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# Engaging Millennial Students through Flipped Classroom: Perspectives from Faculty, Undergraduate Medical and Nursing Students

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# Engaging Millennial Students through Flipped Classroom: Perspectives from Faculty, Undergraduate Medical and Nursing Students

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**Transparency Declaration:**

I, Amber Sultan affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

## ABSTRACT

The 'flipped classroom' is a teaching pedagogy where students are actively involved in the learning process. It reduces passivity, enables students to become active learners through reasoning and concept application, and facilitates student interaction with their peers and instructors. This instructional approach enhances retention and decreases distraction by engaging students.

**Objectives**: The purpose of this study was to train the faculty of the medical college and school of nursing in developing flipped classrooms (FCR) as a strategy and to facilitate them in conducting sessions for their learners.

**Setting**: Private Medical College

**Participants**: A total of 442 students from Medical College and School of Nursing and Midwifery participated in the evaluation survey with a female to male ratio of 339. Faculty members who attended and facilitated the flipped class session were invited to participate in the focus group discussion. Students who attended the flipped class sessions were included in the study sample. Students who did not complete the forms were excluded from the study.

**Results**: Both medical and nursing students found FCR format stimulating. A significantly higher proportion of medical students (73%) found the FCR more engaging and interesting than a traditional lecture as compared to nursing students (59%) (p= 0.009). Similarly, 73 % of medical students believed the learning objectives of both the non-face-to-face (NF2F) and face-to-face (F2F) sessions were shared with them as compared to the 62% of nursing students who believed the same (p=0.002). A significantly higher proportion of medical (76%) versus nursing (61%) students found the FCR format more useful for application of their theoretical knowledge into clinical practice (p=0.030).

**Conclusion:** Students found the flipped classroom (FCR) more engaging and interesting in terms of applying theoretical knowledge into practice. It is recommended to conduct more FCR sessions for an interactive and student-centered learning experience.

**STRENGTHS AND LIMITATIONS**:

1. This is a mixed methods study and was the first capacity-building teacher training study conducted across two health professions faculty.
2. Faculty development workshops were conducted to train faculty on how to conduct Flipped classroom
3. In a Single-center study with those interested flipped classroom teaching format are more likely to participate which may create a response bias.
4. Only the clinical faculty were trained and conducted sessions in clinical years so the results cannot be generalized for faculty from Basic sciences.

**KEYWORDS** Technology enhanced learning, Flipped Classroom, active learning, student engagement, Medical Education, deeper learning.

## BACKGROUND

With higher education being more accessible to the masses, the increased enrolment of students in classes has also created learner's diversity in terms of ability and background (1). Furthermore, the problems surrounding effective learning are compounded by the fact that every student is unique and learns in different ways. To maximize each student's learning, teachers need to be aware of different learning styles, and adjust their teaching strategies accordingly to best fit the students' needs (2).

Different technological tools have been used by medical educators at different medical institutions and they are willing to restructure their classrooms in innovative ways. Advancement in technology has shifted the teaching to learning and the pedagogy from passive to active. It has moved from didactic lectures to modern classroom teaching where students are motivated to learn and are actively involved in the learning process (3).

In undergraduate medical education, educational practices must consider the following facts: the learner is an active contributor in the learning process; learning occurs independently and in collaboration with peers; prior knowledge and previous experience form the basis of acquiring new knowledge; learning should relate to the understanding and management of real-life problems; and the need to understand that application of knowledge is crucial to the development of lifelong learning skills. Medical educators need to adapt teaching and learning approaches that promote critical thinking, problem solving, and application of learned concepts for motivating adult learners. The Accreditation Council for Graduate Medical Education "stresses the value of enhancing the quality and quantity of formal teaching, a challenging task due to increased time constraints for both trainees and faculty members." (4) This new strategy , such as the flipped classroom" (FCR), have been used in a growing number of medical educational settings.

In several studies, blended learning approaches, like the flipped classroom which utilize online technology along with instructor-led active learning strategies have shown favorable results (5). This model of classroom instruction relies primarily on student preparation outside of class to use in-class time for specific kinds of active learning activities, such as Problem Based Learning (PBL) or Team Based Learning (TBL) (6).

Use of different technological tools provides an opportunity for educators to develop sessions and courses that improve student's willingness to participate and be successful in the learning process (1, 7). Technological educational tools can enhance student engagement in the learning process, which results in meeting learning outcomes, and improves students' satisfaction (2, 8).

The concept of flipped classroom is grounded in the theories of self-regulation and socio-constructivism. In self-regulated learning theory, the learner is actively involved in the learning process, however the socio-constructivist theory focuses mainly on discussions and interaction inside class that will ultimately promote higher-order cognitive skills (9).

Flipped class approach "flips" the traditional lecture. The flipped classroom model denotes a slightly different approach to in-class active learning, where students are responsible for learning the basic concepts on their own, usually through online videos. Teachers acquire this by either using their pre-recorded lectures or use ones that are already available on the internet. Teachers may also provide a few reading resources to study before coming to the class. The class time is then best utilized in a variety of active learning activities to reinforce concepts such as using clinical scenarios and case-based discussions (10).

Instead of giving didactic lectures for knowledge acquisition followed by independent assignments/homework, the learner performs independent, self-paced didactic learning for knowledge acquisition followed by classroom-based group assignments, discussion, and/or problem-based learning. Learner-centric group discussions or problem-based learning facilitated by an educator helps create a community of learning and allows for peer-to-peer teaching, dialogue, and support (11).

This approach allows educators to optimize their time and promotes educator–student interaction (12). Flipped classroom not only encourages students to take responsibility for their own education (12) but allows a flexible environment where students can access the resource material at their own pace and in their own time. There is limited data on the effectiveness of a flipped classroom model in undergraduate medical and nursing education. The impact of this innovative teaching methodology is yet to be explored on the assessment of students' scores. The rationale for doing this research study was to do capacity building of faculty in terms of developing and conducting flipped class sessions at the Aga khan University. It is anticipated that this approach will ultimately lead to increased student engagement and will keep them motivated to learn by completing pre-readings at their home. The face-to-face sessions can be used to discuss real life case scenarios to enhance problem-solving and critical thinking skills.

## STUDY OBJECTIVES

- To train faculty members from Medical College and School of Nursing in conducting flipped classroom.
- To enable the study participants to reflect on their experiences regarding their Flipped classroom sessions conducted and attended

## METHODOLOGY

This study was conducted to train the faculty in developing flipped class sessions and to acquire student and faculty perspectives regarding their experience of attending and conducting flipped classrooms respectively. Therefore, both quantitative and qualitative date collection methods were employed to obtain in-depth information about the flipped class sessions at the Aga Khan University (Medical College and School of Nursing and Midwifery). Student Evaluation forms and focus group discussion (FGD) were used to collect the data from the study participants.

Three workshops were conducted during July 2019 to January 2020 for training faculty participants. The workshops were designed in a flip style format. Participation was voluntary. After attending the workshops, the faculty from medical college and school of nursing were approached and assisted in developing their pre-class as well as in class activities for a flipped class session (fig. 1).

Eventually, eight workshop participants voluntarily conducted either one or two flipped class sessions for their students.

The pre-class activities included PowerPoint presentations, videos on EdPuzzle https://edpuzzle.com/ along with quizzes to check students' understanding of the concept. A discussion board was created on Padlet https://padlet.com/ to engage students virtually. Students were encouraged to complete the assigned tasks before coming to the face-to-face session (F2F). The pre-class activities were followed by F2F in class activities such as clinical case-based discussions to clarify the students' misconceptions and queries. An online freely available software called "Kahoot" https://kahoot.com/ was also used by some of the facilitators during the class to check student's prior knowledge and to facilitate student's engagement during class.

Once the facilitators conducted the F2F sessions, students were asked to fill out the session evaluation forms after giving written informed consent. The self-administered questionnaire focused on four main categories such as pre-class material, preparedness for the F2F session, learning acquired during F2F session and role of flipped class in enhancing student's learning. Demographic questions consisted of general information such as program of study, year of study, and gender. The questionnaire comprised of 16 attributes which were scored on a five-point Likert scale where 1 denoted strongly disagree, 3 was neutral, and 5 meant strong agreement of

the item. The questionnaire was developed based on literature review and was validated for content before it was administered. Ethical clearance was also obtained from the Institutional Review Board. Data was analyzed by using SPSS version 20. Frequencies and percentages were reported for categorical variables and presented via graphs. Opinions among the two groups namely medical students and nursing students were assessed by Chi square & Fisher's exact tests. A p-value of less than 0.05 was considered significant. Thematic analysis was done to analyze the qualitative data.

**PATIENT AND PUBLIC INVOLVEMENT:** No patient involved

## RESULTS

A total of 442 students from Medical College and School of Nursing and Midwifery participated in the evaluation survey with a female to male ratio of 339 (76.7%): 103 (23.3%) as shown in Figure 2.

Majority of the students 354 (80.1%) were from School of Nursing and Midwifery while 88 (19.9%) were from the Medical College (Fig. 3).

As shown in table 1, both groups found the flipped class format stimulating. However, a significantly higher proportion of medical students (73%) found flipped classes more engaging and interesting than a traditional lecture as compared to the nursing students (59%) (p= 0.009). Similarly, a significantly higher proportion of medical students (73%) believed the learning objectives of both the pre-class and in class session were shared with them as compared to the 62% of nursing students who believed the same (p = 0.002).

**Table 1: Comparison of FCR evaluation by Medical and Nursing Students**

| Attributes | Scale | Total | MBBS | BSCN | p-Value |
|---|---|---|---|---|---|
| Clear instructions for the different components (non-face to face and face to face) were Provided | Disagree | 35 (8%) | 5 (6%) | 30 (9%) | 0.168 |
| | Neutral | 69 (16%) | 9 (10%) | 60 (17%) | |
| | Agree | 338 (77%) | 74 (84%) | 264 (75%) | |
| The learning objectives of pre class and in class session were provided | Disagree | 74 (17%) | 6 (7%) | 68 (19%) | 0.020* |
| | Neutral | 84 (19%) | 18 (21%) | 66 (19%) | |
| | Agree | 284 (64%) | 64 (73%) | 220 (62%) | |
| The Pre-reading material provided in non-face to face session helped to prepare for discussion in F2F session | Disagree | 21 (5%) | 4 (5%) | 17 (5%) | 0.956 |
| | Neutral | 54 (12%) | 10 (11%) | 44 (12%) | |
| | Agree | 367 (83%) | 74 (84%) | 293 (83%) | |
| Sufficient time was provided before F2F session to gain basic knowledge of the topic being discussed | Disagree | 40 (9%) | 8 (9%) | 32 (9%) | 0.222 |
| | Neutral | 72 (16%) | 9 (10%) | 63 (18%) | |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |
| Flipped class format helped student's ability to find the information using internet/ library | Disagree | 45 (10%) | 6 (7%) | 39 (11%) | 0.499 |
| | Neutral | 90 (20%) | 18 (21%) | 72 (20%) | |
| | Agree | 307 (70%) | 64 (73%) | 243 (69%) | |
| Flipped class format helped students to activate prior knowledge | Disagree | 44 (10%) | 6 (7%) | 38 (11%) | 0.062 |
| | Neutral | 81 (18%) | 10 (11%) | 71 (20%) | |
| | Agree | 317 (72%) | 72 (82%) | 245 (69%) | |
| Flipped class format enabled learner to establish a concrete action plan to achieve their learning goals | Disagree | 52 (12%) | 5 (6%) | 47 (13%) | 0.036* |
| | Neutral | 102 (23%) | 16 (18%) | 86 (24%) | |
| | Agree | 288 (65%) | 67 (76%) | 221 (62%) | |
| Flipped class format encouraged students to actively participate in the learning process. | Disagree | 30 (7%) | 5 (6%) | 25 (7%) | 0.360 |
| | Neutral | 81 (18%) | 12 (14%) | 69 (20%) | |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |

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| Flipped class format promote students to take responsibility of their own learning | Disagree | 35 (8%) | 8 (9%) | 27 (8%) | 0.881 |
| | Neutral | 85 (19%) | 16 (18%) | 69 (20%) | |
| | Agree | 322 (73%) | 64 (73%) | 258 (73%) | |
| The flipped class format was more engaging and interesting than a traditional lecture | Disagree | 77 (17%) | 6 (7%) | 71 (20%) | 0.009 |
| | Neutral | 94 (21%) | 18 (21%) | 76 (22%) | |
| | Agree | 271 (61%) | 64 (73%) * | 207 (59%) | |
| Flipped class format helped students to apply theoretical knowledge into clinical practice | Disagree | 55 (12%) | 7 (8%) | 48 (14%) | 0.030* |
| | Neutral | 104 (24%) | 14 (16%) | 90 (25%) | |
| | Agree | 283 (64%) | 67 (76%) * | 216 (61%) | |
| Discussion during the F2F session-built student's confidence to speak | Disagree | 17 (4%) | 5 (6%) | 12 (3%) | 0.049* |
| | Neutral | 72 (16%) | 21 (24%) * | 51 (14%) | |
| | Agree | 353 (80%) | 62 (71%) | 291 (82%) * | |
| Face to face sessions helped students to develop critical reasoning skills | Disagree | 19 (4%) | 4 (5%) | 15 (4%) | 0.979 |
| | Neutral | 78 (18%) | 16 (18%) | 62 (18%) | |
| | Agree | 345 (78%) | 68 (77%) | 277 (78%) | |
| The role of facilitator in the F2F session was useful | Disagree | 16 (4%) | 6 (7%) | 10 (3%) | 0.187 |
| | Neutral | 47 (11%) | 10 (11%) | 37 (11%) | |
| | Agree | 379 (86%) | 72 (82%) | 307 (87%) | |
| Time allotted for the F2F session was adequate | Disagree | 27 (6%) | 3 (3%) | 24 (7%) | 0.342 |
| | Neutral | 61 (14%) | 10 (11%) | 51 (14%) | |
| | Agree | 354 (80%) | 75 (85%) | 279 (79%) | |
| More Flip class sessions should be organized in future | Disagree | 78 (18%) | 6 (7%) | 72 (20%) * | 0.000 |
| | Neutral | 95 (22%) | 12 (14%) | 83 (23%) * | |
| | Agree | 269 (61%) | 70 (80%) * | 199 (56%) | |

***Significant at P value <0.05 by using Chi square/ Fisher Exact test**

A significantly higher proportion of medical students (76%) as compared to nursing (61%) found the flipped class to be useful for application of theoretical knowledge into clinical practice (p = 0.030). A greater proportion of medical students (76%) believed flipped class helped them to establish a plan for achieving their goals as compared to nursing students (62%) (p value= 0.036).

In addition, a higher proportion of nursing students (82 %), compared to medical (71%) students found the class discussion as a useful tool to enhance oral communication skills (p= 0.049). Greater percentage (82%) of medical students agreed that flipped class format activated prior knowledge as compared to nursing students (69%), however the difference was not statistically significant. A significantly higher proportion (80%) of students in the medical program agreed to have more flipped class sessions in future versus 56% of nursing students ($p \leq 0.001$). 82% of medical students versus 69% nursing students believed that flipped class sessions helped them to activate their prior knowledge although the results were not statistically significant (p = 0.062).

Regarding student's engagement, a significantly higher proportion of medical students (73%) versus 59% of nursing students agreed that the flipped class format was more engaging and interesting than a traditional lecture (p value =0.009).

**Qualitative Data analysis:**

Data from the FGD was analyzed through content analysis. Three coders were identified who independently reviewed the transcriptions and gave codes to each statement. From these derived codes, subthemes were generated which were further clustered and grouped together to form the following four themes.

**Student engagement**

Almost all the facilitators agreed that flipped classroom strategy allowed their students to be more involved and engaged in the learning process. The students were more enthusiastic to learn, and they appreciated the use of flipped classroom methods for teaching of important concepts. One of the facilitators cited that *"there was a new energy and spark in my class"*. Hence, it was found that in almost all the FCR sessions, the student's involvement was improved, and their attention span was considerably increased.

**Capacity building of faculty**

Majority of the facilitators agreed that the technological tools such as edpuzzle, kahoot etc. that were used in flipped Classroom were new modalities for them which they had not used before. Hence, working on their sessions to convert them into FCR gave them an opportunity to learn newer techniques and expand their horizons of teaching. One facilitator stated that *"it was a self-Learning experience for the faculty and teachers as well"*. They believed that the use of flipped classrooms as a teaching strategy was a bit challenging experience, but that helped them to learn new and innovative ways of teaching and became more comfortable with using different innovations to enhance their teaching skills.

**Traditional versus Innovative Teaching**

There were mixed views about offering traditional versus innovative teaching. Some of the facilitators agreed that this was a way better method of teaching the important concepts as it required more effort and active learning on the student's end, hence increasing their understanding of the basic concepts. One facilitator commented "*I could see that students actually took charge of learning that particular topic even before coming to class, and that was the best thing*". One of the facilitators shared that the students preferred traditional methods

instead of new innovative methods. Another facilitator shared students' views "*no, we don't want this; we need a lecture method"*.

**Challenges encountered in conducting FCR**

Time constraint was the biggest challenge reported by some of the faculty members. Flipping a concept and designing it into a flipped classroom takes a lot of time and commitment, especially when it is being done for the very first time. One of the facilitators commented that *"the teachers need to really work hard and give time for the preparation of class*" another said: *"Being a clinical faculty, it is very difficult to find time. This required an additional one to two weeks, to look for videos and kahoot and other resources as pre-reading, which is difficult"*.

Another major challenge the facilitator faced while conducting FCR session was that the students did not come prepared for the session. One of the facilitators commented: *"I think continuing with your plan and sticking with what you are going to teach the students is the main challenge"*.

## DISCUSSION

The term "flipped classroom" was created by Jonathan Bergmann and Aaron Sams, two high school chemistry teachers from Colorado, USA, in 2012 (12). Although the perceptions of undergraduate students towards flipped classrooms have been gathered but specifically, a comparison of medical and nursing students' perceptions is lacking from literature. The remarkable comments gathered after conducting the flipped teaching session was that the FCR is an effective mode of delivering the content than the conventional didactic teaching. Like our findings, a study conducted at another health sciences university in Pakistan used a similar approach to teach medical students during a clinical rotation, reported that students found FCR as a better mode of teaching in their setup as well (13). Similarly, this model was preferred by

participants of a flipped continued medical education (CME) classroom (14). Students believed that FCR method was more stimulating and engaging compared to the traditional instructional approach.

Students were completely aware of the learning objectives, and it really helped them to formulate their learning goals. It helped clarify any misconceptions and ample time was also provided to students during the F2F session to clarify any misconceptions with the facilitator (15). They also found it encouraging that they can apply their knowledge into clinical practice. As for the objectives of the session and the reading resources were provided well in advance, the students were able to acquire new knowledge and activate prior knowledge via case-based discussion held during the F2F session.

In addition to that, students also reported that their communication skills were also improved. Student's comments clearly articulate that this format activated their prior knowledge. The key to success of this teaching approach was that students took responsibility for their own learning. Provision of opportunity to interact with their peers increased, the availability of reading resources and opportunity to access the learning resources and do revisions as many times as required could be improved. Student's learning atmosphere is a combination of social, physical, and psychosocial components. Applying techniques that boost the learning environment in classroom teaching enables learners to progressively understand the topic especially in undergraduate curriculum (16).

The major challenge identified by the facilitators was to invest additional time to identify material for students and generate thought provoking scenarios for case-based discussion. Creating a discussion board on Padlet, uploading videos on EdPuzzle or using freely available

such as Kahoot during F2F sessions to assess their prior knowledge was totally a new experience for facilitators. Majority were unfamiliar with this new technological tool to engage students prior as well as during the class. However, capacity building through conducting workshops and later one-on-one training helped them to create and identify relevant resources. The flipped classroom approach is widely used in many disciplines of learning and education globally (17). The results of the study show that flipped classroom is an effective pedagogy for both students and faculty at our institution. The ability to apply knowledge, develop confidence and engage in the learning process are some of the benefits that students appreciated in the flipped class format.

It was well received by both the entities, however there were significant differences in their perceptions in a few areas. We compared the responses received from medical college and school of nursing students. Medical college students found flipped class format more helpful for application of theoretical concepts into clinical practice as compared to the nursing students.

Similarly, in a comparative study of traditional versus flipped classroom, authors found that the activities developed for flipped classroom challenged students and provided them opportunity to apply their higher-order skills and to come up with practical solutions (18).

Although students from both the entities are useful to establish a concrete action plan in achieving their learning goals, we saw a significantly higher percentage of medical students as compared to nursing students who found this approach useful. It has been widely observed that students find the flipped classroom approach a better option in terms of fulfilling the learning objectives than the conventional didactic teaching (17).

Students from both the groups appreciated the flipped style teaching and agreed that more flipped sessions should be organized in future. Since the introduction of flipped class modality, students

have widely appreciated the value of flipped class sessions and have said that there should be more FCR sessions on other topics (18). Flipped class sessions have also helped students build confidence to speak and take part in discussions. Verbal communication is essential for success. Literature supports flipped class sessions to improve communication skills of students both inside and out of class (20).

Our students found the flipped class format more engaging and interesting than a traditional lecture. Literature also supports role of Flipped classroom in promoting a positive learning experience for students' (21), In another study by Zainuddin et al, a comparison of flipped class with traditional teaching concluded that flipped classroom was more engaging than traditional classroom and majority of the students had appreciated this methodology of teaching and learning (20).

Faculty has found it demanding in terms of time and effort (19). The facilitators of this study felt that providing ample material to students and generating thought provoking scenarios for in-class sessions was challenging (1).

## CONCLUSION

Study results concluded that the flipped classroom approach was perceived as more engaging and stimulating than the traditional mode of delivering the content via lectures. Case-based discussions during flipped classrooms were found to be helpful in developing students' communication skills and were also effective in application of theoretical knowledge into real clinical settings by promoting critical thinking, clinical reasoning, and collaborative learning. We recommend that training workshops on how to design and conduct flipped classrooms should be conducted. It was highly recommended by the medical students to conduct more flipped class

sessions in future for which there is a need to do more faculty development workshops on flipped classroom.

## DECLARATIONS

**Ethics approval and consent to participate:** This study was conducted after obtaining an approval from the Ethical Review Committee at the Aga Khan University, Karachi, Pakistan. The reference number generated for the ERC application is 2019-0999-2767**.** An informed consent was obtained from all the faculty and student participants prior to collecting any participant data, feedback, and evaluation.

**Consent for publication:** Not applicable

**Availability of data and materials:** Not applicable

**Competing Interests:** None to declare

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The funders did not have any role in the study design, collection, analysis and interpretation of data, in the writing of report, and in the decision to submit the manuscript for publication. The researchers were completely independent from funders and all authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

**Authors' contributions**

Dr Amber Sultan was the principal investigator of this research study. She facilitated three workshops on flipped classroom and contributed in the write up of the study, reviewed the manuscript. Dr Rahila Ali facilitated three workshops on flipped classroom, contributed in the write up of the study, reviewed the manuscript. Dr Nida Zahid analyzed and reviewed the data, reviewed the final manuscript. Dr Mehdia Nadeem Rajab Ali reviewed the Manuscript, formatted the write up as per guidelines of the journal, contributed to the submission of the manuscript along with other required documents. Rozmeen Akber conducted FGD and contributed in the write up of the qualitative section. Dr Sadia Fatima conducted Workshops and reviewed the manuscript. Dr Kulsoom Ghias conducted Workshops and reviewed the manuscript. Dr Russell Martins transcribed Focus Group Discussion (Interview). Dr Muhammad Tariq reviewed the Manuscript and Dr Khairulnissa Ajani provided support for faculty participation from School of Nursing & reviewed the manuscript.

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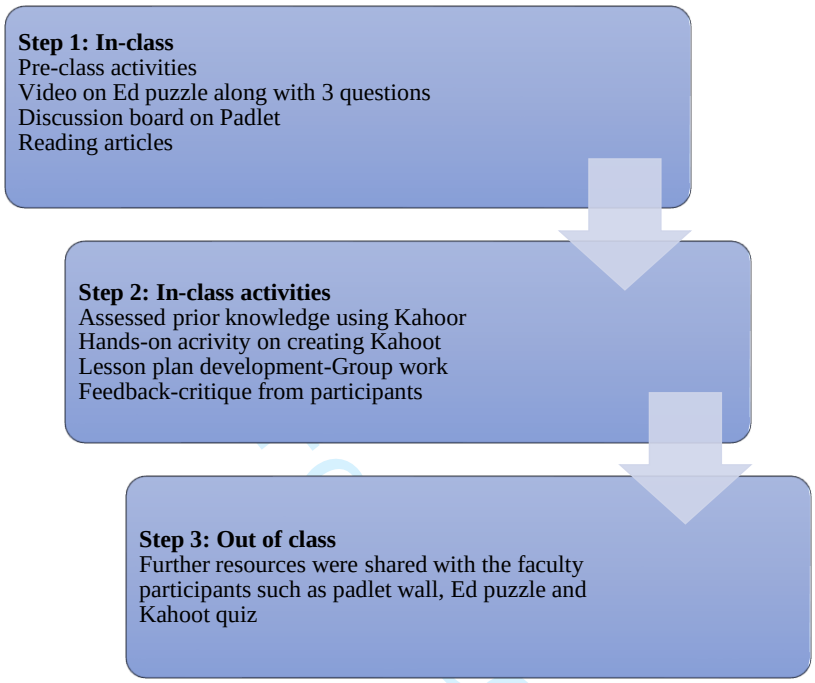



**Figure 1. Workshop for faculty participants "Engaging millenials through flipped classroom"**

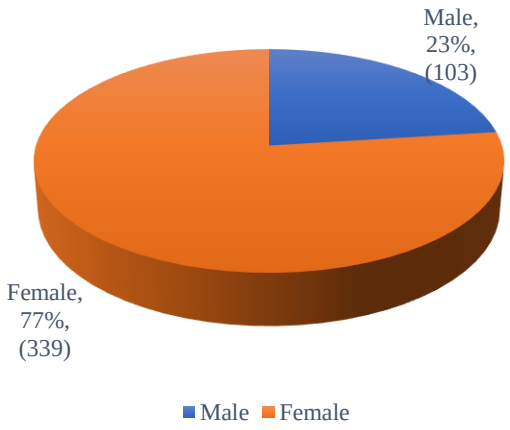
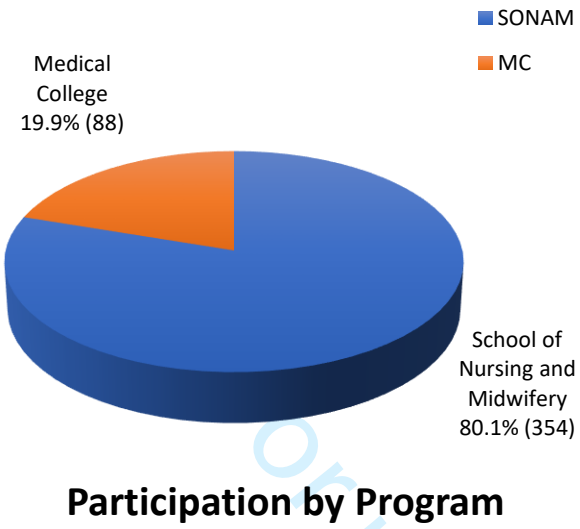



**Figure 2. Distribution of student participants in Flipped Classroom evaluation surveys by gender**



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 1 |
| | | | |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 3 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 5-7 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 8 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 8-9 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 8-9 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 9 |
| Bias | 9 | Describe any efforts to address potential sources of bias | N/A |
| Study size | 10 | Explain how the study size was arrived at | N/A |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8-9 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 9 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 9 |
| | | (*c*) Explain how missing data were addressed | 9 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | N/A |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | N/A |
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 10 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 10-15 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11-13 |
| | | (*b*) Report category boundaries when continuous variables were categorized | N/A |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | N/A |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 16 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 17 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 16-17 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 18 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 20 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

# Experiences of Undergraduate Medical, Nursing students and Faculty regarding Flipped Classroom from a Medical University in Pakistan: A Mixed Method Study.

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# Experiences of Undergraduate Medical, Nursing Students and Faculty regarding Flipped Classroom from a Medical University in Pakistan: A Mixed Method Study.

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**Transparency Declaration:**

I, Amber Sultan affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

## ABSTRACT

The 'flipped classroom' is a teaching pedagogy where students are actively involved in the learning process. It reduces passivity, enables students to become active learners through reasoning and concept application, and facilitates student interaction with their peers and instructors. This instructional approach enhances retention and decreases distraction by engaging students.

**Objectives**: The purpose of this study was to train the faculty of the medical college and school of nursing in developing flipped classrooms (FCR) as an innovative teaching and learning strategy, to facilitate them in conducting flipped sessions for their students and to explore the experiences of medical, nursing students along with faculty members regarding the flipped classroom they had attended and conducted.

**Setting**: Private Medical College

**Participants**: A total of 442 students from Medical College and School of Nursing and Midwifery participated in the evaluation survey with a female to male ratio of 339: Faculty members who attended and facilitated the flipped class session were invited to participate in the focus group discussion. Students who attended the flipped class sessions were included in the study sample. Students who did not complete the forms were excluded from the study.

**Results**: Both medical and nursing students found FCR format stimulating. A significantly higher proportion of medical students (73%) found the FCR more engaging and interesting than a traditional lecture as compared to nursing students (59%) (p= 0.009). Similarly, 73 % of medical students believed the learning objectives of both the non-face-to-face (NF2F) and face-to-face (F2F) sessions were shared with them as compared to the 62% of nursing students who believed the same (p=0.002). A significantly higher proportion of medical (76%) versus nursing (61%)

students found the FCR format more useful for application of their theoretical knowledge into clinical practice (p=0.030).

**Conclusion:** Students found the flipped classroom (FCR) more engaging and interesting in terms of applying theoretical knowledge into practice. Similarly, faculty found this strategy as effective but challenging in terms of involving and engaging students in the learning process. It is recommended to conduct more FCR sessions for an interactive and student-centered learning, but proper planning of the session and using variety of technological tools to engage learners is a key to success.

**STRENGTHS AND LIMITATIONS**:

1. This is a mixed methods study and was the first capacity-building teacher training study conducted across two health professions faculty.
2. Faculty development workshops were conducted to train faculty on how to conduct Flipped classroom
3. In a Single-center study with those interested flipped classroom teaching format are more likely to participate which may create a response bias.
4. Only the clinical faculty were trained and conducted sessions in clinical years so the results cannot be generalized for faculty from Basic sciences.

**KEYWORDS** Technology enhanced learning, Flipped Classroom, active learning, student engagement, Medical Education, deeper learning.

## BACKGROUND

With higher education being more accessible to the masses, the increased enrolment of students in classes has also created learner's diversity in terms of ability and background (1). Furthermore, the problems surrounding effective learning are compounded by the fact that every student is unique and learns in different ways. To maximize each student's learning, teachers need to be aware of different learning styles, and adjust their teaching strategies accordingly to best fit the students' needs (2).

Different technological tools have been used by medical educators at different medical institutions and they are willing to restructure their classrooms in innovative ways. Advancement in technology has shifted the teaching to learning and the pedagogy from passive to active. It has moved from didactic lectures to modern classroom teaching where students are motivated to learn and are actively involved in the learning process (3).

In undergraduate medical education, educational practices must consider the following facts: the learner is an active contributor in the learning process; learning occurs independently and in collaboration with peers; prior knowledge and previous experience form the basis of acquiring new knowledge; learning should relate to the understanding and management of real-life problems; and the need to understand that application of knowledge is crucial to the development of lifelong learning skills. Medical educators need to adapt teaching and learning approaches that promote critical thinking, problem solving, and application of learned concepts for motivating adult learners. The Accreditation Council for Graduate Medical Education "stresses the value of enhancing the quality and quantity of formal teaching, a challenging task due to increased time constraints for both trainees and faculty members." (4) This new strategy , such as the flipped classroom" (FCR), have been used in a growing number of medical educational settings.

In several studies, blended learning approaches, like the flipped classroom which utilize online technology along with instructor-led active learning strategies have shown favorable results (5). This model of classroom instruction relies primarily on student preparation outside of class to use in-class time for specific kinds of active learning activities, such as Problem Based Learning (PBL) or Team Based Learning (TBL) (6).

Use of different technological tools provides an opportunity for educators to develop sessions and courses that improve student's willingness to participate and be successful in the learning process (1, 7). Technological educational tools can enhance student engagement in the learning process, which results in meeting learning outcomes, and improves students' satisfaction (2, 8).

The concept of flipped classroom is grounded in the theories of self-regulation and socio-constructivism. In self-regulated learning theory, the learner is actively involved in the learning process, however the socio-constructivist theory focuses mainly on discussions and interaction inside class that will ultimately promote higher-order cognitive skills (9).

Flipped class approach "flips" the traditional lecture. The flipped classroom model denotes a slightly different approach to in-class active learning, where students are responsible for learning the basic concepts on their own, usually through online videos. Teachers acquire this by either using their pre-recorded lectures or use ones that are already available on the internet. Teachers may also provide a few reading resources to study before coming to the class. The class time is then best utilized in a variety of active learning activities to reinforce concepts such as using clinical scenarios and case-based discussions (10).

Instead of giving didactic lectures for knowledge acquisition followed by independent assignments/homework, the learner performs independent, self-paced didactic learning for

knowledge acquisition followed by classroom-based group assignments, discussion, and/or problem-based learning. Learner-centric group discussions or problem-based learning facilitated by an educator helps create a community of learning and allows for peer-to-peer teaching, dialogue, and support (11).

This approach allows educators to optimize their time and promotes educator–student interaction (12). Flipped classroom not only encourages students to take responsibility for their own education (12) but allows a flexible environment where students can access the resource material at their own pace and in their own time. There is limited data on the effectiveness of a flipped classroom model in undergraduate medical and nursing education. The impact of this innovative teaching methodology is yet to be explored on the assessment of students' scores. The rationale for doing this research study was to do capacity building of faculty in terms of developing and conducting flipped class sessions at the Aga khan University. It is anticipated that this approach will ultimately lead to increased student engagement and will keep them motivated to learn by completing pre-readings at their home. The face-to-face sessions can be used to discuss real life case scenarios to enhance problem-solving and critical thinking skills.

## STUDY OBJECTIVES

- To train faculty members from Medical College and School of Nursing in conducting flipped classroom.
- To enable the study participants to reflect on their experiences regarding their Flipped classroom sessions conducted and attended

## METHODOLOGY

This study was conducted to train the faculty in developing flipped class sessions and to acquire student and faculty perspectives regarding their experience of attending and conducting flipped classrooms respectively. Therefore, both quantitative and qualitative date collection methods were employed to obtain in-depth information about the flipped class sessions at the Aga Khan University (Medical College and School of Nursing and Midwifery). Student Evaluation forms and focus group discussion (FGD) were used to collect the data from the study participants. Three workshops were conducted during July 2019 to January 2020 for training faculty participants. Thirty-two faculty members attended the faculty development workshop on Flipped classroom. The three workshops were designed in a flip style format. Facilitation of flipped class session and later participation in the FGD as part of the research project was voluntary. Five faculty members from Nursing and four faculty members from medical college conducted their session based on Flip style format session for their students and later participated in the focus group discussion. After attending the workshops, the faculty from medical college and school of nursing were approached and assisted in developing their pre-class as well as in-class activities for a flipped class session (fig. 1). Nine sessions

The pre-class activities included PowerPoint presentations, videos on EdPuzzle https://edpuzzle.com/ along with quizzes to check students' understanding of the concept. A discussion board was created on Padlet https://padlet.com/ to engage students virtually. Students were encouraged to complete the assigned tasks before coming to the face-to-face session (F2F). The pre-class activities were followed by F2F in class activities such as clinical case-based discussions to clarify the students' misconceptions and queries. An online freely available software called "Kahoot" https://kahoot.com/ was also used by some of the facilitators during the class to check student's prior knowledge and to facilitate student's engagement during class.

Once the facilitators conducted the F2F sessions, students were asked to fill out the session evaluation forms after giving written informed consent. The self-administered questionnaire focused on four main categories such as pre-class material, preparedness for the F2F session, learning acquired during F2F session and role of flipped class in enhancing student's learning. Demographic questions consisted of general information such as program of study, year of study, and gender. The questionnaire comprised of 16 attributes which were scored on a five-point Likert scale where 1 denoted strongly disagree, 3 was neutral, and 5 meant strong agreement of the item. The questionnaire was developed based on literature review and was validated for content before it was administered. The newly developed evaluation form was validated by two medical educationist along with two faculty members from Basic sciences who are involved in Undergraduate Curriculum Design and has expertise in teaching and learning. Ethical clearance was also obtained from the Institutional Review Board. Data was analyzed by using SPSS version 20. Frequencies and percentages were reported for categorical variables and presented via graphs. Opinions among the two groups namely medical students and nursing students were assessed by Chi square & Fisher's exact tests. A p-value of less than 0.05 was considered significant. Thematic analysis was done to analyze the qualitative data.

**PATIENT AND PUBLIC INVOLVEMENT:** No patient involved

## RESULTS

The total number of study participants is (n=442, 100%) with a female to male ratio of (n= 339, 76%): (n= 103, 23.3%) comprising of medical (n= 88, 20%) and nursing (n=354, 80%) students. as shown in figure 2 and figure 3.

As shown in table 1, both groups found the flipped class format stimulating. However, a significantly higher proportion of medical students (73%) found flipped classes more engaging and interesting than a traditional lecture as compared to the nursing students (59%) (p= 0.009). Similarly, a significantly higher proportion of medical students (73%) believed the learning objectives of both the pre-class and in class session were shared with them as compared to the 62% of nursing students who believed the same (p = 0.002).

**Table 1: Comparison of FCR evaluation by Medical and Nursing Students**

| Attributes | Scale | Total | MBBS | BSCN | p-Value |
|---|---|---|---|---|---|
| Clear instructions for the different components (non-face to face and face to face) were Provided | Disagree | 35 (8%) | 5 (6%) | 30 (9%) | 0.168 |
| | Neutral | 69 (16%) | 9 (10%) | 60 (17%) | |
| | Agree | 338 (77%) | 74 (84%) | 264 (75%) | |
| The learning objectives of pre class and in class session were provided | Disagree | 74 (17%) | 6 (7%) | 68 (19%) | 0.020* |
| | Neutral | 84 (19%) | 18 (21%) | 66 (19%) | |
| | Agree | 284 (64%) | 64 (73%) | 220 (62%) | |
| The Pre-reading material provided in non-face to face session helped to prepare for discussion in face-to-face session | Disagree | 21 (5%) | 4 (5%) | 17 (5%) | 0.956 |
| | Neutral | 54 (12%) | 10 (11%) | 44 (12%) | |
| | Agree | 367 (83%) | 74 (84%) | 293 (83%) | |
| Sufficient time was provided before face-to-face session to gain basic knowledge of the topic being discussed | Disagree | 40 (9%) | 8 (9%) | 32 (9%) | 0.222 |
| | Neutral | 72 (16%) | 9 (10%) | 63 (18%) | |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |
| Flipped class format helped student's ability to find the information using internet/ library | Disagree | 45 (10%) | 6 (7%) | 39 (11%) | 0.499 |
| | Neutral | 90 (20%) | 18 (21%) | 72 (20%) | |
| | Agree | 307 (70%) | 64 (73%) | 243 (69%) | |
| Flipped class format helped | Disagree | 44 (10%) | 6 (7%) | 38 (11%) | |

| | | | | | |
|---|---|---|---|---|---|
| students to activate prior knowledge | Neutral | 81 (18%) | 10 (11%) | 71 (20%) | 0.062 |
| | Agree | 317 (72%) | 72 (82%) | 245 (69%) | |
| Flipped class format enabled learner to establish a concrete action plan to achieve their learning goals | Disagree | 52 (12%) | 5 (6%) | 47 (13%) | |
| | Neutral | 102 (23%) | 16 (18%) | 86 (24%) | |
| | Agree | 288 (65%) | 67 (76%) | 221 (62%) | 0.036* |
| Flipped class format encouraged students to actively participate in the learning process. | Disagree | 30 (7%) | 5 (6%) | 25 (7%) | |
| | Neutral | 81 (18%) | 12 (14%) | 69 (20%) | 0.360 |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |
| Flipped class format promote students to take responsibility of their own learning | Disagree | 35 (8%) | 8 (9%) | 27 (8%) | |
| | Neutral | 85 (19%) | 16 (18%) | 69 (20%) | 0.881 |
| | Agree | 322 (73%) | 64 (73%) | 258 (73%) | |
| The flipped class format was more engaging and interesting than a traditional lecture | Disagree | 77 (17%) | 6 (7%) | 71 (20%) | |
| | Neutral | 94 (21%) | 18 (21%) | 76 (22%) | 0.009* |
| | Agree | 271 (61%) | 64 (73%) | 207 (59%) | |
| Flipped class format helped students to apply theoretical knowledge into clinical practice | Disagree | 55 (12%) | 7 (8%) | 48 (14%) | |
| | Neutral | 104 (24%) | 14 (16%) | 90 (25%) | 0.030* |
| | Agree | 283 (64%) | 67 (76%) | 216 (61%) | |
| Discussion during the face-to-face session-built student's confidence to speak | Disagree | 17 (4%) | 5 (6%) | 12 (3%) | |
| | Neutral | 72 (16%) | 21 (24%) | 51 (14%) | 0.049* |
| | Agree | 353 (80%) | 62 (71%) | 291 (82%) | |
| Face to face sessions helped students to develop critical reasoning skills | Disagree | 19 (4%) | 4 (5%) | 15 (4%) | |
| | Neutral | 78 (18%) | 16 (18%) | 62 (18%) | 0.979 |
| | Agree | 345 (78%) | 68 (77%) | 277 (78%) | |
| The role of facilitator in the face-to-face session of the flipped | Disagree | 16 (4%) | 6 (7%) | 10 (3%) | 0.187 |
| | Neutral | 47 (11%) | 10 (11%) | 37 (11%) | |

| | | | | | |
|---|---|---|---|---|---|
| classroom was useful | Agree | 379 (86%) | 72 (82%) | 307 (87%) | |
| Time allotted for the face-to-face session of the FCR session was adequate | Disagree | 27 (6%) | 3 (3%) | 24 (7%) | 0.342 |
| | Neutral | 61 (14%) | 10 (11%) | 51 (14%) | |
| | Agree | 354 (80%) | 75 (85%) | 279 (79%) | |
| More Flip class sessions should be organized in future | Disagree | 78 (18%) | 6 (7%) | 72 (20%) | 0.000* |
| | Neutral | 95 (22%) | 12 (14%) | 83 (23%) | |
| | Agree | 269 (61%) | 70 (80%) | 199 (56%) | |

***Significant at P value <0.05 by using Chi square/ Fisher Exact test**

A significantly higher proportion of medical students (76%) as compared to nursing (61%) found the flipped class to be useful for application of theoretical knowledge into clinical practice (p = 0.030). A greater proportion of medical students (76%) believed flipped class helped them to establish a plan for achieving their goals as compared to nursing students (62%) (p value= 0.036).

In addition, a higher proportion of nursing students (82 %), compared to medical (71%) students found the class discussion as a useful tool to enhance oral communication skills (p= 0.049). Greater percentage (82%) of medical students agreed that flipped class format activated prior knowledge as compared to nursing students (69%), however the difference was not statistically significant. A significantly higher proportion (80%) of students in the medical program agreed to have more flipped class sessions in future versus 56% of nursing students (p≤ 0.001). Whereas (20%) and (23%) nursing students opposed or gave neutral response regarding more Flipped class sessions should be scheduled in future.

82% of medical students versus 69% nursing students believed that flipped class sessions helped them to activate their prior knowledge although the results were not statistically significant (p = 0.062).

Regarding student's engagement, a significantly higher proportion of medical students (73%) versus 59% of nursing students agreed that the flipped class format was more engaging and interesting than a traditional lecture (p value =0.009). Regarding learning objectives were provided, a higher proportion of nursing students (19%) disagreed as compared to medical students (7%). However the difference was not statistically significant. Similarly, a higher proportion of students from school of nursing (24%) neither agreed nor disagreed regarding flipped class format enabled learner to establish a concrete action plan for achieving the desired learning goals as compared to (18%) medical students. Students from both the entities (18%) neither agreed nor disagreed regarding the development of critical reasoning skills via F2F session.

**Qualitative Data analysis:**

Data from the FGD was analyzed through content analysis. Three coders were identified who independently reviewed the transcriptions and gave codes to each statement. From these derived codes, subthemes were generated which were further clustered and grouped together to form the following four themes.

**Student engagement**

Almost all the facilitators agreed that flipped classroom strategy allowed their students to be more involved and engaged in the learning process. The students were more enthusiastic to learn, and they appreciated the use of flipped classroom methods for teaching of important concepts. One of the facilitators cited that *"there was a new energy and spark in my class"*. Hence, it was found

that in almost all the FCR sessions, the student's involvement was improved, and their attention span was considerably increased.

**Capacity building of faculty**

Majority of the facilitators agreed that the technological tools such as edpuzzle, kahoot etc. that were used in flipped Classroom were new modalities for them which they had not used before. Hence, working on their sessions to convert them into FCR gave them an opportunity to learn newer techniques and expand their horizons of teaching. One facilitator stated that *"it was a self-Learning experience for the faculty and teachers as well".* They believed that the use of flipped classrooms as a teaching strategy was a bit challenging experience, but that helped them to learn new and innovative ways of teaching and became more comfortable with using different innovations to enhance their teaching skills.

**Traditional versus Innovative Teaching**

There were mixed views about offering traditional versus innovative teaching. Some of the facilitators agreed that this was a way better method of teaching the important concepts as it required more effort and active learning on the student's end, hence increasing their understanding of the basic concepts. One facilitator commented "*I could see that students actually took charge of learning that particular topic even before coming to class, and that was the best thing*". One of the facilitators shared that the students preferred traditional methods instead of new innovative methods. Another facilitator shared students' views "*no, we don't want this; we need a lecture method".*

**Challenges encountered in conducting FCR**

Time constraint was the biggest challenge reported by some of the faculty members. Flipping a concept and designing it into a flipped classroom takes a lot of time and commitment, especially when it is being done for the very first time. One of the facilitators commented that *"the teachers need to really work hard and give time for the preparation of class*" another said: *"Being a clinical faculty, it is very difficult to find time. This required an additional one to two weeks, to look for videos and kahoot and other resources as pre-reading, which is difficult"*.

Another major challenge the facilitator faced while conducting FCR session was that the students did not come prepared for the session. One of the facilitators commented: *"I think continuing with your plan and sticking with what you are going to teach the students is the main challenge"*.

## DISCUSSION

The term "flipped classroom" was created by Jonathan Bergmann and Aaron Sams, two high school chemistry teachers from Colorado, USA, in 2012 (12). Although the perceptions of undergraduate students towards flipped classrooms have been gathered but specifically, a comparison of medical and nursing students' perceptions is lacking from literature. The remarkable comments gathered after conducting the flipped teaching session was that the FCR is an effective mode of delivering the content than the conventional didactic teaching. Like our findings, a study conducted at another health sciences university in Pakistan used a similar approach to teach medical students during a clinical rotation, reported that students found FCR as a better mode of teaching in their setup as well (13). Similarly, this model was preferred by participants of a flipped continued medical education (CME) classroom (14). Students believed that FCR method was more stimulating and engaging compared to the traditional instructional approach.

Students were aware of the learning objectives, and it really helped them to formulate their learning goals. It helped clarify any misconceptions and ample time was also provided to students during the F2F session to clarify any misconceptions with the facilitator (15). They also found it encouraging that they can apply their knowledge into clinical practice. As for the objectives of the session and the reading resources were provided well in advance, the students were able to acquire new knowledge and activate prior knowledge via case-based discussion held during the F2F session.

In addition to that, students also reported that their communication skills were also improved. Students' comments clearly articulated that this format activated their prior knowledge. The key to success of this teaching approach was that students took responsibility for their own learning. Provision of opportunity to interact with their peers increased, the availability of reading resources and opportunity to access the learning resources and do revisions as many times as required could be improved. Student's learning atmosphere is a combination of social, physical, and psychosocial components. Applying techniques that boost the learning environment in classroom teaching enables learners to progressively understand the topic especially in undergraduate curriculum (16).

The major challenge identified by the facilitators was to invest additional time to identify material for students and generate thought provoking scenarios for case-based discussion. Creating a discussion board on Padlet, uploading videos on EdPuzzle or using freely available such as Kahoot during F2F sessions to assess their prior knowledge was totally a new experience for facilitators. Majority were unfamiliar with this new technological tool to engage students prior as well as during the class. However, capacity building through conducting workshops and later one-on-one training helped them to create and identify relevant resources. The flipped classroom approach is widely used in many disciplines of learning and education globally (17). The results of the study

show that flipped classroom is an effective pedagogy for both students and faculty at our institution. The ability to apply knowledge, develop confidence and engage in the learning process are some of the benefits that students appreciated in the flipped class format.

It was well received by both the entities, however there were significant differences in their perceptions in a few areas. We compared the responses received from medical college and school of nursing students. Medical college students found flipped class format more helpful for application of theoretical concepts into clinical practice as compared to the nursing students. .Similarly, in a comparative study of traditional versus flipped classroom, authors found that the activities developed for flipped classroom challenged students and provided them opportunity to apply their higher-order skills and to come up with practical solutions (18).

Although students from both the entities agreed that FC is useful to establish a concrete action plan in achieving their learning goals, we saw a significantly higher percentage of medical students as compared to nursing students who found this approach useful. Another study reported that nursing students felt "strange and uncomfortable" which indicates that innovative strategies need to be incorporated to motivate students towards this new approach.

Similarly, studies also considered FC as a useful approach to foster a learner-centered active learning environment for a health assessment course for undergraduate nursing students. However, faculty has found it demanding in terms of time and effort (19). The facilitators of this study felt that providing ample material to students and generating thought provoking scenarios for in-class sessions was challenging. Students from both the groups appreciated the flipped style teaching and agreed that more flipped sessions should be organized in future. Since the introduction of flipped

class modality, students have widely appreciated the value of flipped class sessions and have said that there should be more FCR sessions on other topics.

Similarly, A study conducted on nursing students reported that incorporating blended approach by using innovative technological tool along with interactive classroom activities can enhance students learning but not necessarily improved student satisfaction.[20]. Our study results also indicates that more medical students as compared to nursing students were in favor of implementing this strategy in future. Angadi NB also reported that seventy-six percent students were in favor of having more FC sessions in future (21). It has been widely observed that students find the flipped classroom approach a better option in terms of fulfilling the learning objectives than the conventional didactic teaching.

Students from both the groups appreciated the flipped style teaching and agreed that more flipped sessions should be organized in future. Since the introduction of flipped class modality, students have widely appreciated the value of flipped class sessions and have said that there should be more FCR sessions on other topics. Flipped classroom have also helped students build confidence to speak and take part in discussions. Verbal communication is essential for success. Literature supports flipped class sessions to improve communication skills of students both inside and out of class (22).

In another study by Zainuddin et al, a comparison of flipped class with traditional teaching concluded that flipped classroom was more engaging than traditional classroom and majority of the students had appreciated this methodology of teaching and learning (22). Our students found the flipped class format more engaging and interesting than a traditional lecture. Literature also supports role of Flipped classroom in promoting a positive learning experience for students' (23).

Other studies also highlighted the benefits of FC in terms of student's engagement both inside and outside of class, more efficient use of classroom by using problem-based scenarios (24), Another study highlighted that students valued case-based interactive discussions which were of clinical relevance to cases they would see in clinical practice (25). Previous studies also emphasized the advantages of using FC such as: the improvement of students' learning autonomy, the easier discovery of blind spots in students' learning through students' demonstration of pre-class reading, the more flexible presentation of teaching materials to encourage students' classroom participation, the encouragement of students' cooperation inside and outside the class, class time was used more effectively etc. (26). The COVID-19 epidemic has accelerated the digital transformation of teaching activities and may also be an opportunity to improve the integration of FC teaching into teaching design of medical education (27).

## CONCLUSION

Study results concluded that the flipped classroom approach was perceived as more engaging and stimulating than the traditional mode of delivering the content via lectures. Case-based discussions during flipped classrooms were found to be helpful in developing students' communication skills and were also effective in application of theoretical knowledge into real clinical settings by promoting critical thinking, clinical reasoning, and collaborative learning. We recommend that training workshops on how to design and conduct flipped classrooms should be conducted. It was highly recommended by the medical students to conduct more flipped class sessions in future for which there is a need to do more faculty development workshops on flipped classroom.

## DECLARATIONS

**Ethics approval and consent to participate:** This study was conducted after obtaining an approval from the Ethical Review Committee at the Aga Khan University, Karachi, Pakistan. The reference number generated for the ERC application is 2019-0999-2767**.** An informed consent was obtained from all the faculty and student participants prior to collecting any participant data, feedback, and evaluation.

**Consent for publication:** Not applicable

**Availability of data and materials:** Not applicable

**Competing Interests:** None to declare

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The funders did not have any role in the study design, collection, analysis and interpretation of data, in the writing of report, and in the decision to submit the manuscript for publication. The researchers were completely independent from funders and all authors, external and internal, had full access to all the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

**Authors' contributions**

Dr Amber Sultan was the principal investigator of this research study. She facilitated three workshops on flipped classroom and contributed in the write up of the study, reviewed the manuscript. Dr Rahila Ali facilitated three workshops on flipped classroom, contributed in the write up of the study, reviewed the manuscript. Dr Nida Zahid analyzed and reviewed the data, reviewed the final manuscript. Dr Mehdia Nadeem Rajab Ali reviewed the Manuscript, formatted

the write up as per guidelines of the journal, contributed to the submission of the manuscript along with other required documents. Rozmeen Akber conducted FGD and contributed in the write up of the qualitative section. Dr Sadia Fatima conducted Workshops and reviewed the manuscript. Dr Kulsoom Ghias conducted Workshops and reviewed the manuscript. Dr Russell Martins transcribed Focus Group Discussion (Interview). Dr Muhammad Tariq reviewed the Manuscript and Dr Khairulnissa Ajani provided support for faculty participation from School of Nursing & reviewed the manuscript.

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**Figures Caption**

Figure 1. Workshop for faculty participants "Engaging millennials through flipped classroom"

Figure 2. Distribution of student participants in Flipped Classroom evaluation surveys by gender

Figure 3. Figure 3: Participation by Program

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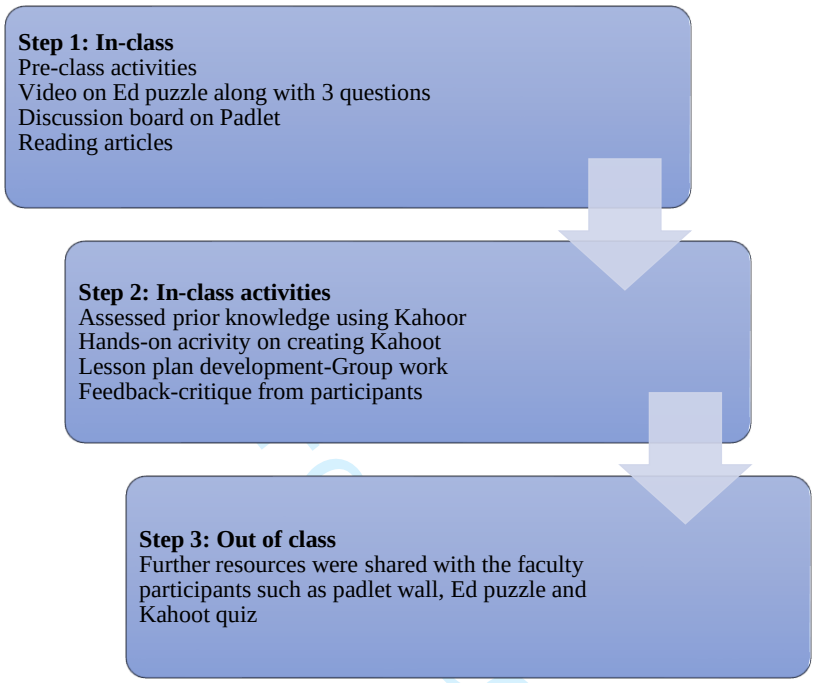


**Figure 1. Workshop for faculty participants "Engaging millenials through flipped classroom"**

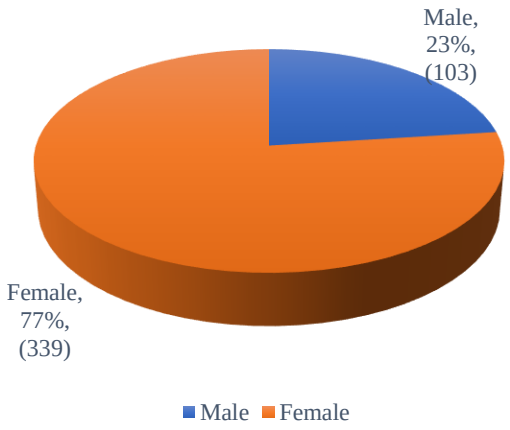


**Figure 2. Distribution of student participants in Flipped Classroom evaluation surveys by gender**

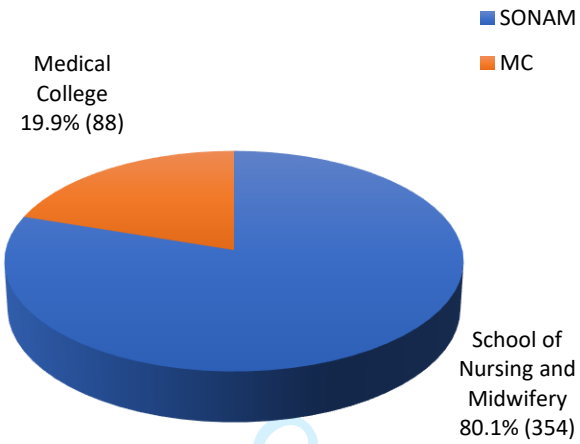


**Figure 3: Participation by Program**

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 1 |
| | | | |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 3 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 5-7 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 8 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 8-9 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 8-9 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 9 |
| Bias | 9 | Describe any efforts to address potential sources of bias | N/A |
| Study size | 10 | Explain how the study size was arrived at | N/A |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8-9 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 9 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 9 |
| | | (*c*) Explain how missing data were addressed | 9 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | N/A |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | N/A |
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 10 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 10-15 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11-13 |
| | | (*b*) Report category boundaries when continuous variables were categorized | N/A |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | N/A |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 16 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 17 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 16-17 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 18 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 20 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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# Experiences of Undergraduate Medical, Nursing students and Faculty regarding Flipped Classroom: A Mixed Method Study at Medical University in Pakistan.

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# Experiences of Undergraduate Medical, Nursing Students and Faculty regarding Flipped Classroom: A Mixed Method Study at Medical University in Pakistan

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I, Amber Sultan affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

## ABSTRACT

The 'flipped classroom' is a teaching pedagogy where students are actively involved in the learning process. It reduces passivity, enables students to become active learners through reasoning and concept application, and facilitates student interaction with their peers and instructors. This instructional approach enhances retention and decreases distraction by engaging students.

**Objectives**: The purpose of this study was to train the faculty of the medical college and school of nursing in developing flipped classrooms (FCR) as an innovative teaching and learning strategy, to facilitate them in conducting flipped sessions for their students and to explore the experiences of medical, nursing students along with faculty members regarding the flipped classroom they had attended and conducted.

**Setting**: Private Medical College

**Participants**:

A total of 442 students from Medical College and School of Nursing and Midwifery participated in the evaluation survey with a female to male ratio of 339:103. Students who attended the flipped class sessions were included in the study sample. Students who did not complete the forms were excluded from the study. Nine faculty members who attended the workshop, agreed to facilitate the flipped classroom session were invited to participate in the focus group discussion.

**Results**: Both medical and nursing students found FCR format stimulating. A significantly higher proportion of medical students (73%) found the FCR more engaging and interesting than a traditional lecture as compared to nursing students (59%) (p= 0.009). Similarly, 73 % of medical students believed the learning objectives of both the non-face-to-face (NF2F) and face-to-face (F2F) sessions were shared with them as compared to the 62% of nursing students who believed

the same (p=0.002). A significantly higher proportion of medical (76%) versus nursing (61%) students found the FCR format more useful for application of their theoretical knowledge into clinical practice (p=0.030).

**Conclusion:** Students found the flipped classroom (FCR) more engaging and interesting in terms of applying theoretical knowledge into practice. Similarly, faculty found this strategy as effective but challenging in terms of involving and engaging students in the learning process. It is recommended to conduct more FCR sessions for an interactive and student-centered learning, but proper planning of the session and using variety of technological tools to engage learners is a key to success.

## STRENGTHS AND LIMITATIONS:

1. This is a mixed methods study and was the first capacity-building teacher training study conducted across two health professions faculty.
2. Faculty development workshops were conducted to train faculty on how to conduct Flipped classroom
3. In a Single-center study with those interested flipped classroom teaching format are more likely to participate which may create a response bias.
4. Only the clinical faculty were trained and conducted sessions in clinical years so the results cannot be generalized for faculty from Basic sciences.

**KEYWORDS** Technology enhanced learning, Flipped Classroom, active learning, student engagement, Medical Education, deeper learning.

## BACKGROUND

With higher education being more accessible to the masses, the increased enrolment of students in classes has also created learner's diversity in terms of ability and background (1). Furthermore, the problems surrounding effective learning are compounded by the fact that every student is unique and learns in different ways. To maximize each student's learning, teachers need to be aware of different learning styles, and adjust their teaching strategies accordingly to best fit the students' needs (2).

Different technological tools have been used by medical educators at different medical institutions and they are willing to restructure their classrooms in innovative ways. Advancement in technology has shifted the teaching to learning and the pedagogy from passive to active. It has moved from didactic lectures to modern classroom teaching where students are motivated to learn and are actively involved in the learning process (3).

In undergraduate medical education, educational practices must consider the following facts: the learner is an active contributor in the learning process; learning occurs independently and in collaboration with peers; prior knowledge and previous experience form the basis of acquiring new knowledge; learning should relate to the understanding and management of real-life problems; and the need to understand that application of knowledge is crucial to the development of lifelong learning skills. Medical educators need to adapt teaching and learning approaches that promote critical thinking, problem solving, and application of learned concepts for motivating adult learners. The Accreditation Council for Graduate Medical Education "stresses the value of enhancing the quality and quantity of formal teaching, a challenging task due to increased time constraints for both trainees and faculty members." (4) This new strategy , such as the flipped classroom" (FCR), have been used in a growing number of medical educational settings.

In several studies, blended learning approaches, like the flipped classroom which utilize online technology along with instructor-led active learning strategies have shown favorable results (5). This model of classroom instruction relies primarily on student preparation outside of class to use in-class time for specific kinds of active learning activities, such as Problem Based Learning (PBL) or Team Based Learning (TBL) (6).

Use of different technological tools provides an opportunity for educators to develop sessions and courses that improve student's willingness to participate and be successful in the learning process (1, 7). Technological educational tools can enhance student engagement in the learning process, which results in meeting learning outcomes, and improves students' satisfaction (2, 8).

The concept of flipped classroom is grounded in the theories of self-regulation and socio-constructivism. In self-regulated learning theory, the learner is actively involved in the learning process, however the socio-constructivist theory focuses mainly on discussions and interaction inside class that will ultimately promote higher-order cognitive skills (9).

Flipped class approach "flips" the traditional lecture. The flipped classroom model denotes a slightly different approach to in-class active learning, where students are responsible for learning the basic concepts on their own, usually through online videos. Teachers acquire this by either using their pre-recorded lectures or use ones that are already available on the internet. Teachers may also provide a few reading resources to study before coming to the class. The class time is then best utilized in a variety of active learning activities to reinforce concepts such as using clinical scenarios and case-based discussions (10).

Instead of giving didactic lectures for knowledge acquisition followed by independent assignments/homework, the learner performs independent, self-paced didactic learning for

knowledge acquisition followed by classroom-based group assignments, discussion, and/or problem-based learning. Learner-centric group discussions or problem-based learning facilitated by an educator helps create a community of learning and allows for peer-to-peer teaching, dialogue, and support (11).

This approach allows educators to optimize their time and promotes educator–student interaction (12). Flipped classroom not only encourages students to take responsibility for their own education (12) but allows a flexible environment where students can access the resource material at their own pace and in their own time. There is limited data on the effectiveness of a flipped classroom model in undergraduate medical and nursing education. The impact of this innovative teaching methodology is yet to be explored on the assessment of students' scores. The rationale for doing this research study was to do capacity building of faculty in terms of developing and conducting flipped class sessions at the Aga khan University. It is anticipated that this approach will ultimately lead to increased student engagement and will keep them motivated to learn by completing pre-readings at their home. The face-to-face sessions can be used to discuss real life case scenarios to enhance problem-solving and critical thinking skills.

## STUDY OBJECTIVES

- To train faculty members from Medical College and School of Nursing in conducting flipped classroom.
- To enable the study participants to reflect on their experiences regarding their Flipped classroom sessions conducted and attended

## METHODOLOGY

This study was conducted to train the faculty in developing flipped class sessions and to acquire student and faculty perspectives regarding their experience of attending and conducting flipped classrooms respectively. Therefore, both quantitative and qualitative date collection methods were employed to obtain in-depth information about the flipped class sessions at the Aga Khan University (Medical College and School of Nursing and Midwifery). Student Evaluation forms and focus group discussion (FGD) were used to collect the data from the study participants. Three workshops were conducted during July 2019 to January 2020 for training faculty participants. Thirty-two faculty members attended the faculty development workshop on Flipped classroom. The three workshops were designed in a flip style format. Facilitation of flipped class session and later participation in the FGD as part of the research project was voluntary. Five faculty members from Nursing and four faculty members from medical college conducted their session based on Flip style format session for their students and later participated in the focus group discussion. After attending the workshops, the faculty from medical college and school of nursing were approached and assisted in developing their pre-class as well as in-class activities for a flipped class session (fig. 1). Nine sessions

The pre-class activities included PowerPoint presentations, videos on EdPuzzle https://edpuzzle.com/ along with quizzes to check students' understanding of the concept. A discussion board was created on Padlet https://padlet.com/ to engage students virtually. Students were encouraged to complete the assigned tasks before coming to the face-to-face session (F2F). The pre-class activities were followed by F2F in class activities such as clinical case-based discussions to clarify the students' misconceptions and queries. An online freely available software called "Kahoot" https://kahoot.com/ was also used by some of the facilitators during the class to check student's prior knowledge and to facilitate student's engagement during class.

Once the facilitators conducted the F2F sessions, students were asked to fill out the session evaluation forms after giving written informed consent. The self-administered questionnaire focused on four main categories such as pre-class material, preparedness for the F2F session, learning acquired during F2F session and role of flipped class in enhancing student's learning. Demographic questions consisted of general information such as program of study, year of study, and gender. The questionnaire comprised of 16 attributes which were scored on a five-point Likert scale where 1 denoted strongly disagree, 3 was neutral, and 5 meant strong agreement of the item. The questionnaire was developed based on literature review and was validated for content before it was administered. The newly developed evaluation form was validated by two medical educationist along with two faculty members from Basic sciences who are involved in Undergraduate Curriculum Design and has expertise in teaching and learning. Ethical clearance was also obtained from the Institutional Review Board. Data was analyzed by using SPSS version 20. Frequencies and percentages were reported for categorical variables and presented via graphs. Opinions among the two groups namely medical students and nursing students were assessed by Chi square & Fisher's exact tests. A p-value of less than 0.05 was considered significant. Thematic analysis was done to analyze the qualitative data.

**PATIENT AND PUBLIC INVOLVEMENT:** No patient involved

## RESULTS

The total number of study participants is (n=442, 100%) with a female to male ratio of (n= 339, 76%): (n= 103, 23.3%) comprising of medical (n= 88, 20%) and nursing (n=354, 80%) students. as shown in figure 2 and figure 3.

As shown in table 1, both groups found the flipped class format stimulating. However, a significantly higher proportion of medical students (73%) found flipped classes more engaging and interesting than a traditional lecture as compared to the nursing students (59%) (p= 0.009). Similarly, a significantly higher proportion of medical students (73%) believed the learning objectives of both the pre-class and in class session were shared with them as compared to the 62% of nursing students who believed the same (p = 0.002).

**Table 1: Comparison of FCR evaluation by Medical and Nursing Students**

| Attributes | Scale | Total | MBBS | BSCN | p-Value |
|---|---|---|---|---|---|
| Clear instructions for the different components (non-face to face and face to face) were Provided | Disagree | 35 (8%) | 5 (6%) | 30 (9%) | 0.168 |
| | Neutral | 69 (16%) | 9 (10%) | 60 (17%) | |
| | Agree | 338 (77%) | 74 (84%) | 264 (75%) | |
| The learning objectives of pre class and in class session were provided | Disagree | 74 (17%) | 6 (7%) | 68 (19%) | 0.020* |
| | Neutral | 84 (19%) | 18 (21%) | 66 (19%) | |
| | Agree | 284 (64%) | 64 (73%) | 220 (62%) | |
| The Pre-reading material provided in non-face to face session helped to prepare for discussion in face-to-face session | Disagree | 21 (5%) | 4 (5%) | 17 (5%) | 0.956 |
| | Neutral | 54 (12%) | 10 (11%) | 44 (12%) | |
| | Agree | 367 (83%) | 74 (84%) | 293 (83%) | |
| Sufficient time was provided before face-to-face session to gain basic knowledge of the topic being discussed | Disagree | 40 (9%) | 8 (9%) | 32 (9%) | 0.222 |
| | Neutral | 72 (16%) | 9 (10%) | 63 (18%) | |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |
| Flipped class format helped student's ability to find the information using internet/ library | Disagree | 45 (10%) | 6 (7%) | 39 (11%) | 0.499 |
| | Neutral | 90 (20%) | 18 (21%) | 72 (20%) | |
| | Agree | 307 (70%) | 64 (73%) | 243 (69%) | |
| Flipped class format helped | Disagree | 44 (10%) | 6 (7%) | 38 (11%) | |

| | | | | | |
|---|---|---|---|---|---|
| students to activate prior knowledge | Neutral | 81 (18%) | 10 (11%) | 71 (20%) | 0.062 |
| | Agree | 317 (72%) | 72 (82%) | 245 (69%) | |
| Flipped class format enabled learner to establish a concrete action plan to achieve their learning goals | Disagree | 52 (12%) | 5 (6%) | 47 (13%) | |
| | Neutral | 102 (23%) | 16 (18%) | 86 (24%) | |
| | Agree | 288 (65%) | 67 (76%) | 221 (62%) | 0.036* |
| Flipped class format encouraged students to actively participate in the learning process. | Disagree | 30 (7%) | 5 (6%) | 25 (7%) | |
| | Neutral | 81 (18%) | 12 (14%) | 69 (20%) | 0.360 |
| | Agree | 330 (75%) | 71 (81%) | 259 (73%) | |
| Flipped class format promote students to take responsibility of their own learning | Disagree | 35 (8%) | 8 (9%) | 27 (8%) | |
| | Neutral | 85 (19%) | 16 (18%) | 69 (20%) | 0.881 |
| | Agree | 322 (73%) | 64 (73%) | 258 (73%) | |
| The flipped class format was more engaging and interesting than a traditional lecture | Disagree | 77 (17%) | 6 (7%) | 71 (20%) | |
| | Neutral | 94 (21%) | 18 (21%) | 76 (22%) | 0.009* |
| | Agree | 271 (61%) | 64 (73%) | 207 (59%) | |
| Flipped class format helped students to apply theoretical knowledge into clinical practice | Disagree | 55 (12%) | 7 (8%) | 48 (14%) | |
| | Neutral | 104 (24%) | 14 (16%) | 90 (25%) | 0.030* |
| | Agree | 283 (64%) | 67 (76%) | 216 (61%) | |
| Discussion during the face-to-face session-built student's confidence to speak | Disagree | 17 (4%) | 5 (6%) | 12 (3%) | |
| | Neutral | 72 (16%) | 21 (24%) | 51 (14%) | 0.049* |
| | Agree | 353 (80%) | 62 (71%) | 291 (82%) | |
| Face to face sessions helped students to develop critical reasoning skills | Disagree | 19 (4%) | 4 (5%) | 15 (4%) | |
| | Neutral | 78 (18%) | 16 (18%) | 62 (18%) | 0.979 |
| | Agree | 345 (78%) | 68 (77%) | 277 (78%) | |
| The role of facilitator in the face-to-face session of the flipped | Disagree | 16 (4%) | 6 (7%) | 10 (3%) | 0.187 |
| | Neutral | 47 (11%) | 10 (11%) | 37 (11%) | |

| | | | | | |
|---|---|---|---|---|---|
| classroom was useful | Agree | 379 (86%) | 72 (82%) | 307 (87%) | |
| Time allotted for the face-to-face session of the FCR session was adequate | Disagree | 27 (6%) | 3 (3%) | 24 (7%) | 0.342 |
| | Neutral | 61 (14%) | 10 (11%) | 51 (14%) | |
| | Agree | 354 (80%) | 75 (85%) | 279 (79%) | |
| More Flip class sessions should be organized in future | Disagree | 78 (18%) | 6 (7%) | 72 (20%) | 0.000* |
| | Neutral | 95 (22%) | 12 (14%) | 83 (23%) | |
| | Agree | 269 (61%) | 70 (80%) | 199 (56%) | |

***Significant at P value <0.05 by using Chi square/ Fisher Exact test**

A significantly higher proportion of medical students (76%) as compared to nursing (61%) found the flipped class to be useful for application of theoretical knowledge into clinical practice (p = 0.030). A greater proportion of medical students (76%) believed flipped class helped them to establish a plan for achieving their goals as compared to nursing students (62%) (p value= 0.036).

In addition, a higher proportion of nursing students (82 %), compared to medical (71%) students found the class discussion as a useful tool to enhance oral communication skills (p= 0.049). Greater percentage (82%) of medical students agreed that flipped class format activated prior knowledge as compared to nursing students (69%), however the difference was not statistically significant. A significantly higher proportion (80%) of students in the medical program agreed to have more flipped class sessions in future versus 56% of nursing students (p≤ 0.001). Whereas (20%) and (23%) nursing students opposed or gave neutral response regarding more Flipped class sessions should be scheduled in future.

82% of medical students versus 69% nursing students believed that flipped class sessions helped them to activate their prior knowledge although the results were not statistically significant (p = 0.062).

Regarding student's engagement, a significantly higher proportion of medical students (73%) versus 59% of nursing students agreed that the flipped class format was more engaging and interesting than a traditional lecture (p value =0.009). Regarding learning objectives were provided, a higher proportion of nursing students (19%) disagreed as compared to medical students (7%). However the difference was not statistically significant. Similarly, a higher proportion of students from school of nursing (24%) neither agreed nor disagreed regarding flipped class format enabled learner to establish a concrete action plan for achieving the desired learning goals as compared to (18%) medical students. Students from both the entities (18%) neither agreed nor disagreed regarding the development of critical reasoning skills via F2F session.

**Qualitative Data analysis:**

Data from the FGD was analyzed through content analysis. Three coders were identified who independently reviewed the transcriptions and gave codes to each statement. From these derived codes, subthemes were generated which were further clustered and grouped together to form the following four themes.

**Student engagement**

Almost all the facilitators agreed that flipped classroom strategy allowed their students to be more involved and engaged in the learning process. The students were more enthusiastic to learn, and they appreciated the use of flipped classroom methods for teaching of important concepts. One of the facilitators cited that *"there was a new energy and spark in my class"*. Hence, it was found

that in almost all the FCR sessions, the student's involvement was improved, and their attention span was considerably increased.

**Capacity building of faculty**

Majority of the facilitators agreed that the technological tools such as edpuzzle, kahoot etc. that were used in flipped Classroom were new modalities for them which they had not used before. Hence, working on their sessions to convert them into FCR gave them an opportunity to learn newer techniques and expand their horizons of teaching. One facilitator stated that *"it was a self-Learning experience for the faculty and teachers as well".* They believed that the use of flipped classrooms as a teaching strategy was a bit challenging experience, but that helped them to learn new and innovative ways of teaching and became more comfortable with using different innovations to enhance their teaching skills.

**Traditional versus Innovative Teaching**

There were mixed views about offering traditional versus innovative teaching. Some of the facilitators agreed that this was a way better method of teaching the important concepts as it required more effort and active learning on the student's end, hence increasing their understanding of the basic concepts. One facilitator commented "*I could see that students actually took charge of learning that particular topic even before coming to class, and that was the best thing*". One of the facilitators shared that the students preferred traditional methods instead of new innovative methods. Another facilitator shared students' views "*no, we don't want this; we need a lecture method".*

**Challenges encountered in conducting FCR**

Time constraint was the biggest challenge reported by some of the faculty members. Flipping a concept and designing it into a flipped classroom takes a lot of time and commitment, especially when it is being done for the very first time. One of the facilitators commented that *"the teachers need to really work hard and give time for the preparation of class*" another said: *"Being a clinical faculty, it is very difficult to find time. This required an additional one to two weeks, to look for videos and kahoot and other resources as pre-reading, which is difficult"*.

Another major challenge the facilitator faced while conducting FCR session was that the students did not come prepared for the session. One of the facilitators commented: *"I think continuing with your plan and sticking with what you are going to teach the students is the main challenge"*.

## DISCUSSION

The term "flipped classroom" was created by Jonathan Bergmann and Aaron Sams, two high school chemistry teachers from Colorado, USA, in 2012 (12). Although the perceptions of undergraduate students towards flipped classrooms have been gathered but specifically, a comparison of medical and nursing students' perceptions is lacking from literature. The remarkable comments gathered after conducting the flipped teaching session was that the FCR is an effective mode of delivering the content than the conventional didactic teaching. Like our findings, a study conducted at another health sciences university in Pakistan used a similar approach to teach medical students during a clinical rotation, reported that students found FCR as a better mode of teaching in their setup as well (13). Similarly, this model was preferred by participants of a flipped continued medical education (CME) classroom (14). Students believed that FCR method was more stimulating and engaging compared to the traditional instructional approach.

Students were aware of the learning objectives, and it really helped them to formulate their learning goals. It helped clarify any misconceptions and ample time was also provided to students during the F2F session to clarify any misconceptions with the facilitator (15). They also found it encouraging that they can apply their knowledge into clinical practice. As for the objectives of the session and the reading resources were provided well in advance, the students were able to acquire new knowledge and activate prior knowledge via case-based discussion held during the F2F session.

In addition to that, students also reported that their communication skills were also improved. Students' comments clearly articulated that this format activated their prior knowledge. The key to success of this teaching approach was that students took responsibility for their own learning. Provision of opportunity to interact with their peers increased, the availability of reading resources and opportunity to access the learning resources and do revisions as many times as required could be improved. Student's learning atmosphere is a combination of social, physical, and psychosocial components. Applying techniques that boost the learning environment in classroom teaching enables learners to progressively understand the topic especially in undergraduate curriculum (16).

The major challenge identified by the facilitators was to invest additional time to identify material for students and generate thought provoking scenarios for case-based discussion. Creating a discussion board on Padlet, uploading videos on EdPuzzle or using freely available such as Kahoot during F2F sessions to assess their prior knowledge was totally a new experience for facilitators. Majority were unfamiliar with this new technological tool to engage students prior as well as during the class. However, capacity building through conducting workshops and later one-on-one training helped them to create and identify relevant resources. The flipped classroom approach is widely used in many disciplines of learning and education globally (17). The results of the study

show that flipped classroom is an effective pedagogy for both students and faculty at our institution. The ability to apply knowledge, develop confidence and engage in the learning process are some of the benefits that students appreciated in the flipped class format.

It was well received by both the entities, however there were significant differences in their perceptions in a few areas. We compared the responses received from medical college and school of nursing students. Medical college students found flipped class format more helpful for application of theoretical concepts into clinical practice as compared to the nursing students. .Similarly, in a comparative study of traditional versus flipped classroom, authors found that the activities developed for flipped classroom challenged students and provided them opportunity to apply their higher-order skills and to come up with practical solutions (18).

Although students from both the entities agreed that FC is useful to establish a concrete action plan in achieving their learning goals, we saw a significantly higher percentage of medical students as compared to nursing students who found this approach useful. Another study reported that nursing students felt "strange and uncomfortable" which indicates that innovative strategies need to be incorporated to motivate students towards this new approach.

Similarly, studies also considered FC as a useful approach to foster a learner-centered active learning environment for a health assessment course for undergraduate nursing students. However, faculty has found it demanding in terms of time and effort (19). The facilitators of this study felt that providing ample material to students and generating thought provoking scenarios for in-class sessions was challenging. Students from both the groups appreciated the flipped style teaching and agreed that more flipped sessions should be organized in future. Since the introduction of flipped

class modality, students have widely appreciated the value of flipped class sessions and have said that there should be more FCR sessions on other topics.

Similarly, A study conducted on nursing students reported that incorporating blended approach by using innovative technological tool along with interactive classroom activities can enhance students learning but not necessarily improved student satisfaction (20). Our study results also indicates that more medical students as compared to nursing students were in favor of implementing this strategy in future. Angadi NB also reported that seventy-six percent students were in favor of having more FC sessions in future (21). It has been widely observed that students find the flipped classroom approach a better option in terms of fulfilling the learning objectives than the conventional didactic teaching.

Students from both the groups appreciated the flipped style teaching and agreed that more flipped sessions should be organized in future. Since the introduction of flipped class modality, students have widely appreciated the value of flipped class sessions and have said that there should be more FCR sessions on other topics. Flipped classroom have also helped students build confidence to speak and take part in discussions. Verbal communication is essential for success. Literature supports flipped class sessions to improve communication skills of students both inside and out of class (22).

In another study by Zainuddin et al, a comparison of flipped class with traditional teaching concluded that flipped classroom was more engaging than traditional classroom and majority of the students had appreciated this methodology of teaching and learning (22). Our students found the flipped class format more engaging and interesting than a traditional lecture. Literature also supports role of Flipped classroom in promoting a positive learning experience for students' (23).

Other studies also highlighted the benefits of FC in terms of student's engagement both inside and outside of class, more efficient use of classroom by using problem-based scenarios (24), Another study highlighted that students valued case-based interactive discussions which were of clinical relevance to cases they would see in clinical practice (25). Previous studies also emphasized the advantages of using FC such as: the improvement of students' learning autonomy, the easier discovery of blind spots in students' learning through students' demonstration of pre-class reading, the more flexible presentation of teaching materials to encourage students' classroom participation, the encouragement of students' cooperation inside and outside the class, class time was used more effectively etc. (26). The COVID-19 epidemic has accelerated the digital transformation of teaching activities and may also be an opportunity to improve the integration of FC teaching into teaching design of medical education (27).

## CONCLUSION

Study results concluded that the flipped classroom approach was perceived as more engaging and stimulating than the traditional mode of delivering the content via lectures. Case-based discussions during flipped classrooms were found to be helpful in developing students' communication skills and were also effective in application of theoretical knowledge into real clinical settings by promoting critical thinking, clinical reasoning, and collaborative learning. We recommend that training workshops on how to design and conduct flipped classrooms should be conducted. It was highly recommended by the medical students to conduct more flipped class sessions in future for which there is a need to do more faculty development workshops on flipped classroom.

## DECLARATIONS

**Ethics approval and consent to participate:** This study was conducted after obtaining an approval from the Ethical Review Committee at the Aga Khan University, Karachi, Pakistan. The reference number generated for the ERC application is 2019-0999-2767**.** An informed consent was obtained from all the faculty and student participants prior to collecting any participant data, feedback, and evaluation.

**Consent for publication:** Not applicable

**Availability of data and materials:** Not applicable

**Competing Interests:** None to declare

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The funders did not have any role in the study design, collection, analysis and interpretation of data, in the writing of report, and in the decision to submit the manuscript for publication. The researchers were completely independent from funders and all authors, external and internal, had full access to all the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

**Authors' contributions**

Dr Amber Sultan was the principal investigator of this research study. She facilitated three workshops on flipped classroom and contributed in the write up of the study, reviewed the manuscript. Dr Rahila Ali facilitated three workshops on flipped classroom, contributed in the write up of the study, reviewed the manuscript. Dr Nida Zahid analyzed and reviewed the data, reviewed the final manuscript. Dr Mehdia Nadeem Rajab Ali reviewed the Manuscript, formatted

the write up as per guidelines of the journal, contributed to the submission of the manuscript along with other required documents. Rozmeen Akber conducted FGD and contributed in the write up of the qualitative section. Dr Sadia Fatima conducted Workshops and reviewed the manuscript. Dr Kulsoom Ghias conducted Workshops and reviewed the manuscript. Dr Russell Martins transcribed Focus Group Discussion (Interview). Dr Muhammad Tariq reviewed the Manuscript and Dr Khairulnissa Ajani provided support for faculty participation from School of Nursing & reviewed the manuscript.

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**Figures Caption**

Figure 1. Workshop for faculty participants "Engaging millennials through flipped classroom"

Figure 2. Distribution of student participants in Flipped Classroom evaluation surveys by gender

Figure 3. Figure 3: Participation by Program

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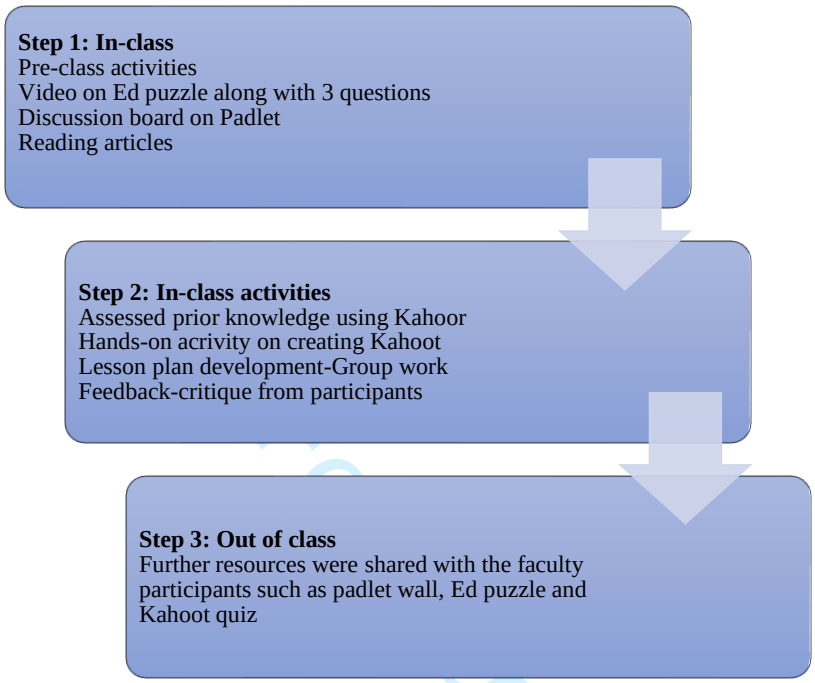


**Figure 1. Workshop for faculty participants "Engaging millenials through flipped classroom"**

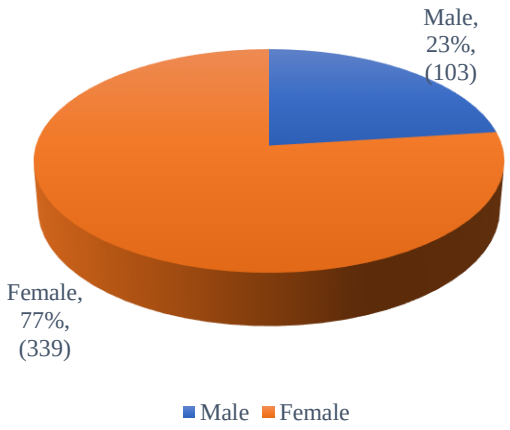


**Figure 2. Distribution of student participants in Flipped Classroom evaluation surveys by gender**

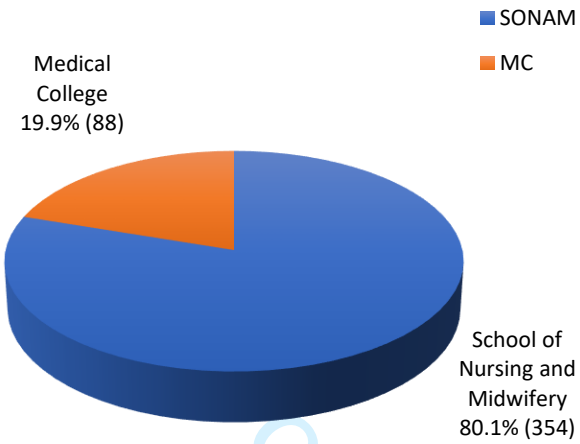


**Figure 3: Participation by Program**

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 1 |
| | | | |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 3 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 5-7 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 8 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 8-9 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 8-9 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 9 |
| Bias | 9 | Describe any efforts to address potential sources of bias | N/A |
| Study size | 10 | Explain how the study size was arrived at | N/A |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8-9 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 9 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 9 |
| | | (*c*) Explain how missing data were addressed | 9 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | N/A |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | N/A |
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 10 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 10-15 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11-13 |
| | | (*b*) Report category boundaries when continuous variables were categorized | N/A |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | N/A |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 16 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 17 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 16-17 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 18 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 20 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.