127	400500127@ZEDRICHUNIVERSITY.EDU.OM	400500127	400500127	P		3	400500141	Student 17	P
4	Student Name(400500128	400500128@ZEDRICHUNIVERSITY.EDU.OM	400500128	400500128	P		4	400500140	Student 16	P
5	Student Name(400500129	400500129@ZEDRICHUNIVERSITY.EDU.OM	400500129	400500129	P		5	400500139	Student 15	P
6	Student Name(400500130	400500130@ZEDRICHUNIVERSITY.EDU.OM	400500130	400500130	P		6	400500138	Student 14	P
7	Student Name(400500131	400500131@ZEDRICHUNIVERSITY.EDU.OM	400500131	400500131	P		7	400500137	Student 13	P
8	Student Name(400500132	400500132@ZEDRICHUNIVERSITY.EDU.OM	400500132	400500132	P		8	400500136	Student 12	P
9	Student Name(400500133	400500133@ZEDRICHUNIVERSITY.EDU.OM	400500133	400500133	P		9	400500135	Student 11	P
10	Student Name(400500134	400500134@ZEDRICHUNIVERSITY.EDU.OM	400500134	400500134	P		10	400500134	Student 10	P
11	Student Name(400500135	400500135@ZEDRICHUNIVERSITY.EDU.OM	400500135	400500135	P		11	400500133	Student 9	P
12	Student Name(400500136	400500136@ZEDRICHUNIVERSITY.EDU.OM	400500136	400500136	P		12	400500132	Student 8	P
13	Student Name(400500137	400500137@ZEDRICHUNIVERSITY.EDU.OM	400500137	400500137	P		13	400500131	Student 7	P
14	Student Name(400500138	400500138@ZEDRICHUNIVERSITY.EDU.OM	400500138	400500138	P		14	400500130	Student 6	P
15	Student Name(400500139	400500139@ZEDRICHUNIVERSITY.EDU.OM	400500139	400500139	P		15	400500129	Student 5	P
16	Student Name(400500140	400500140@ZEDRICHUNIVERSITY.EDU.OM	400500140	400500140	P		16	400500128	Student 4	P
17	Student Name(400500141	400500141@ZEDRICHUNIVERSITY.EDU.OM	400500141	400500141	P		17	400500127	Student 3	P
							18	400500126	Student 2	P

Figure 6: Attendance Automation Using MS Teams and College Database Data

Discussion

As seen above, Column D entries were successfully generated using a LEFT function; however, it should be noted that this formula is a text function and for that all entries are expressed as texts. In order for the VLOOKUP to work in column K, Column E (Values) is inserted. This column converts the text values in Column D into values (numbers). This is needed to match the data from the college database which is expressed in values. Note that the same method or formula should be applied for the college database data if it is in any format which is not detectable by the VLOOKUP. This is to be done by inserting

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additional column beside Column I if it is the case. In addition, note that in all these 3 formulas, only the first-row value is used, e.g., C3, D3, I3 and other outputs are populated using an autofill or by dragging the first output. For VLOOKUP function, the table array should be the entire fields (E: F) without an absolute reference and so any lecturer can use the same template without modifications. In so doing, the formulas can generate accurate status, either Present or absent no matter what the number of attendees or number of students is.

Moreover, for this whole automation to work students should be properly instructed to use the college email assigned to them by the college and not their personal email as their email is linked to their ID numbers in the college database and this is the case in almost all educational institutions around the world. They should be properly invited to MS Teams and/or added by the lecturers. The outputs of this automation can be used by any HEIs with very minimal alterations if all steps above are followed encompassing all the formulas. For those using other apps such as Google Meet amongst others, they have to ensure that students log in using their college email to make it certain that a smooth process is upheld.

Overall, the results as shown above, fig. 6, have demonstrated a fair method of registering attendance without violating ethical considerations as students' identity remain anonymous. In contrast to Wang and Kim (2021) who implemented a facial recognition for online class attendance entries, this method is better if students' private details are to be hidden. This method is also cost friendly and can be easily shared with other lecturers conducting any online classes whether it is a support class, revision class, or normal class. HEI lecturers are then advised to familiarize how to create Teams in MS Teams and classes. In addition, they have to be well-versed in terms of downloading attendance after the class, recording lessons, and conduct other activities which are necessary for the class to be successful. It should be noted that this method is only a suggestion, and this research can be expanded by integrating the formulas generated herein into the College Database using their own business logic and other techniques.

6.3. Identifying Examination Schedule Clashes/Conflicts

Out of 53 modules managed by the faculty, only 30 modules have invigilated exams. This was extracted from the Assessment matrix of all modules within the faculty by filtering only these two categories "In-class Test" and "Practical Exam". It should be noted that all other modules not considered herein have other types of assessments such as debate, poster, presentation, and/or assignment which are not timetabled as students may choose any schedule within the allotted period depending on their availability. At the outset, Registered Students List which contains the list of modules taken during the semester and other details was downloaded. Using the MS Excel feature, students who have multiple modules are highlighted as shown in table 2. This is executed using the Home Tab – Conditional Formatting – Highlight – Duplicate Values. Other fields are not required and hence these are discarded retaining only the SN, Student ID, Modules Short Name (SN), and Student Name.

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Table 2: Registered Students during the Semester (Results after Pre-Processing)

A	B	C	D
SN	**Student ID**	**Module SN**	**Student Name**
1	44990011	CNP	Student 1
2	44990011	NS	Student 1
3	44990022	CSYN	Student 2
4	44990022	ILS	Student 2
5	44990022	DSA	Student 2
6	44990022	LAN	Student 2
7	45990025	DWDM	Student 3
8	45990025	ESB	Student 3
9	48990024	DWDM	Student 4
10	48990024	ESB	Student 4
11	48990024	Interw	Student 4
12	48990024	CNP	Student 4
13	47470029	CNP	Student 5
14	47470029	NS	Student 5
15	458954731	OOP	Student 6
16	458954731	CNP	Student 6
17	448920225	FICT	Student 7
18	448920225	DBMS	Student 8
19	448920225	HCI	Student 8
20	448920225	ESB	Student 8
21…	564789241	ESB	Student 9
1049	459929303	CNP	Student 1049

There are 1049 records as shown in table 2, however not all records are shown for simplicity and to save space. These columns are more than enough and are needed to proceed to the last stage, identifying clashes. Its snapshot is provided below, fig. 7. To perform this process, the following steps are instituted.

1) Add Column E in Sheet 1 using this function: IF (OR (C4=$B$1, C4=$B$2, C4=$C$1, C4=$C$2), TRUE,""). True means the module/s are entered in columns B, C, or D highlighted in green and this further means that the module/s are to be checked for clashes. In fig. 7, for example, CNP and NS modules are to be checked if they clash or not. Note, that TRUE here does not tell whether there is a clash or not as it only says that the module/s are entered and these are the targeted ones. To finally check whether there is a clash or not, a pivot table is used. Note further that "" means FALSE and it is converted to blanks for relative ease.

2) To insert the pivot table on the right (Columns G to J), Columns A to E are selected and the table is inserted in the existing worksheet. The right corner of fig. 7 shows that all fields are ticked. Column E is moved under Filters and TRUE entries are filtered by unticking ALL. Additionally, the SN is moved under Values using ‘count’ to count clashing modules. More than 1 in COUNTIF means that there is a clash

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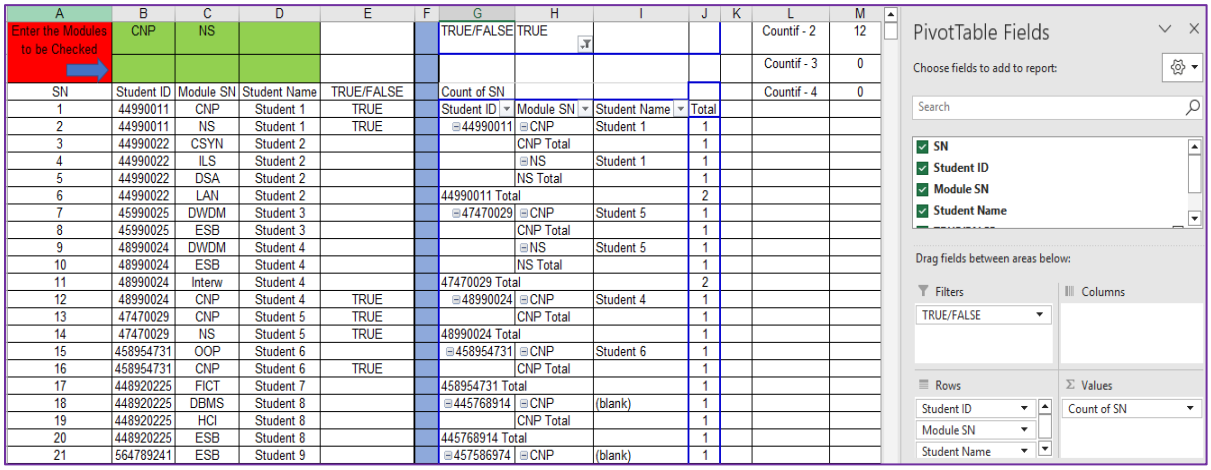
between the modules entered in green cells (columns B, C, or D) as explained below.

3) COUNTIFS functions are used to detect whether there is a clash or not. COUNTIF-2 means there is a clash between 2 modules, COUNTIF- 3 means there is a clash amongst 3 modules, and so on.

Formulas for COUNTIF: COUNTIF(J:J,2) for 2 modules, COUNTIF(J:J,3) for 3 modules, and COUNTIF(J:J,4) for 4 modules.



Enter the Modules to be Checked	CNP	NS				TRUE/FALSE	TRUE				Countif - 2	12
											Countif - 3	0
SN	Student ID	Module SN	Student Name	TRUE/FALSE		Count of SN					Countif - 4	0
1	44990011	CNP	Student 1	TRUE		Student ID	Module SN	Student Name	Total			
2	44990011	NS	Student 1	TRUE		44990011	CNP	Student 1	1			
3	44990022	CSYN	Student 2				CNP Total		1			
4	44990022	ILS	Student 2				NS	Student 1	1			
5	44990022	DSA	Student 2				NS Total		1			
6	44990022	LAN	Student 2			44990011 Total			2			
7	45990025	DWDM	Student 3			47470029	CNP	Student 5	1			
8	45990025	ESB	Student 3				CNP Total		1			
9	48990024	DWDM	Student 4				NS	Student 5	1			
10	48990024	ESB	Student 4				NS Total		1			
11	48990024	Interw	Student 4			47470029 Total			2			
12	48990024	CNP	Student 4	TRUE		48990024	CNP	Student 4	1			
13	47470029	CNP	Student 5	TRUE			CNP Total		1			
14	47470029	NS	Student 5	TRUE		48990024 Total			1			
15	458954731	OOP	Student 6			458954731	CNP	Student 6	1			
16	458954731	CNP	Student 6	TRUE			CNP Total		1			
17	448920225	FICT	Student 7			458954731 Total			1			
18	448920225	DBMS	Student 8			445768914	CNP	(blank)	1			
19	448920225	HCI	Student 8				CNP Total		1			
20	448920225	ESB	Student 8			445768914 Total			1			
21	564789241	ESB	Student 9			457586974	CNP	(blank)	1			

Figure 7: Simulation and Trial & Error Results (Using Formulas & Pivot Table) to Identify Clashes

Discussion

The simulations through a long period of careful data observations, trial and error, and experience of the main author of this paper has led to formidable results as shown in fig. 7. By looking at the advanced features of MS Excel implemented above, the process may look tedious. However, it should be inculcated in mind that this is to be done one time only. Once the formulas are set –up and the pivot table properly inserted, institutional leaders be it PMs, DoS, or Quality Assurance Directors can use this template by just copying and pasting the new entries of registered students in the upcoming semesters with very minimal changes. In addition, the green cells in Columns B and C can be used for any modules to be checked, i.e., 2 to 4 modules which can be expanded depending on the requirement of the HEI. Note that every time new modules are checked for clashes, the pivot table should be refreshed. This is done by hovering through the pivot table – right click – then click refresh. Furthermore, for the upcoming semesters, the only process to be executed is the pre-processing and that is by downloading the new registered students list and going further until the data is fully processed, meaning unnecessary columns are removed and additional columns are inserted. Once done, the same sheet 1 in table 2 above can be used by overwriting the previous data and refreshing the pivot table every time modules are checked for clashes.

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Moreover, by looking at the results above, it can be seen that by inputting CNP and NS, the COUNTIF function shows that there is a clash amongst 12 students and hence these 2 modules should not be scheduled at the same time. Amongst these students are 15201296, 16901468, 18901076, etc. There are more 9 more students if scrolled down; however, for simplicity the image captured only a few records. Of all the studies reviewed, there is no similarity in terms of the techniques and formulas used in this model and hence the approach herein can be considered novel and HEIs are advised to implement this method of identifying clashes to save maximum amount of time devoted to checking clashes in the examination schedule.

6.4. Archiving Data in HEIs

In this proposed academic process in HEIs, a central filing system for the staff and faculty members will be designed using MS Teams. Sample folders will be created which are named accordingly based on the requirement. Note that the folders used in this scenario are not the exhaustive list and any other HEI can modify their folders and sub-folders accordingly based on their needs. Managing files in MS Teams involves multiples steps and the following shows the guide on how to manage files in MS Teams along with the general process involved.

1) Download MS Teams and Create a Team named as HEI Central Filing System. Add all the members.
2) Access: Open MS Teams and navigate to the Team created – HEI Central Filing System. Files can be accessed from the Files tab in the top menu of the team or channel.
3) Uploading: Upload files by clicking on the “Upload” button in the files tab. Files can be selected from any computing device or drag and drop them into the MS Teams interface. Once the file is uploaded, it will be available for collaboration and sharing within the team.
4) Folder Creation: To organize files, cerate folders within the Files tab. Click on the “New” button and select “Folder”. Give the folder a name and press enter. Multiple folders can be created to categorize and structure files.
5) Sharing: To share a file with the team members, select the file from the Files tab and click on the “Share” button or right-click on the file and choose ‘Share”. Permissions can be specified for each person, allowing them to view or edit the file. In addition, files can be shared with external collaborators by entering their email addresses.
6) Collaboration on Files: When a file is shared, team members can access and collaborate on it. They can open the file directly in Teams, make edits, add comments, or start discussions around the file. The file will be automatically saved and synced for all collaborators.
7) Version Control: Teams keep track of file versions, allowing you to view and restore previous versions if needed. Select a file from the Files tab, click on the ellipses

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(…) button, and choose “Version history”. A list of versions can be seen with their timestamps. Select a version to view it or restore it if necessary.

8) File Search: MS Teams provides a search bar at the top of the interface. Enter keywords related to the file and teams will display relevant results. Files can be searched based on their names, contents, associated conversations, etc.

9) File Permissions: File permissions can be managed to control who can access and edit the files. Navigate to the Files tab, select a file or folder, click on the ellipses (…) and choose “Manage Access”. From there, adding and removing individuals or groups can be done while assigning permissions.

10) Integration with MS 365: MS Teams integrates with other MS 365 apps like SharePoint and OneDrive. When a file is uploaded or files are created in Teams, they are stored in SharePoint or OneDrive, depending on the underlying architecture. This integration allows seamless access and collaboration across various MS Applications.

Fig. 8 below shows a snapshot of the MS Team created named as the HEI Central Filing System for a particular Department or Faculty. This is dedicated for the Faculty of IT and other Faculties can create their own version and/or template depending on the files they require in their respective departments.

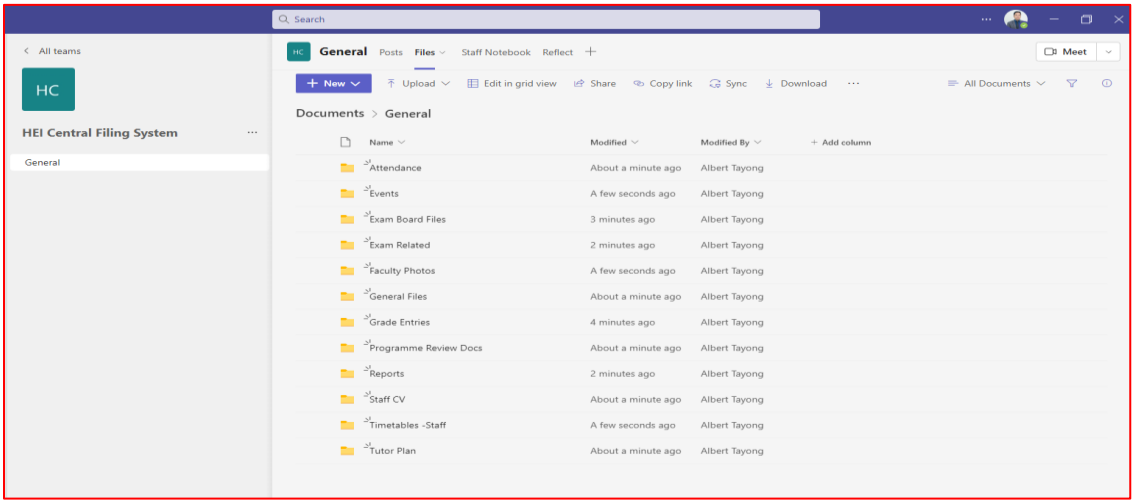

Figure 8: Simulation Results for HEI Central Filing System in HEIs

Discussion

Managing files in MS Teams is a crucial aspect of collaboration and organization of documents within a department or organization. The steps outlined in the foregoing along with the folders and subfolders created within the folders and the documents within these folders provided a comprehensive guide on how to effectively manage files in MS Teams. Overall, this filing system provides a centralized location for accessing files, a facility to upload files from computers or through drag and drop functionality with relative ease,

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ability to organize files and maintain a structured workspace through folders, sharing possibilities with team members or external collaborators with customizable permissions for viewing and editing, real-time collaborations for working on files simultaneously, tracking of file versions, a feature to easily search or find a file, granular control over permissions ensuring that only authorized individuals can access and edit files, and integration with other apps providing a productive collaboration across MS applications. There have been studies conducted related to the effectiveness of MS Teams such as those performed by Laquindanum (2022) who found that MS Teams require a strong connection of internet to work adequately. However, her study focused on the use of MS Teams in terms of activities and not on filing system. In terms of usefulness of MS Teams and not on the effectiveness based on the connectivity, there have been several studies conducted showing the power of MS Teams. Almodaires et al (2021), for instance, confirmed that MS Teams is an effective virtual learning platform because of the user friendliness, quality, and functionalities. These are justified by the results of this study as depicted above in terms of central filing system. The effectiveness of MS Teams is also supported by the study conducted by Wea and Kuki (2021).

Additionally, in terms of the central filing system, a few authors have explored the use of MS Teams and similar to the results of this study, they have found that MS Teams can be a powerful tool not just in terms of storing data but also in terms of collaboration, sharing, and security. This is supported by Makarova (2021), Grob (2022), and Finnerty (2020) who emphasized the importance of using MS Teams as a central filing system tool. Nonetheless, their studies used data which are entirely targeting their own domains and not on data pertinent to HEIs and hence the output of this research is valuable for the higher education industry. In addition, significant amount of studies dedicated for MS Teams effectiveness are focused on the conduct of classes and activities and not on the filing system. Consequently, the steps delineated above along with the result based on the trial and error along with the algorithm approach implemented by the main author of this paper presents not just a perfect system for HEIs but a novel approach after the COVID-19 pandemic to manage the academic data archiving procedures and processes within the institutions.

6.5. Developing Timetabling Techniques

In this study, the authors focused on developing techniques for timetabling, aiming to speed up the process of scheduling of classes of various modules in 4 levels using the college registration software. It should be noted that the institution under study has already a system which is maintained by the Registry Department called as the Integrated System for Registration (ISFR) and this is used by all the Faculties, namely Faculty of Business Management, Faculty of IT, and Faculty of English Language Studies for timetabling and other purposes. This system has a perfect detection tool for all types of clashes and other features to edit and create timetables; however, proper data is needed in order for the system to work perfectly. The aim of this research is then not to develop the algorithms and set-up a timetabling software but to introduce techniques and feed appropriate data that will aid in terms of speed and accuracy in timetabling and its clash

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detection. The output will then be used in the final stage where all timetables are entered in the system. This process consists of 3 phases such as assigning codes, collaborative scheduling, and actual timetabling techniques. Fig. 9 below shows the results of phase 1 where modules in various levels and semesters are assigned group codes that will help the system detect clashes. Without properly setting-up these codes, the system will not be able to identify clashes and it will keep on adding timetables as per the entries of the people who are in-charge of the registration.

For students not to have conflicts, the main author assigned group codes to every module which are based on their level and semester, e.g., L1S1 stands for Level 1 & Semester 1, L1S2 for Level 1 & Semester 2, and so on and so forth until Level 4. Based on these levels and semesters, ordinal codes are then assigned which are crafted in a manner that uses some numbers incrementally for easy reference. L1S1, for instance, takes T1A where 1 stands for semester 1, T2A for semester 2, and so on and so forth. Note that that these groups are sent to the Registry Department and are included in the “Options” menu by the system developer. These are needed by the PMs When groups are assigned during timetabling. Nonetheless, these groups are not fixed and can be changed any time and other groups can be created as well depending on the number of students. A case in point is a group which is T1B or T1C which could be an additional group for any module in semester 1 where student numbers might require more groups, i.e., ALS/OCC, EVU, FBM, or FICT (Refer to fig. 9). Note that ALS and OCC are optional modules and hence assigned only 1 cell.

G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
T1A	T1A	T1A	T1A	T2A	T2A	T2A	T2A	T3A	T3A	T3A	T3A	T4A	T4A	T4A	T4A
L1S1	L1S1	L1S1	L1S1	L1S2	L1S2	L1S2	L1S2	L2S3	L2S3	L2S3	L2S3	L2S4	L2S4	L2S4	L2S4
ALS/OCC	EVU	FICT	FBM	EGRW	PCSE	B & ENTRE	LPSS	ILS	MSS	CSYN	ITP	ARW	DLD	DSA	SAD
ALS/OCC	EVU	FICT	FBM	EGRW	PCSE	B & ENTRE	LPSS	ILS	MSS	CSYN	ITP	ARW	DLD	DSA	SAD
ALS/OCC	EVU	FICT	FBM	EGRW	PCSE	B & ENTRE	LPSS	ILS	MSS	CSYN	ITP	ARW	DLD	DSA	SAD
ALS/OCC	EVU	FICT	FBM	EGRW	PCSE	B & ENTRE	LPSS	ILS	MSS	CSYN	ITP	ARW	DLD	DSA	PARE
ALS/OCC	EVU	FICT	FBM	EGRW	PCSE	B & ENTRE	LPSS	ILS	MSS	CSYN	ITP	ARW	FOF	POB	SAD

Figure 9.1: Level 1 to level 2 Modules and their Assigned Groups Based on Semesters and Levels (LEVEL 1 & 2)

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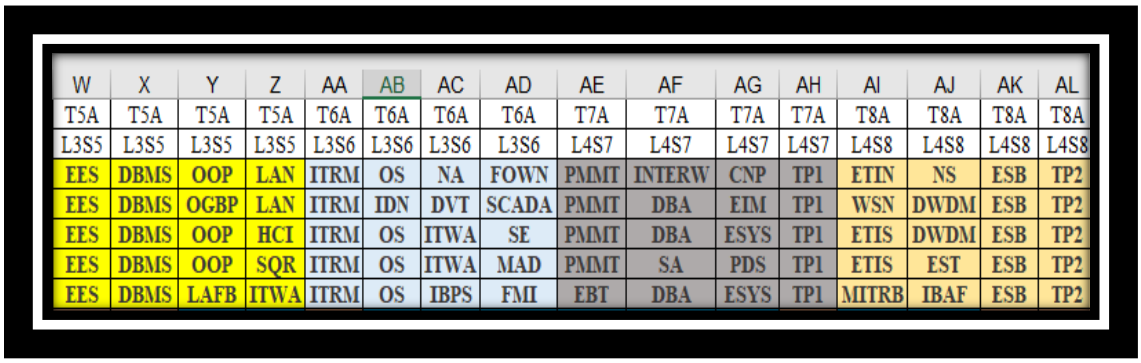

W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
T5A	T5A	T5A	T5A	T6A	T6A	T6A	T6A	T7A	T7A	T7A	T7A	T8A	T8A	T8A	T8A
L3S5	L3S5	L3S5	L3S5	L3S6	L3S6	L3S6	L3S6	L4S7	L4S7	L4S7	L4S7	L4S8	L4S8	L4S8	L4S8
EES	DBMS	OOP	LAN	ITRM	OS	NA	FOWN	PMMT	INTERW	CNP	TP1	ETIN	NS	ESB	TP2
EES	DBMS	OGBP	LAN	ITRM	IDN	DVT	SCADA	PMMT	DBA	EIM	TP1	WSN	DWDM	ESB	TP2
EES	DBMS	OOP	HCI	ITRM	OS	ITWA	SE	PMMT	DBA	ESYS	TP1	ETIS	DWDM	ESB	TP2
EES	DBMS	OOP	SQR	ITRM	OS	ITWA	MAD	PMMT	SA	PDS	TP1	ETIS	EST	ESB	TP2
EES	DBMS	LAFB	ITWA	ITRM	OS	IBPS	FMI	EBT	DBA	ESYS	TP1	MITRB	IBAF	ESB	TP2

Figure 9.2: Level 3 to level 4 Modules and their Assigned Groups Based on Semesters and Levels (LEVEL 3 & 4)

As seen in fig. 9.1 and 9.2 above, phase 1 of the process resulted to a complete list of modules of 5 pathways in the Faculty of IT where every module is assigned a unique code. This resulted to consistency across all modules and with the use of these codes, the system can now easily detect clashes using the exact match as these are consistent with the module short names fed in the college database. Note that these short names are downloaded from the database and summarized by the main author based on the course offerings. With this first output (fig. 9.1 and 9.2), the main author of this study then proceeded to phase 2 which is the implementation and evaluation of the so-called 'collaborative scheduling' using a Google Sheet where stakeholders and relevant parties in the scheduling process are involved in order to help in entering the initial (temporary) timetables and determining potential conflicts early on. Using these group codes, the Registry Head or whoever is assigned then created a template and share the same with other institutional leaders such as the PMs, DoS, DoQA, amongst others to work on the files resulting to fig. 10 below. For simplicity, only 2 groups' timetables are displayed; however, it should be known that this Sheet which contains real-time data consists of many groups formed by copying and pasting the same template for other groups while changing only the group names. Note that every cell contains the module name, name of the lecturer, and the room number. For instance, "EVU Dr. X M308" stands for EVU module, taught by Dr. X, scheduled in room M308. Note that red cells mean that these hours cannot be used and are blocked in the system. These timings are used for meetings, examinations, and other purposes.

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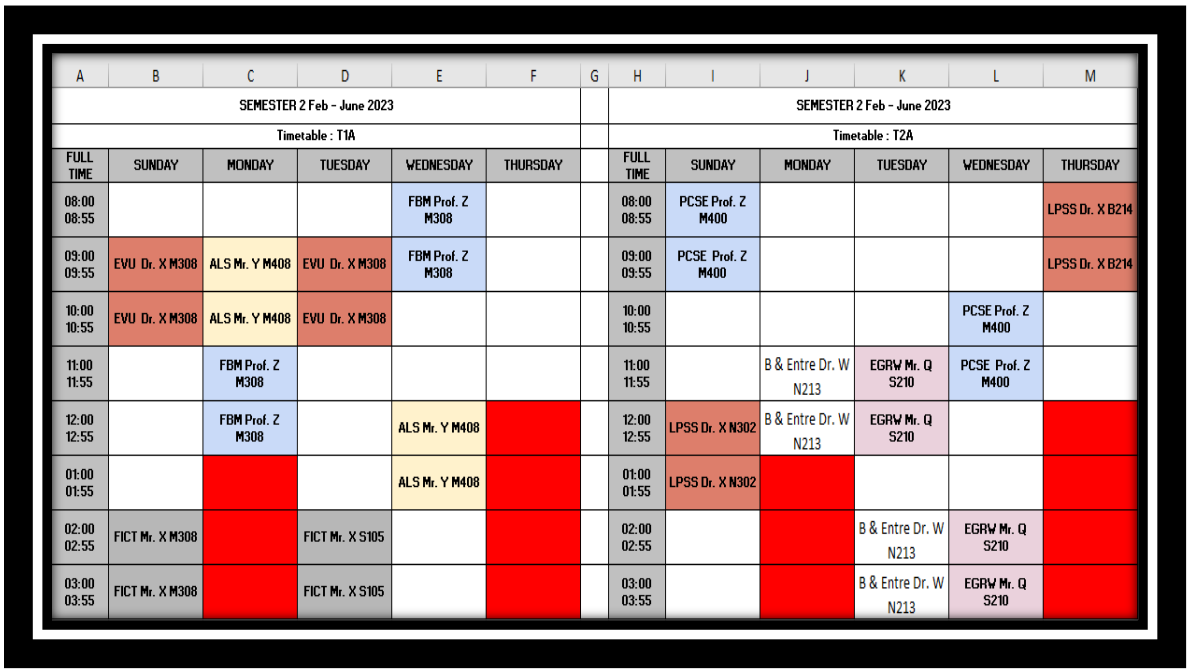

A	B	C	D	E	F	G	H	I	J	K	L	M
SEMESTER 2 Feb - June 2023							SEMESTER 2 Feb - June 2023					
Timetable : T1A							Timetable : T2A					
FULL TIME	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY		FULL TIME	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
08:00 08:55				FBM Prof. Z M308			08:00 08:55	PCSE Prof. Z M400				LPSS Dr. X B214
09:00 09:55	EVU Dr. X M308	ALS Mr. Y M408	EVU Dr. X M308	FBM Prof. Z M308			09:00 09:55	PCSE Prof. Z M400				LPSS Dr. X B214
10:00 10:55	EVU Dr. X M308	ALS Mr. Y M408	EVU Dr. X M308				10:00 10:55				PCSE Prof. Z M400	
11:00 11:55		FBM Prof. Z M308					11:00 11:55		B & Entre Dr. W N213	EGRW Mr. Q S210	PCSE Prof. Z M400	
12:00 12:55		FBM Prof. Z M308		ALS Mr. Y M408			12:00 12:55	LPSS Dr. X N302	B & Entre Dr. W N213	EGRW Mr. Q S210		
01:00 01:55				ALS Mr. Y M408			01:00 01:55	LPSS Dr. X N302				
02:00 02:55	FICT Mr. X M308		FICT Mr. X S105				02:00 02:55			B & Entre Dr. W N213	EGRW Mr. Q S210	
03:00 03:55	FICT Mr. X M308		FICT Mr. X S105				03:00 03:55			B & Entre Dr. W N213	EGRW Mr. Q S210	

Figure 10: Samples of Group Timetables Generated through Collaborative Scheduling Using Google Sheets

Once the Google Sheet above, fig. 10, is populated and the temporary timetables are observed to have no conflicts as per the output of synchronized collaborations and review of the people involved, every Faculty PM's will then immediately start finalizing the timetables in the college registration database. While executing the timetabling using the College database, phase 3 is then instituted by implementing other multiple techniques such as those related to transferring modules to other lecturers, swapping rooms, and ignoring some clashes in a way that will not impact the operations. In order to execute these techniques, the following measures and/or approaches are instituted.

Transferring a Module to another Lecturer

The main author used trial and error method along with various simulations to test some samples of classes to be transferred to other lecturers to resolve clashes. The trials and simulations produced the following results, which are series of steps to follow when a clash occurs. HEIs are recommended to follow this process for efficient load transfers.

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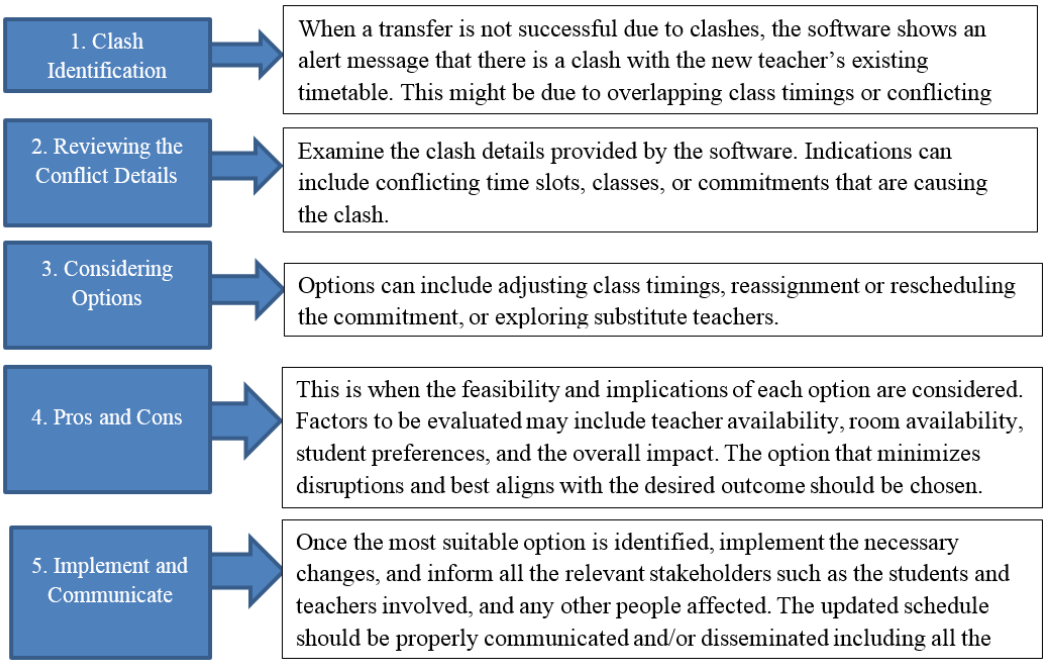

Figure 11: Process to Transfer a Module to a New Lecturer

Swapping Rooms

In multiple occasions, PMs are requested to change classrooms or swap classrooms due to certain matters like scheduling conflicts, room maintenance, class size changes, lab or resource requirement, or other logistical reasons. Using some hypothetical data, the main author applied some trials and simulations, and these had led to the following step-by-step recommendations on how to swap or change rooms.

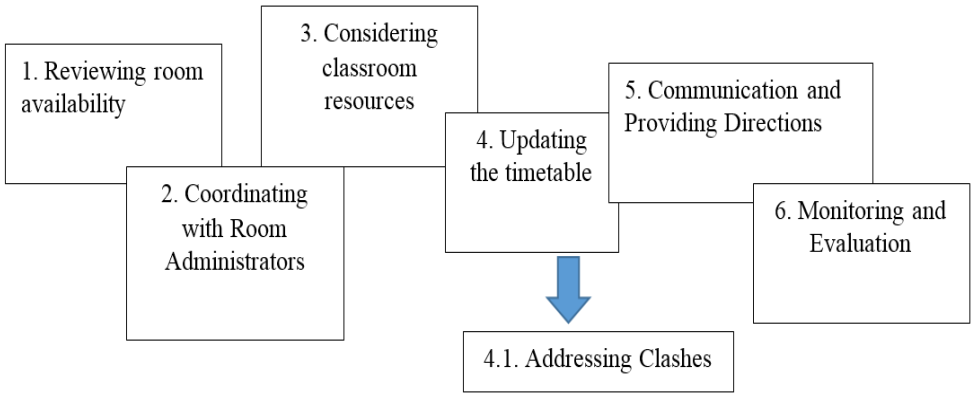

Figure 12.1 Room Swapping/Transfer

Addressing Conflicts during Swapping Rooms

Direct swapping is not possible in any software program. There is a need to apply some techniques that would solve the problem. One best method discovered after a series of

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explorations and trials along with the simulations is the use of a dummy room. The Registry Department is tasked to set-up dummy rooms and use the same for clash management. Room N205, for example, can have "*N205" as its dummy account. This can be applied as well for other rooms to have additional dummies. The following diagram shows the problem and the solution pertinent to room swapping after some trials and simulations.

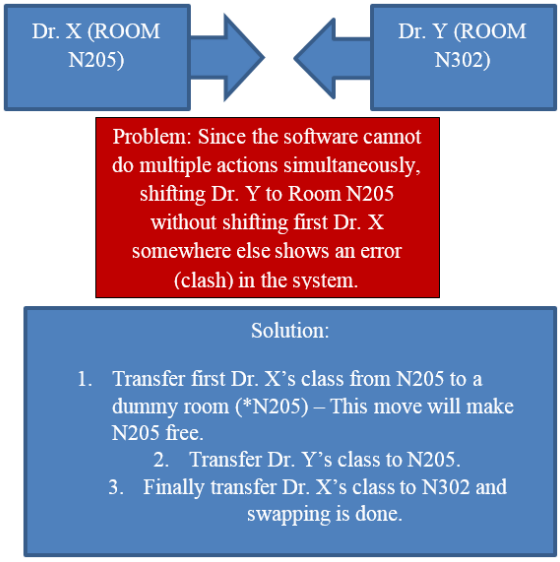

Figure 12.2. Swapping Rooms Using Dummies

Discussion

In light of the foregoing elaborations, the results of implementing various timetabling techniques, including clashes detection, swapping rooms, transferring modules to other teachers, and collaborative scheduling along with the simulations implemented through trial and error and data observation methods have shown formidable outcomes in optimizing and managing timetables as a fundamental support for the Bespoke ISFR.

Phase 1 (Coding) has been very effective in terms of maintaining consistency across all modules by providing unique group codes to all modules based on their corresponding semesters. This helps the system to accurately identify clashes and provide alerts to the in-charge of registration. In terms of Phase 2 (Collaborative Scheduling), its implementation has facilitated the involvement of multiple stakeholders in the timetable creation process. The input and feedback from the individuals involved helped the schedulers in terms of considering preferences, availability, and constraints. This resulted not only in increased satisfaction amongst students and teachers, but the approach had promoted transparency, communication, and a sense of ownership within the process of timetabling. Furthermore, the last stage, phase 3 also provided promising results. The technique of conflict detection proved effective in identifying timetable clashes and overlapping activities mainly by adjusting timings, reassigning resources, or exploring options and the results have demonstrated improved accuracy and minimized disruptions.

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Specifically, the swapping of room technique using a dummy account has proven to be an efficient technique for addressing scheduling conflicts and logistical challenges in changing and/or room swapping resulting in a smoother transition for both teachers and students. Lastly, in terms of transferring modules to other teachers has proven beneficial in cases where teacher availability or scheduling conflicts arise. Additionally, it had resulted to increased flexibility in handling their schedules, allowing for timely adjustments and avoiding significant disruptions and cancellations.

Overall, the results of timetabling techniques have shown their effectiveness in timetable optimization, conflict management, and efficient utilization of resources. Using the built-in detection feature of ISFR for clashes, and techniques for room swapping, group coding, collaborative scheduling, and effective room swapping and module transfers, HEIs can achieved improved timetable accuracy, reduced disruptions, and enhanced stakeholder satisfaction. Nonetheless, it is important to continue refining and integrating these approaches/techniques within the scheduling process, taking into considerations the institutions' unique requirements and constraints. Further research in this area can lead to enhanced timetabling practices and improved educational experiences amongst students and teachers.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Automating Grade Entry and Statistics

Automating the grade entry and its statistics is a highly valuable process that streamlines the grading workflow and provides comprehensive insights into student performance. The implementation of automated systems for grading entry and analysis using advanced formulas and techniques in MS Excel has shown significant benefits in terms of accuracy, efficiency, and informed decision-making. The automation technique presented herein eliminates the need for manual data entry, reducing the potential errors and saving valuable time for module coordinators. By leveraging technology, grading data can be directly entered into a centralized system, allowing for immediate access and analysis. This automation enhances the overall grading process, ensuring consistency and reliability in the recorded grades. Moreover, the powerful statistical analysis provides module team members a comprehensive understanding of student achievement and determine areas that need attention or improvement. Based on these benefits, HEIs are recommended to implement automated grading systems, integrate statistical analysis tools, train and support lecturers, conduct regular data analysis and review, and apply continuous improvement and optimization.

7.2. Registering Online Attendance Entry

The automation of attendance entry using MS Excel and its advanced formulas and features offers significant advantages in terms of efficiency, accuracy, and data management. Through the implementation of automated attendance systems, HEIs can streamline the process of tracking student attendance and save valuable time and resources. Based on the findings, it is evident that using MS Excel to automate the

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attendance entry of online classes provides numerous benefits. Automating attendance entry using the said software program eliminates the need for manual data entry, reducing human errors, and ensuring consistency. By leveraging formulas and functions within MS Excel, attendance can be automatically calculated, aggregated, and analyzed. It also offers attendance management. Conditional formatting can be used to highlight patterns or exceptions in attendance, making it easier to identify trends or issues. Based on these results, HEIs are advised to standardized attendance recording when conducting online classes, use MS Excel formulas and functions, implement data validation, provide regular data backup, execute periodic analysis, and explore integration with the college database that they are using.

7.3. Examination Schedule Clashes Identification

The use of MS functions, simulations, and pivot tables for identifying examination schedule clashes provided significant advantages in terms of accuracy, efficiency, and conflict resolutions. Automating the clash identification within examination schedule using MS functions like IF statements, VLOOKUP, and COUNTIF enables efficient and accurate detection of clashes. These functions as implemented in this study can be utilized to compare student enrollment data to identify potential clashes. By applying appropriate formulas and logical conditions along with the pivot tables, MS Excel can quickly highlight conflicting modules, and reducing the manual effort required in clashes identification. The final output using the pivot table produced promising results in terms of summarizing and analyzing the data which in turn provided valuable insights for conflict resolution and decision making. With these benefits, HEIs are advised to perform data standardization, utilize MS Excel functions, conduct simulations, implement pivot tables, perform regular data updates, and perform collaborative decision making.

7.4. Data Archiving - Central Filing System using MS Teams

The development and implementation of techniques for a central filing system using MS Teams offer significant benefits in terms of organization, collaboration, and easy access to files and documents. By leveraging the features and capabilities of MS Teams, HEIs can streamline their file management processes, enhance productivity, and improved information sharing. Based on the findings and results obtained in this study, it is apparent that this approach provides solutions for efficient file management. Creating a central filing system in MS Teams enables the consolidation of files and documents in a single platform, eliminating the need for multiple scattered locations. By using Teams' channels and folders, files can be categorized and organized according to specific projects, departments, or teams. This ensures easy navigation and retrieval of files, saving time and reducing the risk of information silos.

7.5. Developing Timetabling Techniques

The development of timetabling technologies and techniques through group coding, collaborative scheduling, and other techniques imposed during the actual timetabling process such as room swapping, transferring tutor timetables, and assigning dummies, along with trial-and-error method and simulations offers paramount benefits in terms of

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optimizing scheduling efficiency, resolving conflicts, and ensuring effective resource allocation. By implementing these techniques, HEIs can streamline their timetabling processes, enhance flexibility, and improve overall timetabling outcomes. Based on the findings and results obtained from developing these techniques and approaches, it is clear that they contribute to the effective management of timetables. Collaborative scheduling allows for the involvement of several stakeholders including administrators, lecturers, and other institutional leaders in the whole process of timetabling. Using Google Sheet, the approach enables a more inclusive and balanced timetable creation process, considering the needs and preferences of all stakeholders. Swapping classrooms and transferring lecturers' timetables using dummies created a novel approach in terms of avoiding hiccups in swapping rooms and changing particular rooms. These techniques ensure optimal utilization of resources and minimizes disruptions caused by clashes or classroom availability matters. Additionally, it helps maintain continuity in course delivery while accommodating changes or resolving clashes in timetables. Based on these outcomes, HEIs are recommended to implement collaborative scheduling, establish clear communication channels, utilize timetable management software programs, train staff on swapping room techniques, and perform regular timetable evaluation and optimization.

8. LIMITATIONS & FURTHER RESEARCH

This study did not include techniques and/or models for faculty members' tutor allocation and identifying students' remaining modules, which are also very important academic processes in HEIs. These are not included as these are already explored in other research works of the main author of this study. For reference and for more details of these works, refer to the first page of this paper for the correspondence. Note that the techniques and optimization/automation models developed and implemented in this study are limited to 5 areas only and hence further research can be delved into pertinent to other academic processes which may deem fit according to the requirements of HEIs being considered. Other methods and techniques can also be explored in this regard, which might provide more promising results.

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