

LEARNING STRATEGIES FOR INTEGRATING MEDICAL INFORMATICS COURSE IN UNDERGRADUATE MEDICAL EDUCATION: A CASE STUDY

Ahmed I. Albarrak

Prof. Dr., Medical Informatics and E-Learning Unit, Medical Education Department, Health Informatics and Promotion Research Chair, College of Medicine, King, Saud University, Riyadh, Saudi Arabia, albarrak@ksu.edu.sa

Abstract

Medical education aims to equip students and graduate clinicians with the required knowledge, skills and strategies to apply them in the clinical practice. Medical informatics is defined as the scientific field that deals with acquisition, storage, retrieval, sharing and innovative management and utilization of data, information, and knowledge in medical practice for problem solving, scientific inquiries and decision making.

In year 2010, I have participated as the course coordinator in developing the medical informatics course for undergraduate medical students in The College of Medicine, King Saud University. Medical Informatics course was integrated in the third-year undergraduate medical curriculum and was assigned two credit hours and stated in 2011. A survey study was conducted previously in the medical school to assess medical students' knowledge, skills and attitudes towards medical informatics. The study results showed the urgent need for medical informatics to be integrated in the undergraduate medical curriculum so that students at the time of graduation are able to utilize the ever-developing advancements in medical informatics, medical knowledge, and medical technologies and to benefit from the online resources, and to utilize advanced tools in medical education such as online learning and simulation. A detailed literature review and benchmarking from literature and international standards and best practices were conducted.

Based on literature review and benchmarking, standards and best practices and the results of the survey study on medical students, the course was designed to provide third year medical students with basic knowledge and skills that is required in future clinical practice. Students should learn by end of the course, how data, information and knowledge are created, acquired, managed and processed using information and communication technologies. This course also introduced students to electronic health record, computerized physician order entry, imaging informatics, and Internet health applications. It is very important to provide students with stimulating, engaging communication environments which would allow them to interact intensely with other students, and instructors. Students should learn how to deal with the new cases, how to search, access and utilize clinical information supporting investigation, diagnosis and treatment.

Course delivery included approaches such as; Face to face lectures, flip classroom, team-based learning and workshops. The course consisted of more than thirty hours conducted on a yearly basis. The content was identified based on literature review and benchmarking from literature and international standards. A Modified team-based learning and blended learning approach were later applied using face-to-face lectures, various e-learning technologies, workshop and seminars. A survey study was conducted in three consecutive years: 2017-2019 on medical students. The survey contained items regarding student perception of various types of blended learning techniques applied in the course. It was observed that the blended-learning technique is highly essential to overcome challenges facing teaching medical informatics course, due to a large number of students and the

need for various exposures to reach the course's learning goals. Furthermore, modified team-based learning reported facilitating learning and asking questions without embarrassment.

Keywords: medical informatics, medical education, team based learning, flipped classroom.

MEDICAL INFORMATICS IN MEDICAL EDUCATION

Medical informatics is an interdisciplinary scientific field that study, and apply methods and tools for an innovative management and utilization of data, information, and knowledge in medical practice for problem solving, scientific investigations and decision making. A broader definition for medical informatics was given as "the science underlying the acquisition, maintenance, retrieval, and application of biomedical knowledge and information to improve patient care, education, research, and administration". (Chen et al., 2005)

Medical informatics is located at the intersection of information technology, information science and different disciplines of medicine and health care. As clearly stated in definitions, medical informatics has both theoretical fundamental theories and methods and practical applied aspects characteristics. It develops and assesses methods and systems for the acquisition, processing and interpretation of patient data with the support of information technology and knowledge that is obtained in scientific literature. Most notably, these definitions make no mention of computers or information technology itself, instead, they focus on the subject matter which are data, information, and knowledge rather than the tools which could be a computers and systems. (Chen et al., 2005) (Davies et al., 2020)

Medical education aims to equip students and graduate clinicians with the essential knowledge and skills and the strategies for applying them in the clinical practice. Theories and approaches applied in medical education are varying ranging from traditional one-way lectures to interactive online methods, e-learning, and distance learning. (Colace et al., 2006) (Hovenga, 2004)

However, the introduction of e-learning and information technologies in medical education has made it mandatory for medical students to have sufficient information technology and medical informatics skills and knowledge to assist them achieving their goals in learning and practice and to gain from online tools and resources. . (Hayashi et al., 2006)

In addition, computer applications in medical education have grown as well to enhance traditional teaching strategies, and to provide new methods of learning. In the same time, the introduction of medical informatics courses in undergraduate medical education has reported improved capabilities in acquiring and utilizing knowledge among medical students. (Gjerde et al., 2004a) (Davies et al., 2020; Lattouf, 2022)

LITERATURE REVIEW

It is becoming more obvious that the revolution of information technology and the accelerating advances in computer performance should effectively be employed to enhance and improve medical practices and education. (Shortliffe & Blois, 2014)

It is believed that medical informatics application and methods would be an effective solution for many challenges facing healthcare professionals in current clinical care settings, one of which is the appropriate management of data and information and knowledge based decision making.

Medical Informatics was among the nine objectives in the Council on Graduate Medical Education report that was underpinning the conduction of the Undergraduate Medical Education for the twenty first Century (UME-21) curriculum project. (Gjerde et al., 2004a). UME-21 leaders designated medical informatics and evidence based medicine as key skills to prepare physicians to practice in the changing health care environment. (Gjerde et al., 2004b) "Medical students should be able, at the time of graduation, to utilize biomedical information for: formulating problems; arriving at strategies for solutions; collecting, critiquing, and analyzing information; taking action based on findings; and communicating and documenting these processes and the results." This was a quote from the Medical School Objectives Project (MSOP) which was developed by the Association of American Medical Colleges. (The Association of American Medical Colleges, n.d.)1998. (Cooper, 2019; Lattouf, 2022)

The National Autonomous University of México Faculty of Medicine recently implemented a curriculum reform that included two medical informatics sequential courses and assessed students' knowledge and satisfaction after the curriculum implementation. The study shows a significant increase in medical informatics knowledge after an educational intervention in four medical student cohorts, and an overall positive evaluation by the students. (Sánchez-Mendiola et al., 2015)

The acquisition and development of competencies and skills in medical informatics are progressively recognized as essential elements for the effective and safe clinical practice, and there has been a significant demand and movement to include these skills and competencies in the formal curricula for both undergraduate and graduate medical and health professions education and training. (Sánchez-Mendiola et al., 2015)

The recent update by the American Board of Medical Specialties in the United States for clinical informatics as a subspecialty has contributed to a progressive development of graduate programs in medical informatics. Such a formal acknowledgement of medical informatics as a professional subspecialty medical discipline is considered a significant step towards the recognition of medical informatics as a science and is a big step towards its academic and societal acceptance. (American Board of Medical Specialties, 2010)

In addition, the movements of higher education and medical schools in Saudi Arabia in particular to meet the international standards with other medical schools in the world, a continuous quality assessment and improvement must be in place. The SaudiMEDs framework for undergraduate medical schools stated the learning outcomes and enabling competencies that are expected by medical graduates. Every medical college in Saudi Arabia has the autonomy to tailor the program content and the teaching and learning strategies to achieve the national framework of SaudiMEDs. The program learning outcome (PLO12) states; "use medical informatics in healthcare system effectively", and stated mainly two course-level learning outcomes; use technology and information systems effectively, including storing and retrieving of information and use the information retrieved from relevant sources appropriately and ethically in relation to patient care and health promotion. (Tekian & Ahwal, 2015) (Alrukban et al., 2016a)

CRITICAL ANALYSIS OF THE EDUCATION/TEACHING EVENT

There are many studies on the poor efficacy of face to face lectures and the limited short-term and long-term impacts on learning (Cox et al., 2006) (Hunt et al., 2011)(Mclaughlin et al., 2014). The use of interactive lectures can promote active learning, improve attention and motivation, give feedback to the teacher and the student, and increase satisfaction. Active learning in medical education is more effective than passive learning. Team-based learning (TBL), an active-learning, group-based instructional format was one approach applied in this course after review and evaluation. Theory suggesting that adults learn more effectively when the basis for learning is experiential, social, and active. Participants are accountable for individual and group learning, work in small groups to solve predefined application problems, they are encouraged to discuss and defend their answers, and receive immediate feedback regarding their performance. Studies indicate that the TBL approach changed learning, behavior, and the level of medical student satisfaction. Levine and colleagues also looked at learning outcomes of students in a psychiatry clerkship, they documented that in comparing average scores of two classes, the team learning group scored significantly higher than those in the conventional didactic clerkship. There is a growing body of evidence confirming the effectiveness and high acceptability of TBL in medical education. (Koles et al., 2010)

TBL is building on the constructive theory, which stress on that learner has to take role and responsibilities in their own learning and the learning is building on learner previous knowledge and experiences. In constructive theory the learner is an information constructor where new information is linked to prior knowledge. (Parmelee et al., 2012) The flipped classroom instructional model or inverted classroom is a promising substitute to conventional face to face lectures, it offers an outline for integrating e-learning technologies with active and collaborative learning. The main concept in flipped classroom model is to flip the common instructional approach. The flipped classroom model could be considered as a type of blended learning where in-class learning is integrated with online learning experiences. (Fulton, 2012) Previous studies showed that the flipped classroom, is more effective than either face-to-face or online learning alone. (Street et al., 2015) The major characteristic of the flipped classroom instructional model is that content and material are delivered primarily to students while in-class time is used "to work through problems, advance concepts, and engage in collaborative learning". (Galway et al., 2014) The flipped classroom model involves more than shifting content delivery outside

of class time, it represents a broader shift in how we think about the learning process. The flipped classroom model is grounded in several interconnected theories of learning and pedagogy, mainly the interactive and collaborative learning drawing on Piaget's theory of active learning. (Heng, 2014)

COURSE OVERVIEW

A survey study was conducted and published in 2010 to assess medical students' skills and attitudes towards medical informatics. The study results indicated that male and female students had very good basic computer skills; however they lacked professional medical informatics knowledge and skills. (I. Albarrak, 2010) The study results clearly points out the urgent needs for medical informatics to be integrated in the undergraduate medical curriculum so that students at the time of graduation are able to utilize the ever-developing advances in medical informatics, medical knowledge, and medical technologies and to benefit from the online resources, and to utilize advanced tools in medical education such as distance learning.

In 2011, the medical informatics course for undergraduate medical students was introduced in the CoM, KSU.

The course was designed to provide third year medical students with basic and relevant knowledge and skills that is required in medical informatics for medical practice. Students by end of the course should know how data, information and knowledge are created, managed and processed using information and communication technologies, and the methods used in medical practice for decision support and problem solving. Black Board is the learning management system that is considered as the main learning platform in the CoM and was used heavily in delivering and managing the course. In addition, the course introduced students to electronic health record, computerized physician order entry, imaging informatics, and Internet health applications. The course consisted of more than thirty hours conducted on a yearly basis (two semesters). The content was identified based on literature review and benchmarking from literature and international standards and best practices. The medical informatics has been endorsed by the Association of American Medical Colleges Medical School Objectives Project (MSOP) report on medical informatics and population health which focused mainly on areas including; information literacy subjects, including medical literature searching, biostatistics, and critical appraisal. (The Association of American Medical Colleges, n.d.).

In 2010, The College of Medicine (CoM) in King Saud University was the first medical college to go through an accreditation process from The National Commission for Accreditation Academic and Assessment (NCAAA) and was succeeded to get accredited for seven years long. Back then, the committee gave commendable comments on the medical informatics as one of the courses in the curriculum that provide remarkable support to the students. In 2018, NCAAA accreditation was conducted and the Medical College was reaccredited and received additional seven years accreditation. The panel reviewers recommended that Medical Informatics course for the second time was one of the exemplar course in the CoM (Handbook for Quality Assurance and Accreditation Part National Commission for Academic Accreditation and Assessment, 2015)

Approaches applied in course delivery

Face to face lectures, this element of the course aimed to introduce students to medical informatics concepts, history, theories and main areas. The availability of instructor in lecturing is very important element in student engagement and understanding of new topics. The course content is listed in Table 1.

Patient safety workshop, in this three-hour workshop students were divided into small groups and were given medical error predesigned cases, students were asked to analysis the case assigned to their group to find out what elements such as; kind of medical error occurred in that case, what was the main reasons for that error, how it could be prevented and what medical informatics application or tools could help. Students are requested to search for online resources, articles and studies that would help understand the case and support their analysis and hypothesis, and are requested to deliver ten minutes presentations. Evaluation are conducted by minimum two faculty members. After the workshop, students are requested to submit a short report on the case including the analysis and utilized resources and literature.

Hospital information system workshop, during this three-hour workshop, students were introduced to the information system the including the hospital information system, picture archiving and communications system, lab access system, pharmacy, and patient master index. A life system demos are conducted on each of these systems. Students are usually evaluated on the attendance only.

Assessment included quizzes done online, midterm and final multiple-choice questions exam. In addition to the workshops assessments and participations marks are given.

Paper appraisal workshop: in this three hours workshop students were divided into small group, where each group were given one article on one of the medical informatics published studies. Paper are usually assigned to groups two weeks before the workshop. During the workshop every group are requested to answers questions on the significance, methodology and importance of the study they were assigned. Every group is requested to deliver 10 minutes presentation. Students have the chance to discuss medical informatics paper in a team based learning approach. At the end of the workshop, an evaluation consisting of question from every assigned article are conducted using personal response systems (iclicker) a responding and voting electronic system. Ref students are evaluated on completing the paper appraisal task and presentation on the group level, and evaluated individually by the iclicker assessment.

Table 1: initial course content and after modification

Course content	Course content after review and modification
Introduction to Medical Informatics part one	Introduction to Medical Informatics
Introduction to Medical Informatics part two	Merged with part one
Clinical Data	Clinical Data
Electronic Medical Records	Electronic Medical Records
Medical literature searching	Removed
Consumer Health Informatics	Consumer Health Informatics
Ethics, Privacy & Confidentiality	Ethics, Privacy & Confidentiality
Clinical Decision Support systems	Clinical Decision Support systems
Telemedicine and Telehealth	Telemedicine and Telehealth
Computerized Physician Order Entry	Computerized Physician Order Entry
Reducing Medical errors through Informatics	Reducing Medical errors through Informatics
---	Artificial intelligence in medicine and health care
Imaging informatics	Removed
Clinical Informatics as a discipline for Physicians	Seminar: Clinical Informatics as a discipline for Physicians
Patient safety workshop	Removed
Hospital information system workshop	Hospital information system workshop

COURSE EVALUATION AND MODIFICATIONS

Despite the fact that medical informatics were new to most students and the nature of medical informatics course is relatively different from other medical school courses, it was observed that the course was running smoothly each year, students were fully engaged in lectures as well as the workshops and assessments. In addition, many students showed interest in medical informatics further learning. However and despite students' engagements it was difficult in the early years of the course conduction to convince students with the importance of the course for their future medical career. Although it is strongly believed that medical informatics tools and methods play an essential role in health care and clinical practice in particular, however the students' opinions do not necessarily reflect this importance, rather, they do not really understand why they have to study this subject. It was so prominent that students were under various misconceptions concerning the role of medical informatics in medicine.

The nature of the course being focusing on information manipulation and technology, could be a reason for students struggle, and it was not easy for many medical students to get engaged and understand the importance of such methods and skills and why it was introduced as part of the undergraduate medical curriculum. We have noticed students' issues with the course through discussions during lectures and workshops, students' feedback, survey and the course evaluations. Students found it hard to relate medical informatics topics and applications to the clinical practice at this level of their college education. Students numbers and Infrastructure were among the main challenges faced the integration and delivery of the medical informatics course. Students' patches ranged from 260 to 300 students during the first few years. In addition to the unavailability of computer laboratories in addition to lack of laboratories for training in information retrieval was among the challenges been faced during integrating and running this course. In addition to the limited access to hospital information system and limited number of health informatics application implemented in the teaching hospitals which in turn limited the sessions for hands-on clinical training.

Later the course outline and objectives and learning and teaching approaches were modified in several stages. It was agreed that it is very important that we provide students with stimulating, engaging communication environments which would allow them to interact intensely with other students, and instructors. Students should learn how to deal with the new cases, how to search, access and utilize information supporting investigation, diagnosis and treatment.

A modified flipped class approach and modified TBL was introduced. The first component is the face-to-face lectures where some topics were delivered, then lecture slides are uploaded with other course resources on BB. The second component is recorded lectures, which had been prerecorded and uploaded on LMS using virtual classes on BB. Third component is tutorials where the modified flipped class approach and modified TBL were implemented. (A. I. Albarak et al., 2021) In addition guiding questions for every topic where also uploaded on LMS to help students in group discussion and homework. Students were divided into groups of four or five students and were requested to present in the next few days a short presentation of their own on the assigned topic. In every tutorial session two groups were presenting for the same topic. Each group are supposed to deliver a fifteen to twenty min presentation followed by 5-10 min discussion. The rest of the students are encouraged to participate in the discussion. In this approach we were able to integrate face to face lecture with e-learning, team based passive learning, and in class interactive learning. Figure 1 shows the main approaches applied in the course.

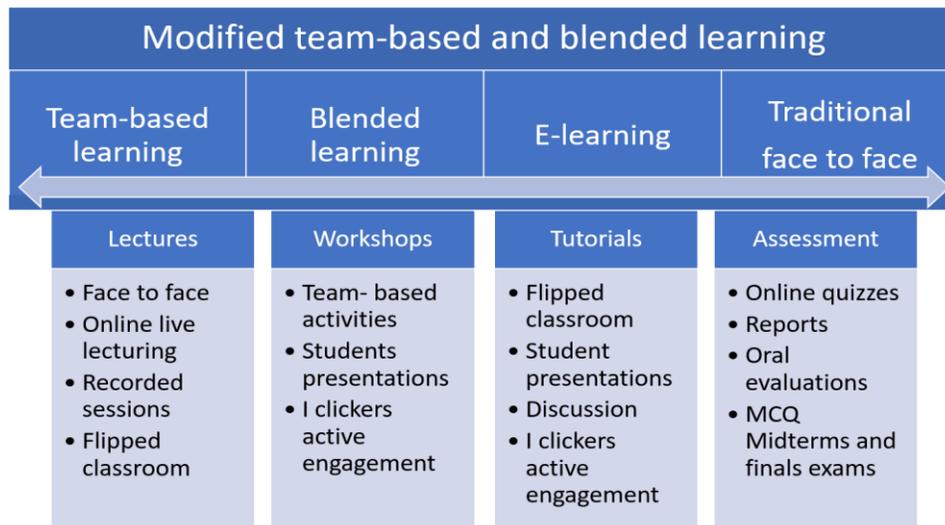


Figure 1: The team-based learning and blended learning approaches and activities applied the course.

In terms of Bloom’s taxonomy of thinking and learning, the modified flipped classroom enables both higher and lower levels of cognitive work where students do lower level cognitive work, like the acquisition of knowledge in class, and independently outside of class while higher-order cognitive work including knowledge application, analysis, and synthesis happens during both before and in class time with the support of peers and instructors. Also it draws on Mesriow’s theory of transformative adult learning and Habermas’ related theory of knowledge and human interests. (Galway et al., 2014) We are trying to integrate reflection, which is a key aspect of learning into the course to complement the before class content delivery and the in/before class application of knowledge. There is no single or standard way to design and convey the flipped classroom model. The approach of delivering content and the ways in which face-to-face class time is used will vary depending on the course type, students’ characteristics and background, instructor, available resources.

The course was redesigned with new and modified several components including face to face lectures, workshops, and tutorials (modified flipped classroom). The use of interactive lectures can stimulate active learning, increase attention and motivation, support the feedback to the lecturer and the student, and increase satisfaction for both. (Steinert et al., n.d.) We focused more on the main components of medical informatics aimed to introduce students to medical informatics main concepts, history, theories and main applications. The course content after modification are listed in Figure 1.

The Hospital Information systems and system appraisal workshops replaced the previous workshops, the hospital information systems workshop was modified to include students’ hands on experiences. in addition, a seminar included invited experienced speakers from the industry and hospitals to speak about topics and recent trends and advancement in health informatics, and health care updates, including their experiences with medical informatics applications in clinical settings. The session is conducted as a panel discussion perceived by half an hour presentation for each speaker. Students are encouraged to ask questions and participate in discussions.

Hospital information system workshop, during this three hours workshop, students were introduced to the hospital information systems which is the integrated health information systems that connect radiology, surgery, primary care, pharmacy in one system. The students are given live demo and step by step instruction how to add diagnosis, allergy and lab orders as well as view medical history and how to modify dynamic documentation. After the demo session, each students have to perform several tasks and the trainers will evaluate students’ performance.

System appraisal workshop, in this three hours workshop students were divided into small group, where each group were given a list of clinical systems and applications to chooses from. Applications are usually assigned to

groups two weeks before the workshop. During the workshop every group are requested to answers questions on the significance, importance, limitations and drawbacks of the system or application they were assigned. Every group is requested to deliver 10 minutes presentation. Students have the chance to discuss medical informatics applications in a team-based learning approach. At the end of the workshop, an evaluation consisting of question from every assigned application/system are conducted using personal response systems (iclicker) a responding and voting electronic system. (albarrak et al 2021) Students are evaluated on completing the application appraisal task and presentation on the group level, and evaluated individually by the iclicker assessment.

Assessment strategies should be consistent with desired learning outcomes, multiple-choice questions (MCQ's) are one of the approaches that may diversify the assessment approach. Assessment included quizzes, midterm and final MCQ exam and in addition to the workshops assessments and participations. After the implementation of Saudimed (Alrukban et al., 2016b), the assessment strategies have been modified and all of the of assessment questions must be tied to the course learning outcomes and program outcomes. When setting up all examination questions, we must ensure all questions cover the NCAAA domains (Knowledge, cognitive, interpersonal skills and responsibility, communication and information technology, numerical skills and psychomotor skills as well as seventeen program learning outcomes, whereby Medical informatics skill is listed as one of the subdomain under communication and collaboration theme. (Alrukban et al., 2016b)

In addition the course included basic knowledge topics on the capabilities and limitations of hospital applications and systems, principles, their desirable and undesirable effects. By end of the course students should be aware of the professional, legal and ethical implications of the use of such systems.

The modified course content and methods included more interactions, less lecturing, more students' activates.

DISCUSSION AND CONCLUSION

It is believed that medical informatics application and methods would be an effective solution for many current challenges facing healthcare. Medical Informatics was among the nine objectives in the Council on Graduate Medical Education report that was underpinning the conduction of the Undergraduate Medical Education for the twenty first Century (UME-21) curriculum project. (Gjerde et al., 2004a). "Medical students should be able, at the time of graduation, to utilize biomedical information for: formulating problems; arriving at strategies for solutions; collecting, critiquing, and analyzing information; taking action based on findings; and communicating and documenting these processes and the results." This was a quote from the Medical School Objectives Project (MSOP) which was developed by the Association of American Medical Colleges. (The Association of American Medical Colleges, n.d.) The course consisted of thirty hours conducted on a yearly basis (two semesters). The National Autonomous University of México Faculty of Medicine implemented a curriculum reform that included two medical informatics courses and assessed students' knowledge and satisfaction afterwards. The published study showed a significant increase in medical informatics knowledge after an educational intervention in four medical student cohorts, and an overall positive evaluation by the students. (Sánchez-Mendiola et al., 2015)

The acquisition and development of competencies and skills in medical informatics are progressively recognized as essential elements for the effective and safe clinical practice, and there has been a significant demand and movement to include these skills and competencies in the formal curricula for both undergraduate and graduate medical and health professions education and training. (Sánchez-Mendiola et al., 2015)

The American Board of Medical Specialties in the United States included clinical informatics as a subspecialty which has contributed to a progressive development of graduate programs in clinical informatics. Such a formal acknowledgement of medical informatics as a professional subspecialty medical discipline is considered a significant step towards the recognition of medical informatics as a science and is a big step towards its academic and societal acceptance. (American Board of Medical Specialties, 2010)

In addition, many applications such as telemedicine, mobile health, health analytics, and artificial intelligence are more common and getting more popularity in clinical practice and health care in general. (A. I. Albarrak et al., 2021) (Alanazi et al., 2021; Batis & Albarrak, 2021)

In addition, the movements of higher education and medical schools in in Saudi Arabia in particular to meet the international standards with other medical schools in the world, a continuous quality assessment and

improvement must be in place. In 2010, The CoM was the first medical college to go through an accreditation process from The National Commission for Accreditation Academic and Assessment (NCAAA) and was succeeded to get accredited for seven years long. Back then, the committee gave commendable comments on the medical informatics as one of the courses in the curriculum that provide remarkable support to the students. In 2018, NCAAA accreditation was conducted and CoM was reaccredited and received additional seven years accreditation. The panel reviewers recommended that Medical Informatics course for the second time was one of the exemplar course in the CoM ((Handbook for Quality Assurance and Accreditation Part National Commission for Academic Accreditation and Assessment, 2015)

We have introduced a modified team based flipped classroom as part of the tutorial sessions. The flipped classroom is a relatively new educational approach, it includes typically an online or an asynchronous lectures and self-learning before the class and practice problem-solving as homework, then an active in-class active, group-based presentation and discussions. (Drewery et al., 2016) This new pedagogical method represents a unique combination of learning theories including self-learning, peers learning and discussion, group discussion. Lecture are delivered in a session of 40-50 min, handouts are given to students. Along with the slide handout the assigned group are given a guiding questions to help them to construct a power point presentation on the same topic. Students are given three days to a week to present. In every tutorial session two groups were for the same topic. Each group are supposed to deliver a fifteen to twenty min presentation followed with 5-10 min discussion. The rest of the students are encouraged to participate in the discussion.

The modified course planning was designed to overcome most of the limitations and to increase students' engagement in learning process. So the number of lectures was reduced and we introduced the flipped classroom approach to increase students' engagements. This give chance for more group discussions, students self-learning and engagements. A new system appraisal workshop was introduced, students have the chance to discuss medical informatics systems and applications in a team-based learning approach. (Sisk, 2011) Using iclickers during sessions and workshops were another innovative approach for student engagement, feedback and discussion. Moreover modifying the hospital information systems workshop to include hands on experience, gave the students' the chance to touch and recognize the positive effects of medical informatics methods and applications. Students found tutorials and workshops to be effective learning activities and reported that working in groups had facilitated their learning process, and students generally prefer blended over face-to-face and fully online courses.

PERSONAL REFLECTIONS

Continuous course monitoring and evaluation are very important for effective teaching and successful implementations. The implementations and selective utilizing of e-learning and new technology would help in achieving and delivering course objectives. Educational methods should be well reviewed and customized to fit the course objectives. it is important not only to focus on learning and content, it is essential to remember always to make learning and teaching an enjoyable experience both for students and instructors. I released how valuable teacher encouragements and motivation is for students' progress and motivation. It may be difficult and sometimes it can be a struggle, but if something goes wrong, there is always a way to fix it. As an educator, and based on my educational experiences and readings, I intend to motivate students while teaching and working together taking any appropriate opportunity for motivation no matter it is a mistake, question, problem, challenge or an achievement. I believe educational philosophy and teaching styles may change throughout any academic career and educators should remain receptive as possible for future development and to suggestions.

REFERENCE LIST

- Alanazi, A., Albarrak, A., Alanazi, A., & Muawad, R. (2021). 5PSQ-184 Knowledge and attitude assessment of pharmacists toward telepharmacy in Riyadh City, Saudi Arabia. *European Journal of Hospital Pharmacy*, 28(Suppl 1), A146–A146. <https://doi.org/10.1136/EJHPHARM-2021-EAHPCONF.303>
- Albarrak, A. I., Zakaria, N., Almulhem, J., Khan, S. A., & Karim, N. A. (2021). Modified team-based and blended learning perception: a cohort study among medical students at King Saud University. *BMC Medical*

Education, 21(1), 1–8. <https://doi.org/10.1186/S12909-021-02639-2/TABLES/6>

- Albarrak, I. (2010). *Assessment of Medical Informatics Skills of Undergraduate Medical Students at College of Medicine , King Saud University*. 7(1), 1–9.
- Alrukban, M., Al-Rumayyan, A., Abdulghani, H., Al-kadi, A., Saleh, S., Al-hayani, A., Alqunaizi, K., Alsaedi, S., & Zaini, R. (2016a). *SaudiMED Framework: Saudi Medical Education Directives Framework*. September.
- Alrukban, M., Al-Rumayyan, A., Abdulghani, H., Al-kadi, A., Saleh, S., Al-hayani, A., Alqunaizi, K., Alsaedi, S., & Zaini, R. (2016b). *SaudiMED Framework: Saudi Medical Education Directives Framework*. September.
- American Board of Medical Specialties. (2010). *Specialty Certificates | American Board of Medical Specialties*. Part 5. <https://www.abms.org/member-boards/specialty-subspecialty-certificates/>
- Batis, A. A., & Albarrak, A. (2021). Preferences and features of a blood donation smartphone app: A multicenter mixed-methods study in Riyadh, Saudi Arabia. *Computer Methods and Programs in Biomedicine Update*, 1, 100005. <https://doi.org/10.1016/J.CMPBUP.2021.100005>
- Chen, H., Fuller, S. S., Friedman, C., & Hersh, W. (2005). Knowledge Management, Data Mining, and Text Mining in Medical Informatics. In *Medical Informatics* (pp. 3–33). Kluwer Academic Publishers. https://doi.org/10.1007/0-387-25739-X_1
- Colace, F., Santo, M., & Pietrosanto, A. (2006). Evaluation Models for E-Learning Platform: an AHP approach. *Proceedings. Frontiers in Education. 36th Annual Conference*, 1–6. <https://doi.org/10.1109/FIE.2006.322312>
- Cooper, L. F. (2019). Digital Technology: Impact and Opportunities in Dental Education. *Journal of Dental Education*, 83(4), 379–380. <https://doi.org/10.21815/JDE.019.042>
- Cox, M., Irby, D. M., Cooke, M., Sullivan, W., & Ludmerer, K. M. (2006). Medical Education: American Medical Education 100 Years after the Flexner Report. *N Engl J Med*, 355(13), 1339–1344. <https://doi.org/355/13/1339> [pii]n10.1056/NEJMr055445
- Davies, A., Mueller, J., & Moulton, G. (2020). Core competencies for clinical informaticians: A systematic review. *International Journal of Medical Informatics*, 141. <https://doi.org/10.1016/j.ijmedinf.2020.104237>
- Drewery, D., Nevison, C., & Pretti, T. J. (2016). Education + Training Article information : *Education + Training*, 58(2), 179–192. <https://doi.org/10.1111/etap.12087>
- Fulton, K. (2012). Upside Down and Inside Out: Flip Your Classroom to Improve Student Learning. In *Learning & Leading with Technology* (Vol. 13).
- Galway, L. P., Corbett, K. K., Takaro, T. K., Tairyan, K., & Frank, E. (2014). *A novel integration of online and flipped classroom instructional models in public health higher education* (Vol. 14). <https://doi.org/10.1186/1472-6920-14-181>
- Gjerde, C. L., Pipas, C. F., & Russell, M. (2004a). *Teaching of Medical Informatics in UME-21 Medical Schools: Best Practices and Useful Resources*.
- Gjerde, C. L., Pipas, C. F., & Russell, M. (2004b). Teaching of medical informatics in UME-21 medical schools: best practices and useful resources. *Family Medicine*, 36 Suppl, S68-73.
- Handbook for Quality Assurance and Accreditation Part National Commission for Academic Accreditation and Assessment*. (2015).
- Hayashi, T., Tominaga, H., & Yamasaki, T. (2006). Blended learning contents for university education. *2006 7th International Conference on Information Technology Based Higher Education and Training*, 499–502. <https://doi.org/10.1109/ITHET.2006.339802>
- Heng, N. M. (2014). Teaching Tip : The Flipped Classroom. *Journal of Information Systems Education*, 25(1), 7–12.
- Hovenga, E. J. S. (2004). Globalisation of health and medical informatics education—what are the issues? *International Journal of Medical Informatics*, 73(2), 101–109.

<https://doi.org/10.1016/J.IJMEDINF.2003.11.004>

- Hunt, J. B., Bonham, C., & Jones, L. (2011). *Understanding the Goals of Service Learning and Community-Based Medical Education : A Systematic Review*. 86(2), 246–251.
<https://doi.org/10.1097/ACM.0b013e3182046481>
- Kamei, R. K., Cook, S., Puthuchery, J., & Starmar, & C. F. (2012). Medical Science Educator © IAMSE 2012 Volume 22(2) 57 21 st Century Learning in Medicine: Traditional Teaching versus Team-based Learning. In *The Journal of the International Association of Medical Science Educators Med Sci Educ* (Vol. 22, Issue 2).
- Koles, P. G., Stolfi, A., Borges, N. J., Nelson, S., & Parmelee, D. X. (2010). *The Impact of Team-Based Learning on Medical Students ' Academic Performance*. 85(11), 1739–1745.
<https://doi.org/10.1097/ACM.0b013e3181f52bed>
- Lattouf, O. M. (2022). Impact of digital transformation on the future of medical education and practice. *Journal of Cardiac Surgery*, 37(9), 2799–2808. <https://doi.org/10.1111/JOCS.16642>
- Mclaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., Esserman, D. A., & Mumper, R. J. (2014). *The Flipped Classroom : A Course Redesign to Foster Learning and Engagement in a Health Professions School*. 89(2), 236–243.
<https://doi.org/10.1097/ACM.0000000000000086>
- Parmelee, D., Michaelsen, L. K., Cook, S., & Hudes, P. D. (2012). Team-based learning: A practical guide: AMEE Guide No. 65. *Medical Teacher*, 34(5). <https://doi.org/10.3109/0142159X.2012.651179>
- Sánchez-Mendiola, M., Martínez-Franco, A. I., Lobato-Valverde, M., Fernández-Saldívar, F., Vives-Varela, T., & Martínez-González, A. (2015). Evaluation of a Biomedical Informatics course for medical students: a Pre-posttest study at UNAM Faculty of Medicine in Mexico. *BMC Medical Education*, 15(1), 64.
<https://doi.org/10.1186/s12909-015-0349-7>
- Shortliffe, E. H., & Blois, M. S. (2014). Biomedical informatics: The science and the pragmatics. In *Biomedical Informatics: Computer Applications in Health Care and Biomedicine: Fourth Edition*.
https://doi.org/10.1007/978-1-4471-4474-8_1
- Sisk, R. J. (2011). Team-Based Learning: Systematic Research Review. *Journal of Nursing Education*, 50(12), 665–669. <https://doi.org/10.3928/01484834-20111017-01>
- Steinert, Y., Snell, L. S., & Ar, S. M. (n.d.). *Interactive lecturing: strategies for increasing participation in large group presentations*.
- Street, S. E., Gilliland, K. O., McNeil, C., & Royal, K. (2015). The Flipped Classroom Improved Medical Student Performance and Satisfaction in a Pre-clinical Physiology Course. *Medical Science Educator*, 25(1), 35–43.
<https://doi.org/10.1007/s40670-014-0092-4>
- Tekian, A. S., & Ahwal, M. S. A. (2015). Aligning the SaudiMED framework with the National Commission for Academic Accreditation and Assessment domains. *Saudi Medical Journal*, 36(12), 1496–1497.
<https://doi.org/10.15537/smj.2015.12.12916>
- The Association of American Medical Colleges. (n.d.). *Medical School Objectives Project (MSOP) - Initiatives - AAMC*. Retrieved October 24, 2018, from <https://www.aamc.org/initiatives/msop/>