UNIVERSITE MOHAMMED V-RABAT
FACULTE DE MEDECINE ET DE PHARMACIE RABAT

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DOES DEVELOPING MULTIPLE CHOICE QUESTIONS IMPROVE MEDICAL STUDENTS' LEARNING? A SYSTEMATIC REVIEW.

THESIS

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BY :
Mr Youness TOUISSI
Born on January the 23 th, 1996 in Temara

To obtain a diploma of DOCTOR OF MEDICINE

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Pr. BEKKALI Hicham *	Anesthésie-Réanimation
Pr. BENAZZOU Salma	Chirurgie Maxillo-Faciale
Pr. BOUABDELLAH Mounya	Biochimie-Chimie
Pr. BOUCHRIK Mourad*	Parasitologie
Pr. DERRAJI Soufiane*	Pharmacie Clinique
Pr. DOBLALI Taoufik	Microbiologie
Pr. EL AYOUBI EL IDRISSI Ali	Anatomie
Pr. EL GHADBANE AbdedaimHatim*	Anesthésie-Réanimation
Pr. EL MARJANY Mohammed*	Radiothérapie
Pr. FEJJAL Nawfal	Chirurgie Réparatrice et Plastique
Pr. JAHIDI Mohamed*	O.R.L
Pr. LAKHAL Zouhair*	Cardiologie
Pr. OUDGHIRI NEZHA	Anesthésie-Réanimation
Pr. RAMI Mohamed	Chirurgie Pédiatrique
Pr. SABIR Maria	Psychiatrie
Pr. SBAI IDRISSI Karim*	Médecine préventive, santé publique et Hyg.

*** Enseignants Militaires**

AOUT 2015

Pr. MEZIANE Meryem	Dermatologie
Pr. TAHIRI Latifa	Rhumatologie

PROFESSEURS AGREGES :

JANVIER 2016

Pr. BENKABBOU Amine	Chirurgie Générale
Pr. EL ASRI Fouad*	Ophtalmologie
Pr. ERRAMI Noureddine*	O.R.L
Pr. NITASSI Sophia	O.R.L

JUIN 2017

Pr. ABBI Rachid*	Microbiologie
Pr. ASFALOU Ilyasse*	Cardiologie
Pr. BOUAITI El Arbi*	Médecine préventive, santé publique et Hyg.
Pr. BOUTAYEB Saber	Oncologie Médicale
Pr. EL GHISSASSI Ibrahim	Oncologie Médicale
Pr. HAFIDI Jawad	Anatomie
Pr . MAJBAR Mohammed Anas	Chirurgie générale
Pr. OURAINI Saloua*	O.R.L
Pr. RAZINE Rachid	Médecine préventive, santé publique et Hyg.
Pr. SOUADKA Amine	Chirurgie générale
Pr. ZRARA Abdelhamid*	Immunologie

Mai 2018

Pr. AMMOURI Wafa	Médecine interne
Pr. BENTALHA Aziza	Anésthésie Réanimation
Pr. EL AHMADI Brahim	Anésthésie –Réanimation
Pr. EL HARRECH Youness**	urologie
Pr. EL KACEMI Hanan	Radiothérapie
Pr. EL MAJJAOUI Sanaa	Radiothérapie
Pr. FATIHI Jamal*	Médecine Interne
Pr. GHANNAM Abdel ilah	Anésthésie Réanimation
Pr. JROUNDI Imane	Médecine préventive, santé publique et Hyg
Pr. MOATASSIM BILLAH Nabil	Radiologie
Pr. TADILI Sidi Jawad	Anésthésie Réanimation
Pr. TANZ Rachid*	Oncologie Médicale

NOVEMBRE 2018

Pr. AMELLAL Mina	Anatomie
Pr. SOULY Karim	Microbiologie
Pr. TAHRI Rajae	Histologie-Embryologie-Cytogénétique

*** Enseignants Militaires**

NOVEMBRE 2019

Pr. AATIF Taoufiq *	Néphrologie
Pr. ACHBOUK Abdelhafid *	Chirurgie Réparatrice et Plastique
Pr. ANDALOUSSI SAGHIR Khalid *	Radiothérapie

Pr. BABA HABIB Moulay Abdellah *	Gynécologie-obstétrique
Pr. BASSIR RIDA ALLAH	Anatomie
Pr. BOUATTAR TARIK	Néphrologie
Pr. BOUFETTAL MONSEF	Anatomie
Pr. BOUCHENTOUF Sidi Mohammed *	Chirurgie Générale
Pr. BOUZELMAT Hicham *	Cardiologie
Pr. BOUKHRIS Jalal *	Traumatologie-orthopédie
Pr. CHAFRY Bouchaib *	Traumatologie-orthopédie
Pr. CHAHDI Hafsa *	Anatolmie Pathologique
Pr. CHERIF EL ASRI Abad *	Neurochirugie
Pr. DAMIRI Amal *	Anatolmie Pathologique
Pr. DOGHMI Nawfal *	Anesthésie-réanimation
Pr. ELALAOUI Sidi-Yassir	Pharmacie Galénique
Pr. EL ANNAZ Hicham *	Virologie
Pr. EL HASSANI Moulay EL Mehdi *	Gynécologie-obstétrique
Pr. EL HJOUJI Aabderrahman *	Chirurgie Générale
Pr. EL KAOUI Hakim *	Chirurgie Générale
Pr. EL WALI Abderrahman *	Anesthésie-réanimation
Pr. EN-NAFAA Issam *	Radiologie
Pr. HAMAMA Jalal *	Stomatologie et Chirurgie Maxillo-faciale
Pr. HEMMAOUI Bouchaib *	O.R.L
Pr. HJIRA Naoufal *	Dermatologie
Pr. JIRA Mohamed *	Médecine Interne
Pr. JNIENE Asmaa	Physiologie
Pr. LARAQUI Hicham *	Chirurgie Générale
Pr. MAHFOUD Tarik *	Oncologie Médicale
Pr. MEZIANE Mohammed *	Anesthésie-réanimation
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Pr. MOUZARI Yassine *	Ophtalmologie
Pr. NAOUI Hafida *	Parasitologie-Mycologie
Pr. OBTEL Majdouline	Médecine préventive, santé publique et Hyg.
Pr. OURRAI Abdelhakim *	Pédiatrie
Pr. SAOUAB Rachida *	Radiologie
Pr. SBITTI Yassir *	Oncologie Médicale
Pr. ZADDOUG Omar *	Traumatologie Orthopédie
Pr. ZIDOUH Saad *	Anesthésie-réanimation

*** Enseignants Militaires**

2 - ENSEIGNANTS-CHERCHEURS SCIENTIFIQUES

PROFESSEURS DE L'ENSEIGNEMENT SUPERIEUR

Pr. ABOUDRAR Saadia	Physiologie
Pr. ALAMI OUHABI Naima	Biochimie-chimie
Pr. ALAOUI KATIM	Pharmacologie
Pr. ALAOUI SLIMANI Lalla Naïma	Histologie-Embryologie
Pr. ANSAR M'hammed	Chimie Organique et Pharmacie Chimique
Pr .BARKIYOU Malika	Histologie-Embryologie
Pr. BOUHOUCHE Ahmed	Génétique Humaine
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Pr. FAOUZI Moulay El Abbes	Pharmacologie
Pr. IBRAHIMI Azeddine	Biologie moléculaire/Biotechnologie
Pr. OULAD BOUYAHYA IDRISSI Med	Chimie Organique
Pr. RIDHA Ahlam	Chimie
Pr. TOUATI Driss	Pharmacognosie
Pr. ZAHIDI Ahmed	Pharmacologie

PROFESSEURS HABILITES

Pr BENZID Hanane	Chimie
Pr. CHAHED OUAZZANI LallaChadia	Biochimie-chimie
Pr DOUKKALI Anass	Chimie Analytique
Pr. EL JASTIMI Jamila	Chimie
Pr. KHANFRI Jamal Eddine	Biologie
Pr LYAHYAI Jaber	Génétique
Pr OUADGHIRI Mouna	Microbiologie et Biologie
Pr RAMLI Youssef	Chimie
Pr SERRAGUI Samira	Pharmacologie
Pr TAZI Ahnini	Génétique
Pr. YAGOUBI Maamar	Eau, Environnement

Mise à jour le 05/03/2021
KHALED Abdellah
Chef du Service des Ressources Humaines
FMPR

Dédicaces

Mom, Dad and Sisters

you did everything for me, and i did it all for you.
I hope you will be always proud of me.

Family

Thank you for being so close and helpful,
Thank you for being a real family.

Friends

I Can't thank you enough, without you, it wouldn't be possible.

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INTRODUCTION

In order to face the enormous volume of knowledge they have to assimilate; medical students adopt different strategies mainly orientated by assessments methods [1]. And, due to a variety of reasons as time constraints, they mostly rely on passive learning, in which information is directly transmitted to them through conventional approaches such as lectures or presentations, which gives no guarantees that learning takes place. However, constructing their own understanding of things and making connections between information they grasp, through actively involving in tasks where the students represent the main element of the learning process, is more beneficial and superior to passively absorbing mere facts [2].

Multiple-choice questions (MCQs) are the most common assessment tool in medical education worldwide [3]. Therefore, it is only reasonable that students would favor practicing MCQs either from old exams or commercial question banks over other learning methods in order to get ready for their examinations [4]. Although this approach might seem practical for students as it strengthens their knowledge and gives them a prior exam experience, it might incite surface learning instead of constructing more elaborate learning skills as application and analysis [5].

Writing multiple choice questions by students themselves seems to be a potential solution that combines between students' pragmatic approach and active learning, as the development of good questions in general necessitates a deep understanding and a firm knowledge of the material that is evaluated [6], let alone writing good MCQs, which requires erroneous but possible discriminators as well as correct answers and a meticulously drafted stem [7-8]. Consequently, creating a well-constructed MCQ requires more cognitive abilities than answering one [9].

Several studies have shown that the process of producing questions is an efficient way to motivate students and enhance their performance [10-11]. Creating distractors for example, may reveal misconceptions and mistakes and underlines when students have a defective understanding of the course material [6-12]. In contrast, other studies indicated there is no

considerable impact of this time-consuming MCQs development activity on students' learning [9] or that question-generation might benefit only some categories of students [13].

Because of the conflicting conclusions about this approach in different studies, we conducted a systematic review to define and document evidence of the effect of writing MCQs activity on students learning, and understand how and under what circumstances it could benefit medical students. Forasmuch as to our knowledge, there is no prior systematic review addressing the effect of student generated multiple choice questions on medical students' learning.

METHODS

A. Study design:

This systematic review is conducted in accordance with the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) [14], and since this is a systematic review of studies previously published and does not include any individual participant information, ethical approval was not necessary.

B. Inclusion and exclusion criteria:

Studies to be included in this review were selected based on eligibility criteria following PICO guidelines. The population targeted was under and post graduated medical students while biomedical, nursing and dental students were excluded as any other health related students. The intervention was about generating MCQs, all types included. Studies combining the generation of MCQs with other questions types were also included as long as they gave distinct results about MCQs, and since evidence-based medical education is crowded with single-group cross-sectional studies there was no exclusive criterion regarding comparisons. Concerning outcomes, studies of interest were the ones that indicated effect of the intervention in terms of performance, behavior and satisfaction using validated or non-validated measurement instruments. Hence, entirely descriptive publications without an evaluation section were excluded.

C. Search strategy :

In April 2020, Two reviewers separately conducted a systematic search on 4 databases, Medline (via PubMed), Scopus, Web of Science and Eric using terms as (Medical students, Multiple choice questions, Learning , Creating) and their possible synonyms and abbreviations using different combinations by applying Boolean logic terms (AND, OR, NOT) with convenient search syntax for each database (Appendix 1), then listed all the references they could find using Zotero software for eventual selection. They also checked manually the references list of selected publications for more relevant papers. Moreover, 'Similar Articles'

section below articles (e.g. PubMed) was verified for possible additional articles. No restrictions regarding time, language or origin country were applied.

D. Study selection:

The selection process was directed by two reviewers independently, started with screening all papers generated with the databases search then removing duplicates. Adopting a sensitive approach, all titles that had a potential relation to the research subject were kept to an ensuing abstract screening at same time eliminating titles that were obviously irrelevant. Then, reviewers performed an abstract screening and all studies selected were retrieved to last full text screening. The references list of selected papers was also a subject of the same approach previously stated. Any disagreement between the reviewers in relation with papers inclusion was settled through consensus.

E. Data collection

Data collection was initiated by the selection of a small sample of articles. Two reviewers worked separately to create a provisional data extraction sheet. Then, they met to finalize the coding sheet by adding, editing and deleting sections, leading to a final template, implemented using Microsoft Excel to ensure the consistency of collected data. After that, each reviewer extracted data independently using the created framework.

The items listed in the sheet were article authorship, study settings including study design and participants characteristics, intervention and strategy details, instruments and the outcome (Cf. Table 1).

F. Assessment of study methodological quality

There are few scales to assess the methodological rigor and trustworthiness of quantitative research in medical Education; to cite Best Medical Education Evaluation global scale [15], Newcastle–Ottawa Scale [16] and Medical Education Research Study Quality Instrument

(MERSQI, Appendix 2) [17]. We chose the latter to assess quantitative studies because it provides a detailed list of items with specified definition, a solid validity evidence, and its scores are correlated with the citation rate in the succeeding 3 years of publication, and with the journal impact factor [18-19]. When a study reported more than one instrument addressing our question, we only considered the one yielding the higher level of learning outcome on Kirkpatrick model.

RESULTS

A. Literature search:

Eight hundred eighty-four papers were identified after the initial databases search (Cf. Figure 1), of which 18 papers were retained after abstract and title screening. Seven of them didn't fit in the inclusion and exclusion criteria for reasons as the absence of learning outcome or the population targeted weren't medical students. In the end, only 11 articles were obtained, added to another 6 articles retrieved by cross referencing.

For the 17 articles included, the two reviewers agreed about 16 articles, and only one paper was discussed and decided to be included.

B. Study and population characteristics:

The 17 included papers reported 18 studies, as one paper included two distinct studies. Thirteen out of the eighteen studies were single group studies representing the most used study design (Cf. Table 1). Eleven of those single group studies were cross sectional while two were pre-post-test studies. The second frequent study design encountered were cohorts adopted in three studies. The remaining two were randomized controlled trials (RCT). The studies have been conducted between 1996 and 2019, 13 studies (79%) from 2012 to 2019.

Regarding research methodology, fifteen were quantitative studies while two were qualitative and one study had mixed methods with a qualitative part and a quantitative one (focus group).

Altogether, 2122 students participated in the 17 included papers. All participants were undergraduate medical students representing the first five years of medical school, the preclinical stage being the most represented, with 13 out of the 17 papers included students enrolled in one of the first two years of medical studies.

Most studies used surveys as main instrument to collect data (n=7). Data resources for the other studies were; qualitative feedback (n=5), qualitative feedback turned to quantitative data (n=1),

pre-post-test (n=3), and post-test (n=3), taking into account that a mixed study contained an open ended survey and a qualitative feedback, and a paper contained two studies.

Eleven studies had more than one data resources. Pre-post-test studies had also a section for students' feedback, and item analysis describing MCQs characteristics as discriminatory index was present in five studies.

C. Quality assessment:

Overall, the MERSQI scores used to evaluate the quality of the 14 quantitative studies were relatively above average, with a mean MERSQI score of 10.42, ranging from 6.5 to 14 out of an 18 maximal possible score. (details of MERSQI score for each study in table 2)

Studies lost points on MERSQI for using single groups designs, limiting to a single institution, for the lack of validity evidence for instrument. All studies but two, used an instrument lacking internal structure validity, content validity and relationship to other variables. Furthermore, studies measured outcome only in terms of perception (6 studies) and skills/knowledge (8 studies).

D. Findings:

The evaluation of the educational effect of MCQs writing was carried out using objective measures in 8 out of the 18 studies included, based on pre-post-test or post-test only. Subjective assessments as surveys and qualitative feedbacks were present as a second data resources in 5 of these 8 studies, whereas they were the main measures in the remaining 10. Hence, 15 studies assessed learning outcome in sort of satisfaction and perception towards the activity which represents the first level of Kirkpatrick model. Out of these 15 studies, three studies wherein students expressed dissatisfaction of the process and found it disadvantageous compared to other learning methods, whereas two studies found mixed results as students admitted the

process interest though they had doubt about its efficiency. On the other hand, 10 studies provided favorable results of the exercise which was considered of an immense importance and helped students consolidate their understanding and knowledge, although students showed reservations about the time expense of the exercise in 3 studies.

The 8 studies that used objective measures assessed skills and knowledge which represent the second level of Kirkpatrick model. Following the process, 5 studies reported a significant improvement in students' grades doing this activity, 2 studies showed no noticeable difference in grades, and one showed a slight drop in grades.

One study suggested differences in performance based on the module concerned and also based on students' sex. Two studies found the activity beneficial to all students' categories while another two suggested it was more interesting for low performers.

Four Studies also found that writing and peer review combinations were more beneficial than solely writing MCQs. On the other hand, 2 studies revealed that peer reviewing groups didn't promote learning and a 1 study found mixed results.

Figure 1: Flow-chart of the Study selection

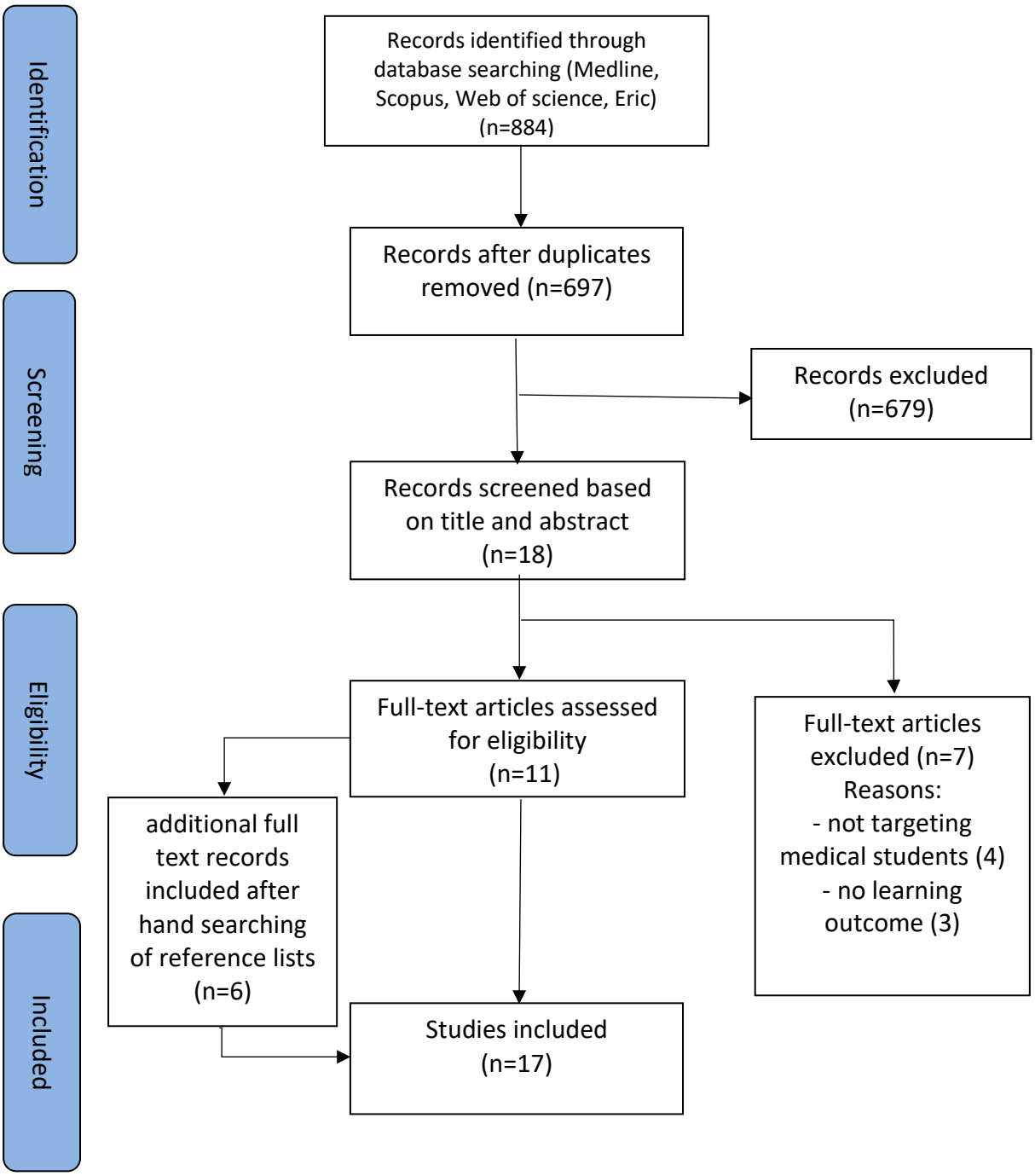

Table 1: Demographics, interventions and outcome of the included studies.

References, year	Settings	Intervention AND strategy	Instrument	Outcome
Palmer E et al. 2006[9]	*Australia* Randomized Controlled Trial 4th year (N=51). Module: Surgery	Students were split randomly to 2 groups, first group had to write a case report while the second had to write 3 MCQs in addition to the case report.	Pre-post-test. Survey (learning methods ranking)	Both groups ranked learning methods similarly. similar improvement in pre-post-test, no significant difference
	Australia Single-group cross-sectional: 5th year (N=53). Module: Divers	Students were asked to rank their preferred learning methods before and after an activity in which they had to do research on a topic with a presentation and construct 3 MCQs for their peers to answer.	Pre and post activity survey	significant difference for the MCQ as a learning exercise option (p=0.04) but the ranking among other activities remains poor.
Chanberlain S et al. 2006 [21]	*UK* Single-group cross-sectional: 1st year (N=3), 2nd year (N=3)	Training included writing MCQs with feedback on each option given. Participants were recruited on a fulltime basis.	Qualitative feedback	Students Considered the Process of a huge interest.
Gooi AC et al., 2014[22]	*Canada* Single-group cross-sectional: 1st year (N=113), divided to 14 Groups, 7-8 students each. Module: otolaryngology	First step: Introductory session to how to write a high quality MCQs. Second step: Self-study session Last step: students created and reviewed each other's MCQs.	Post-session Survey	Creating MCQs valuable= 78%. Reviewing MCQs valuable= 79% Class-created MCQs is a valuable resource = 91% Interested in collaborating in future session = 86%.

References, year	Settings	Intervention AND strategy	Instrument	Outcome
Grainger R et al. 2018 [23]	*New Zealand* Single-group cross-sectional: 4th year (N=106), Module: anatomic pathology	Students were required to write at least 2 MCQs and to answer 20 peer-generated MCQs, the explanation of the answer and distractors was required	Post-course survey. Open-ended text feedback.	Not satisfied with the process = 81% (50/62).
Shah MP et al. 2019 [24]	*USA* Single-group cross-sectional: 2nd year (N=11), Module: cardio-pulmonary-renal	Students took a 2 hours workshop on how to write good quality MCQs. Questions were written with detailed explanations and reviewed by the faculty.	Qualitative feedback	Test writers reviewed key objectives and refined their test taking strategies. In the future, they would like to engage in similar activities.
Walsh J et al. 2016 [25]	*UK* cohort: Final year (5th) (n=20). Module: Divers	Students were recruited to create an online bank for MCQs. Questions produced were arranged into a series of tests accessible online to be taken freely by students. the performance of question writers was compared to the rest of students.	Post-test	Students who wrote and reviewed question scored higher than average compared to the rest of students in the end of year summative exam ($p \leq 0.001$)

References, year	Settings	Intervention AND strategy	Instrument	Outcome
Kurtz JB et al. 2019 [26]	*USA* Single-group cross-sectional: 2nd year (N=18). Module: Cardiology	Participants were randomly divided into 6 groups of 3 students each, then students had to write 2 MCQs from exam blueprint subjects, peer-reviewed within the group, then sent to other teams and faculty for review.	qualitative analysis (n=8). open-ended survey (n=10).	Students found this activity beneficial on how to strategically approach MCQs examinations. Students voiced frustration about the amount of time needed for this activity. They did not agree or deny that this was an appropriate method to review cardiology
Benjamin HL et al. 2015 [27]	*UK* Single-group cross-sectional: 5th year (N=20). Module: Divers	Students were asked to volunteer to create an online MCQ database, first students had to write MCQs in a standard format, then students checked each other's MCQs, the senior clinician was asked to review and approve MCQs.	Mixed method feedback	100% positive feedback students reported question writing and/or peer review to be valuable for learning and useful for preparation and described it as enjoyable.
Herrero JI et al. 2019 [28]	*Spain* Randomized Controlled Trial: 2nd & 3rd year (N=75 & N=109). Module: General pathology & Physiopathology	Students were invited to write 4 MCQs in a topic that was randomly chosen. They were offered an extra 0.25 point if their questions were good enough. Best 2 questions on each topic were selected to be included in the exam.	Post-test	Students who created Immunopathology MCQs performed considerably better. Students who wrote good questions about Respiratory system got better grades in that topic than those who wrote good questions about blood. In pathophysiology male students wrote good questions more often than female students.

References, year	Settings	Intervention AND strategy	Instrument	Outcome
Rajendiren S et al. 2014 [29]	*India* Single-group Pre and post-test: First year (N= 135). Module: Biochemistry	Students were classified into three categories: high, medium and low performers. They took a pre-test, then the 3 different groups were given MCQ stems of the same subject and were asked to create distractors and the right answer separately, then they were tested again.	Pre and post-tests. Students feedback	Significant difference between pre and post-tests in both high and low performers. 55% of students found the exercise to be challenging and must be used as a learning exercise.
Bobby Z et al. 2012 [30]	*India* Single-group Pre and post-tests: First year (N=84). Module: Biochemistry	Students took a pre-test then they were given 4 distractors in which one could be the answer. They were then asked to individually write the stem based on given key words.	Pre and post-tests. Students Feedback	Significant difference between pre and the two post-tests in all students categories. 95% of students wanted a second session in the future, 99 % felt the exercise was not a burden.
Sircar SS et al. 1999 [31]	*India* Single-group cross-sectional: First year (N=37). Module: Physiology	A contest in which student had to write assertion-reasons MCQs was organized. The questions submitted were rated on a six-point scale (0–5). the contributors of the best and highest number of MCQs would be awarded certificates.	Students Feedback	The contest was of high educational importance to most students, though some found it time-consuming.

References, year	Settings	Intervention AND strategy	Instrument	Outcome
McLeod PJ & Snell L. 1996 [32]	*Canada* Single-group cross-sectional: 2nd & 3rd year (N=150). Module: Divers	Students were divided to 3 groups, each one spent in rotation a 10 weeks clinical course. Each one was expected to write two to five MCQs. All accepted students-generated questions were included in the summative exams.	Students Feedback	Students appreciated how involved they were in the learning process. they recognized the benefits of reading when formulating a question.
Papinczak T et al. 2012 [33]	*Australia* Cohort: 1st & 2nd year (N=384). Module: Divers	In small groups, students were asked to devote at least 1 hour a week to write short-answer & complex patient-based question & MCQs type assertion-reason. MCQs and answers were reviewed by one or 2 academics before being loaded to a questions bank.	pre and post-test Questionna-ire.	Students appreciated how involved they were in the learning process. They recognized the benefits of reading when formulating a question.
Stone MR et al. 2017 [34]	*USA* Single-group cross-sectional: 1st & 2nd year (N=39). Module: Divers	Students interested in sharing their students-written questions singed up to participate in crowd sourced practice quizzes made of MCQs, matching and true/false questions, based on the material taught at their school. Each participant had to write questions for a certain number of lectures then submit them to shared folder.	Post-test and Survey.	81.3 % of students stated they felt more positive when they wrote MCQ. No statistically significant difference between participants and non-participants performance in the post test.

References, year	Settings	Intervention AND strategy	Instrument	Outcome
Walsh JL et al. 2018 [35]	*UK* Cohort: 1st & 2nd year (N=603). Module: Divers.	PeerWise® was introduced to the first year class of 2014. Over 2 years, students were asked to write, comment and rate their peers' MCQs. For each student during each academic year, the frequency of these three activities was reported and correlated to the summative examination results.	Summative exam. Survey (students' perceptions).	There were significant correlations between writing, answering and commenting frequency with summative examination performance ($p<0.001$, R=0.24, 0.13 and 0.15, respectively). PeerWise® users performed significantly better than non-users ($p<0.001$).
Jobs A et al. 2013 [36]	*Germany* Single-group cross-sectional: 4th year (N=102). Module: Internal Medicine.	Internal Medicine was divided into 4 sections which students had to take exam on each. Students wrote MCQs 3 weeks before exams instructed by an approved manual, exam included some questions written by students	Questionnaire.	students spent less time designing MCQs compared to other methods. No apparent beneficial effects on learning habits.

Table 2: methodological quality of included studies

Authors	design	Sampling		Type of Data	Validity of content			Data analysis		Types of outcome measured				Total
		Institutios studied	Response Rate		Content	Internal structure	Relationship to other variables	Appropria-teness	Complexity	Satisfactio, Attitudes, perception	Knowledge, Skills	Behaviors	Patient/ Care outcomes	
Edward Palmer, 2006 [9]	3	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	13.5
	1	0.5	0.5	1	0	0	0	1	2	1	-	-	-	7
SUZANNE CHAMBERLAIN,2006 [21] Error! B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADRIAN C.C. GOOI,2014 [22]	1	0.5	1.5	1	0	0	0	1	1	1	-	-	-	7
Rebecca Grainger,2018 [23] Error! Bookmark not	1	0.5	1	1	1	1	1	1	1	1	-	-	-	9.5

Authors	design	Sampling		Type of Data	Validity of content			Data analysis		Types of outcome measured				Total
		Institutios studied	Response Rate		Content	Internal structure	Relationship to other variables	Appropria-teness	Complexity	Satisfactio, Attitudes, perception	Knowledge, Skills	Behaviors	Patient/ Care outcomes	
Manan P. Shah,2018 [24] Error! Bookmark not	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jason L Walsh,2016 [25] Error! Bookmark not	2	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	12.5
Josh B Kurtz,2019 [26]	1	0.5	1.5	1	0	0	0	1	1	1	-	-	-	7
Benjamin H. L, 2015 [27]	1	0.5	1.5	1	0	0	0	1	1	1	-	-	-	7
Jose Ignacio Herrero, 2019 [28]	3	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	13.5

Authors	design	Sampling		Type of Data	Validity of content			Data analysis		Types of outcome measured				Total
		Institutios studied	Response Rate		Content	Internal structure	Relationship to other variables	Appropria-teness	Complexity	Satisfactio, Attitudes, perception	Knowledge, Skills	Behaviors	Patient/ Care outcomes	
Soundravally Rajendiren, 2014 [29]	1.5	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	12
Zachariah Bobby, 2012 [30]	1.5	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	12
Sabyasachi S. Sircar,1999 [31]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. J. McLEOD & L. SNELL, 1996 [32]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tracey Papinczak, 2012 [33]	2	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	12.5

Authors	design	Sampling		Type of Data	Validity of content			Data analysis		Types of outcome measured				Total
		Institutios studied	Response Rate		Content	Internal structure	Relationship to other variables	Appropria-teness	Complexity	Satisfactio, Attitudes, perception	Knowledge, Skills	Behaviors	Patient/ Care outcomes	
M. Rick Stone, 2017 [34]	1.5	0.5	1.5	3	1	1	1	1	2	-	1.5	-	-	14
Jason L Walsh,2018 [35]	1.5	0.5	1.5	3	1	0	0	1	2	-	1.5	-	-	12
Alexander Jobs,2013 [36]	1	0.5	1	1	0	0	0	1	1	1	-	-	-	6.5

DISCUSSION

This paper methodically reviewed 17 articles investigating the impact of writing multiple choice questions by medical student on their learning. Several studies pointedly examined the effect of the activity inquired, whereas it was generally just a small section of each article which was used for the review, as studies focused on other concepts like assessing the quality of students generated questions or the efficiency of online questions platforms, reflecting the scarce research on the impact of a promising activity in medical education.

The mean MERSQI score of quantitative studies was 10.42 which is below the level suggestive of a solid methodology set to 10.7 or higher [17], indicating the weak methodology used by most studies included. Only two study [23-34] used a valid instrument in terms of internal structure, content and relation to other variable, making the lack of the validity of instrument in addition to the use of a single site and single group design as the main methodological issues identified. Furthermore, the studies assessing the outcome in terms of knowledge and skills scored higher than the ones appraising the learning outcome regarding perception and satisfaction, ergo we recommend that future research should provide more details on the validity parameters of instruments used, and also focus on higher learning outcome levels; precisely skills and knowledge as they are typically more linked with the nature of the studied activity.

A previous review explored the effect of student-generated questions on learning, and concluded that the process of constructing questions raised students' abilities of recall and promoted understanding of essential subjects as well as problem solving skills [37]. Yet, this review gave a general scope on the activity of generating questions, taking into consideration all questions formats. Thus, its conclusions will not necessarily concord with our review on the grounds that medical students define a special students' profile [38], along with the particularity of multiple-choice questions. As far as we know, this is the first systematic review made to appraise the pedagogical interest of the described process in medical education.

Students' viewpoints and attitudes toward the MCQ generation process was evaluated in

multiple studies, and the results were generally encouraging, despite a few exceptions where students expressed negative impressions of process, and favored other learning methods over it [4-9]. The most pronouncing critical remarks were essentially on the time-consumption limiting the process efficiency. This was mainly related to the complexity of the task given to students who were required to add writing MCQs to their already stuffed planning.

Since the most preferred learning method for students is learning by doing, they presumably benefit more when instructions are conveyed in shorter segments, and when introduced in an engaging format [39]. Thus, some researchers tried more flexible strategies as providing the MCQs distractors and asking students for the stem or better providing the stem and requesting distractors as these were considered as the most challenging parts of the process [26]. Some authors used online platforms to create and share questions making the MCQs generation smoother. Another approach to motivate students was including some generated MCQs in examinations, in order to boost students' confidence and enhance their reflective learning [40]. These measures supposed to facilitate the task, were perceived positively by students.

Regarding students' performance, MCQs-generation exercise broadly improved students' grades. However, not all studies have reported positive results. Some noted no significant effect of writing MCQs on students' exam scores [9-34], still explained by the small number of participants, lack of faculty input in addition to the fact that students were tested on a material broader than the one they were instructed to write MCQs on, meaning that students could have effectively benefit from the process if they created a larger number of MCQs covering a wider range of material or if the process was aligned with the whole curriculum content. Besides, some studies reported that low performers benefited more from the process of writing MCQs, concordantly with the findings of other studies which indicate that activities promoting active learning advantage lower-performing students more than higher-performing students[43-44]. Another suggested explanation was the fact that low achievers tried to memorize students-

generated MCQs when these made part of their examinations, reversely favoring surface learning instead of deep learning anticipated from this activity, especially that other studies found no differences between students' categories in term of performance. This created a dilemma between enticing students to participate in this activity and the disadvantage of memorizing MCQs. Including modified student-generated MCQs after faculty input, rather than the original student-generated version in the examinations' material, might be a reasonable option along with awarding extra points when students are more involved in the process of writing MCQs.

Students' performance tends to be also related to their ability to generate high-quality questions, as suggested in a preceding review [45] on the intervention of students generated questions as well as in Song's review [37], assisting students in constructing questions may enhance the accuracy of the students' questions, encourage learning, and improve students' achievement. Also, guiding students to write MCQs able to test higher order skills as application and analysis beside recall and comprehension. Accordingly, several studies used this approach, providing students with instructions in the form of seminars or teaching modules on how to write high-quality multiple-choice questions, resulting in high-quality student-generated MCQs. Even so, such guidelines must take into account not to make students' job more challenging in order to maintain the process as pleasant.

Several papers discussed various factors that influence the learning outcome of the activity, to mention working in groups and peer checking MCQs which were found to be associated with higher performance. These factors were also viewed favorably by students because of their potential to broaden and deepen one's knowledge, as well as to notice any misunderstandings or problems, according to many studies, that highlighted a variety of beneficial outcomes of peer learning approaches in the education community [46-47]. However, in other studies, students preferred to work alone and demanded that time devoted to peer reviewing MCQs be

reduced. This was mostly due to students' lack of trust in the quality of MCQs created by peers; thus, evaluating students' MCQs by seniors was also a component of an effective intervention.

STRENGHTS AND LIMITATIONS

The main limitation of our review is the scarcity of studies in the literature. We used a narrowed inclusion criterion leading to the omission of articles published in non-indexed journals and papers from other health care fields that may have been instructive. However, the choice of limiting the review scope to medical students only was motivated by the specificity of the medical education curricula and teaching methods compared to other health professions categories in most settings. Another limitation is the weak methodology of most studies included in this review which makes drawing and generalizing conclusions a delicate exercise. On the other hand, this is the first review to summarize data on the learning benefits of creating MCQs in medical education, and to shed light on this interesting learning tool.

CONCLUSION

Writing multiple choice questions as a learning method seems to be a valuable process to enhance medical students learning despite doubts raised on its real efficiency and pitfalls in terms of time and effort.

There is currently a scarcity of research that precisely analyzes the impact of student-generated MCQs on learning. Future research on the subject are must needed to refine strategies for a variety of contexts in order to reach the most fitting circumstances for the activity to get the best out of it.

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ABSTRACTS

SUMMARY

Title : Does developing Multiple Choice Questions improve medical students' learning? A Systematic Review.

Author : TOUISSI Youness.

Reporter : Professor AZEDDINE Ibrahimi**.**

Key-words : Multiple-choice-questions, Learning, Medical students, Medical education

Background: Practicing Multiple choice questions is a popular learning method among medical students. While MCQs are commonly used in exams, writing them might provide another opportunity for students to boost their learning. Yet, the effectiveness of student-generated multiple-choice questions in medical education has been questioned. The aim of this study is to verify the effects of student-generated MCQs on medical learning, as well as define the circumstances that would make this activity more constructive.

Methods: Articles were identified by searching 4 databases MEDLINE, SCOPUS, Web of Science, and ERIC, as well as scanning references. The titles and abstracts were selected based on a pre-established eligibility criteria and the methodological quality of articles included was assessed by MERSQI.

Results: 884 papers were identified, 11 being papers retained after abstract and title screening the full-text screening added to another 6 articles recovered from cross referencing, making it 17 articles in the end. Most studies showed positive results either in term of students' perception or performance, the mean MERSQI score was 10.42.

Conclusion: Few articles in the literature examined the influence of student-generated MCQs on medical students learning. Amid some concerns about time and needed effort, writing multiple choice questions as a learning method appears to be a useful process for improving medical students' learning.

RÉSUMÉ

Titre : L'élaboration de questions à choix multiples améliore-t-elle l'apprentissage des étudiants en médecine ? Une revue systématique.

Auteur : TOUISSI Youness.

Rapporteur : Professeur AZEDDINE Ibrahimi.

Mots clés : Questions à choix multiples, Apprentissage, Étudiants en médecine, Enseignement medical.

Contexte : La pratique des questions à choix multiples est une méthode d'apprentissage populaire parmi les étudiants en médecine. Alors que les QCM sont couramment utilisés dans les examens, les rédiger pourrait offrir aux étudiants une autre occasion de stimuler leur apprentissage. Pourtant, l'efficacité des questions à choix multiples générées par les étudiants dans l'enseignement médical a été remise en question. L'objectif de cette étude est de vérifier les effets des QCM générés par les étudiants sur l'apprentissage de la médecine, ainsi que de définir les circonstances qui rendraient cette activité plus constructive.

Méthodes : Les articles ont été identifiés par une recherche dans 4 bases de données : MEDLINE, SCOPUS, Web of Science et ERIC, ainsi que par l'analyse des références croisées. Les titres et les résumés ont été sélectionnés sur la base des critères d'éligibilités préétablis et la qualité méthodologique des articles inclus a été évaluée par le MERSQI.

Résultats : 884 articles ont été identifiés, 11 étant des articles retenus après la sélection des résumés, des titres et du texte integral. 6 autres articles récupérés par référence croisée, soit 17 articles au total. La plupart des études ont montré des résultats positifs en termes de perception ou de performance des étudiants, le score moyen de la MERSQI étant de 10,42.

Conclusion : Peu d'articles dans la littérature ont examiné l'influence des QCM générés par les étudiants sur l'apprentissage des étudiants en médecine. Malgré certaines préoccupations concernant le temps et l'effort nécessaire, la rédaction de questions à choix multiples comme méthode d'apprentissage semble être un processus utile pour améliorer l'apprentissage des étudiants en médecine.

الملخص

العنوان : هل يؤدي تطوير الأسئلة المتعددة الاختيارات الى تحسين تعلم طلاب الطب ؟ مراجعة منهجية.

الكاتب : التويسي يونس.

المقرر: الأستاذ الإبراهيمي عز الدين.

الكلمات المفتاحية : الاسئلة المتعددة الاختيارات ، التعلم ، طلاب الطب ، التعليم الطبي.

المقدمة : ممارسة الاسئلة المتعددة الاختيارات طريقة تعليمية شائعة بين طلاب الطب. بينما تُستخدم هذه الأسئلة بشكل شائع في الاختبارات ، قد توفر كتابتها من طرف الطلاب فرصة أخرى لتعزيز تعلمهم. ومع ذلك ، فإن فعالية الاسئلة المتعددة الاختيارات التي وضعها الطلاب تظل *موضع تساؤل* من حيث فعاليتها في التعليم الطبي. الهدف من هذه الدراسة هو التحقق من فعالية هاته الأسئلة التي أنشأها الطلاب على تعليمهم الطبي ، وكذلك تحديد الظروف التي من شأنها أن تجعل هذا النشاط أكثر إيجابية.

الأساليب: تم تحديد المقالات من خلال البحث في قواعد البيانات MEDLINE و SCOPUS و Web of Science و ERIC ، بالإضافة إلى مسح المراجع. تم اختيار العناوين والملخصات بناءً على معايير الأهلية المحددة مسبقًا وتم تقييم الجودة المنهجية للمقالات المدرجة بواسطة MERSQI.

النتائج: تم تحديد 884 ورقة بحثية ، 11 منها تم الاحتفاظ بها بعد فحص الملخص والعنوان وفز النص الكامل. 6 مقالات أخرى تم الحصول عليها من الإسناد الترافقي، مما جعلها 17 مقالة في النهاية. أظهرت معظم الدراسات نتائج إيجابية سواء من حيث إدراك الطلاب أو أدائهم ، وكان متوسط درجة MERSQI 10.42.

الخلاصة: فحصت مقالات قليلة تأثير الاسئلة المتعددة الاختيارات التي أنشأها الطلاب على تعلم طلاب الطب. على الرغم من بعض المخاوف بشأن الوقت والجهد المطلوب لهذه العملية ، يبدو أن كتابة الاسئلة المتعددة الاختيارات كأسلوب تعلم عملية مفيدة لتحسين تعلم طلاب الطب.

APPENDIX

Appendix 1 : *Search strategy*

- **Medline:**
    - Query : ((((Medical student) OR (Medical students)) AND (((Create) OR (Design)) OR (Generate))) AND ((((multiple choice question) OR (Multiple choice questions)) OR (MCQ)) OR (MCQs))) AND (Learning)
    - Results: **300**
- **Scopus:**
    - Query: ALL (medical PRE/0 students) AND ALL (multiple PRE/0 choice PRE/0 questions) AND ALL (learning) AND ALL (create OR generate OR design)
    - Results: **468**
- **Web of science:**
    - Query: (ALL= "Multiple Choice Questions" OR ALL= "Multiple Choice Question" OR ALL=MCQ OR ALL=MCQs) AND (ALL="Medical Students" OR ALL="Medical Student") AND (ALL=Learning OR ALL=Learn) AND (ALL=Create OR ALL=Generate OR ALL=Design)
    - Results: **109**
- **ERIC:**
    - Query: "Medical student" AND "Multiple choice questions" AND Learning AND (Create OR Generate OR Design)
    - Results: **7**

Total=884

After deleting double references: Number: 697

Appendix 2*: Medical Education Research Quality Instrument - for quantitative studies*

Domain	MERSQI Item	Score	Max Score
Study design	Single group cross-sectional or single group posttest only	1	3
	Single group pretest & posttest	1.5	
	Nonrandomized, 2 groups	2	
	Randomized controlled trial	3	
Sampling	*Institutions studied*:		3
	1	0.5	
	2	1	
	3	1.5	
	Response rate, %:		
	Not applicable		
	<50 or not reported	0.5	
	50-74	1	
	≥75	1.5	
Type of data	Assessment by participants	1	3
	Objective measurement	3	
Validity of evaluation instrument	*Internal structure:*		3
	Not applicable		
	Not reported	0	
	Reported	1	
	Content:		
	Not applicable		
	Not reported	0	
	Reported	1	
	Relationships to other variables:		
	Not applicable		
	Not reported	0	
	Reported	1	
Data analysis	*Appropriateness of analysis:*		3
	Inappropriate for study design or type of data	0	
	Appropriate for study design, type of data	1	
	Complexity of analysis:		
	Descriptive analysis only	1	
	Beyond descriptive analysis	2	
Outcomes	Satisfaction, attitudes, perceptions, opinions, general facts	1	3
	Knowledge, skills	1.5	
	Behaviors	2	
	Patient/health care outcome	3	
Total possible score*			**18**

Serment d'Hippocrate

Au moment d'être admis à devenir membre de la profession médicale, je m'engage solennellement à consacrer ma vie au service de l'humanité.

- *Je traiterai mes maîtres avec le respect et la reconnaissance qui leur sont dus.*
- *Je pratiquerai ma profession avec conscience et dignité. La santé de mes malades sera mon premier but.*
- *Je ne trahirai pas les secrets qui me seront confiés.*
- *Je maintiendrai par tous les moyens en mon pouvoir l'honneur et les nobles traditions de la profession médicale.*
- *Les médecins seront mes frères.*
- *Aucune considération de religion, de nationalité, de race, aucune considération politique et sociale ne s'interposera entre mon devoir et mon patient.*
- *Je maintiendrai le respect de la vie humaine dès la conception.*
- *Même sous la menace, je n'userai pas de mes connaissances médicales d'une façon contraire aux lois de l'humanité.*
- *Je m'y engage librement et sur mon honneur.*

قسم أبقراط

بسم الله الرحمان الرحيم

أقسم بالله العظيم

في هذه اللحظة التي يتم فيها قبولي عضوة في المهنة الطبية أتعهد علانية:

- بأن أكرس حياتي لخدمة الإنسانية.
- وأن أحترم أساتذتي وأعترف لهم بالجميل الذي يستحقونه.
- وأن أمارس مهنتي بوازع من ضميري و شرفي جاعلة صحة مريضي هدفي الأول.
- وأن لا أفشي الأسرار المعهودة إلي.
- وأن أحافظ بكل ما لدي من وسائل على الشرف والتقاليد النبيلة لمهنة الطب.
- وأن أعتبر سائر الأطباء إخوة لي.
- وأن أقوم بواجبي نحو مرضـــاي بدون أي اعتبار ديني أو وطني أو عرقي أو سياسي أو اجتماعي.
- وأن أحافظ بكل حزم على احترام الحياة الإنسانية منذ نشأتها.
- وأن لا أستعمل معلوماتي الطبية بطريق يضر بحقوق الإنسان مهما لاقيت من تهديد.
- بكل هذا أتعهد عن كامل اختيار ومقسمة بشرفي.

والله على ما أقول شهيد.

المملكة المغربية
جامعة محمد الخامس بالرباط
كلية الطب والصيدلة
الرباط

سنة : 2021 أطروحة رقم : 186

هل يؤدي تطوير الأسئلة المتعددة الاختيارات الى تحسين تعلم طلاب الطب ؟ مراجعة منهجية.

أطروحة

قدمت ونوقشت علانية يوم : / /2021.

من طرف

السيد يونس التويسي

المزداد في 23 يناير 1996 بتمارة

لنيل شهادة

دكتور في الطب

الكلمات الأساسية : الاسئلة المتعددة الاختيارات ، التعلم ، طلاب الطب ، التعليم الطبي

أعضاء لجنة التحكيم:

السيد علي كتاني أستاذ في الإنعاش والتخدير	**رئيس**
السيد عز الدين إبراهيمي أستاذ في البيوتكنولوجيا الطبية	**مشرف**
السيدة نعيمة الحافيظي أستاذة في طب الأطفال	**عضوة**
السيد عبد الرزاق حاجيوي أستاذ في الطب الفيزيائي وإعادة التأهيل	**عضو**
السيدة مريم فرطاسي أستاذة في الطب الفيزيائي وإعادة التأهيل	**عضوة**