Disadvantages of an informal course vs. a formal course when learning critical reading and assessment of medical articles, in groups of undergraduate interns.

Authors
Héctor Cobos Aguilar *
Patricia Pérez Cortés *
Héctor de la Garza Quintanilla *
Ricardo M. Aguirre Velázquez **
Salvador Gómez García **
Miguel Ángel Romero García**

Affiliations
* Division, Clinical Health Sciences. Universidad de Monterrey.

** Health Education and Research. HGZ 2, HGZ 4, HGZ 33. Delegación Nuevo León. Instituto Mexicano del Seguro Social.

Correspondence
Héctor Cobos Aguilar
Calle 8 No. 430
Col. Villa Azul.
San Nicolás de los Garza, N. L. CP: 66420
E-mail:
cobos.hector@gmail.com
Tel: 01 81 83 76 85 04

Abstract

Introduction: Research is fundamental during the undergraduate internship year. A formal course on critical reading and appraisal has positive effects on the students´ learning. Aim: to compare the results obtained after a formal critical appraisal course *vs.* an informal course in interns.
Material and methods: We studied 79 interns divided into four groups: 1 (n14), 2 (n16), 3 (n15), 4(n13 and n13). The formal course was offered to G_2 and G_4 and the informal one to G_1 and G_3. The formal course was taught by professors with previous experience, it lasted 40 hours and included reading an article, solving guidelines and group discussions led by the interns; the informal course was defined by any of the following: missing more than three sessions, no homework, no discussion. Instrument: valid and consistent, with 96 items, 32 for interpretation, judgment and proposal, and 12 evaluating study design: case-control, diagnostic tests, surveys, instruments, RCT, cohorts, meta-analysis and follow-up. It was applied at the beginning and at the end of the courses. The overall maximum grade was 96, 32 per indicator and 12 for designs. The randomness of answers was determined as well as the weighed progress.
Results: Overall initial *vs*. final (G_1: 18 *vs*. 17, G_2: 20 *vs*. 32*, G_3: 25 *vs*. 26 and G_4: 25 *vs*. 41*); also in judgment and proposals in G_2 and G_4. (*Wilcoxon <0.05). Randomness decreased to 3% and 5% in G_2 and G_4, 9% in G_3, but it increased to 50% in G1. Weighed progress determinations were 2.5 and 3.2 in G_2 and G_4. There was greater progress in the evaluation of designs at the end of formal courses (5 *vs*. 0 and 1).
Conclusion. Formal critical reading and appraisal during the internship increases student advancement and should be appropriately implemented at some point throughout the year.

Key words: critical reading, critical appraisal, internship, formal course.

Introduction.

Several studies have been published worldwide emphasizing the importance of learning research methods during undergraduate training, as well as analyzing the students´ attitude towards this subject,[1] and its obstacles.[2-5] Most have reported inadequate results in this fundamental aspect of contemporary Medicine,[6-8] and that sustains evidence-based medicine as well as provides students with the irreplaceable complex methodology tools required in their daily tasks.

These studies have reported that little attention is placed on these subjects in the curricula as well as educational strategies that do not foster their learning and actually promote their rejection.[9-10]

It is usually considered as an activity pertaining to the postgraduate level and hence, unnecessary for undergraduate students.[11]

Other reports have underscored the implicit difficulties in attempting to combine clinical and research activities, although active publication does improve clinical skills.[12] However, promising interventions at the undergraduate level have also been reported, particularly during internship.[13-14]

The scarce interest attributed to the development of these abilities in undergraduate studies and particularly during internship (a year of in-hospital clinical training after university), leads to its non-inclusion in that year´s study plan that preferably focuses on clinical skills and psychomotor procedures.

In some areas such as Nuevo León, Mexico and specifically at the *Instituto Mexicano del Seguro Social*, the subject of research was introduced during the internship, and its weight was as significant as the fundamental clinical rotations (surgery, pediatrics, internal medicine, emergency care, gynecology and family medicine); results were encouraging and were further strengthened with participative educational interventions such as critical reading in randomized groups so as to decrease possible assignment biases hinging on the assigned medical institution.[15]

These interventions are based on critical reading and appraisal, defined as the reader´s capacity to become conscious of his/her own position on what is expressed in the text, discover the supposed implications, the directive idea, the strong and weak points of the presented arguments and the proposal of other approaches outpointing the authors´ and thus, reaffirming or modifying the student´s own position. It consists of three sub-components: a) interpret what the text´s implicit data deciphers (theories, problem, hypothesis, type of study, design, etc.), b) judge: differentiate the strong *vs.* the weak components (conclusions, type of study and design, instruments, application, data collection and analysis, statistics used and result analysis, etc.) and c) propose: to think about those components that would confer further strength to the critiqued report.[16]

Due to its relevance, the research module has been introduced in other institutions, but the courses have been informal and we believe this compromises the students´ learning of such a transcendental activity in their professional training.

Therefore, the aim of this study is to compare the effects of a formal course *vs.* an informal one in learning the task of critical appraisal of research, among groups of interns in institutions in Nuevo León, a northeastern state in Mexico.

Material and Methods.

Population: we studied 79 undergraduate medical interns (UMI) assigned to several institutions by their respective medical schools, usually on the basis of their grade average. The UMI were divided into several groups: G_1:14, G_2: 16, G_3: 15 and G_4: 26 (subdivided into two groups with n13). The professors´ experience in educational strategies is measured in years: below 10, 10, 5 and 15 and 20, respectively. Groups G_1, G_2 and G_3 belonged to general area hospitals from a social security institution, while group G_4 and its two subgroups were assigned to a private hospital. The frequency of being on-call followed an ABCD pattern in social security institutions and an ABC pattern in the private institution. We requested the interns´ grade average when they began their internship as well as the name of their medical school.

Formal course: Formal course refers to that which the professor conducted in its entirety, no missed classes, and a 40-hour program with weekly 90-minute classes had been previously designed. Students had to be present in all sessions except during their vacation period, and this was corroborated with the student list. Documents were managed in a Blackboard platform that sent the articles to be reviewed one week before class, as well as the recommended references for the type of study and reading guidelines to allow discussion based on solid arguments; they were also sent to the professor in a timely manner so he/she could fully review it, and in-class discussion took place in two sessions (see educational strategy).

Informal course: Informal course is applied to the activities that took place without an established program, the content did not require punctual completion and there was no homework review.

Learning: Learning was operationalized with the results of an instrument, it was expressed as medians, determined in students in all groups, at the beginning and at the end of the course.

Instrument: We applied a valid, reliable (KR: 0.78) and balanced instrument with 96 items: 32 evaluated interpretation, judgment and proposals, 48 were "true" answers, and 48 were "false" answers; 12 items explored relevant aspects pertaining to validity, consistency, designs, statistical methods used, result analysis and conclusions. The following designs were presented during the course: case-control studies, diagnostic tests, surveys, instruments, randomized clinical trials, cohorts, meta-analyses and follow-up. The answer options were "true", "false" and "I don´t know". Grades were obtained by adding one point for every correct answer and subtracting one point if the answer was incorrect. "I don't know" answers neither added nor led to point subtraction. The analysis unit was the median.[17]

Learning strategy: In the formal course, the professor reviewed the solved guidelines and students would discuss with arguments in favor or against the concepts suggested by the items. The professor would intervene in order to

contrast different or even opposite points of view until the correct answer was obtained. The professor would jolt the discussion should it begin to dwindle, until the guideline was completed. In the informal course, the same methodology was suggested for the sessions that took place.

Statistics: We used non-parametric statistic methods, Wilcoxon to analyze progress before and after the course in each group, Mann-Whitney´s U for between-group comparisons before and after the course, the Kruskall-Wallis test to compare all groups before and after the course and for comparisons between the medical schools of origin. We also determined the randomness of the students´ answers with the formula designed by Padilla and Viniegra, as well as the weighed progress by group according to the latter author.[18]

Results

Eight students were excluded due to incomplete evaluations or a change of institution (two in $G_{1,}$ three in G_3 and three in G_4).

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Table 1. Before and after overall and sub-component comparison of results of critical appraisal in Appraisal from all groups.

Grp.	Avge. (SD)	Maximum Grade Indicator: 32 Int1	Int2	Jud1	Jud2	Pro1	Pro2	Overall:92 Ove1	Ove2
1(n:14)	84.9	4	0	9	7	8	10	19	17
Range	(1.9)	(8-10)	(-5 a 6)	(4-21)	(-2 a 17)	(3-19)	(0-9)	(6-40)	(2-36)
2(n:16)	80.6	4	3	7	14[&]	10	17[&]	20	32[&]
Range	(3.0)	(-9 a 13)	(-8 a 12)	(-2 a 14)	(4-24)	(0-16)	(6-21)	(-2 a 37)	(16-52)
3(n:15)	87	1	4	9	12	11	11	25	26
Range	(3.4)	(-12a14)	(-4 a 7)	(-4 a 20)	(-1 a 17)	(.2 a 19)	(6-18)	(-6 a 53)	(-3 a 40)
4(n:26)	88.9	7	12[&]	8	15[&]	11	14[&]	25	41[&]
Range	(2.5)	(-1 a 21)	(0-24)	(0-18)	(3 a 26)	(-3 a 23)	(-8 a 24)	(4-49)	(3-71)
p*	0.01**	NS	0.01	NS	0.02	NS	0.02	NS	0.001

Grp: group, Avge: average, SD: standard deviation, Int: interpretation, Jud: judgment, Pro: proposal, Ove: overall. 1: initial, 2: final. *Kruskal-Wallis, **ANOVA, [&]Wilcoxon<0.05. U de Mann-Whitney favoring $G_{3 \text{ and }} G_4$, in all indicators and final overall grades.

Table 1 shows results by sub-component and the overall results of critical appraisal before and after the course, of the students in all four institutions. There were grade average differences in G4, but no differences were observed before the intervention. Differences were significant in the three sub-components and in the overall results in the groups that followed the formal course (G_2 except in interpretation).

In table 2, significant progress is observed in G_2 in four of the eight designs, and in five in G_4. This progress was not observed in the groups in the informal course.

Table 2. Comparison of initial and final medians, by group and design.

	Maximum grade by design: 12															
Grp.	Ca-Co		Sur		Instr		DxT.		RCT		Coho.		Meta		Surv	
	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I	F
1(n:14)	-2	-1	4	5	4	3	4	3	3	2	4	5	2	4	2	0
2(n:16)	0	0	6	7*	4	4	2	4*	3	6	3	6*	0	4*	3	2
3(n:15)	0	2	4	4	4	3*	3	5	6	4	2	5	2	4	-1	1
4(n:26)	0	3*	4	6*	4	5	4	6*	4	6	4	6*	4	5	2	4
p[&]	NS	0.01	NS	0.01	NS	0.03	NS	0.01	NS	0.01	NS	NS	0.02	NS	NS	0.01

Ca-Co: case-control, Sur: survey, Instr: instrument, DxT.: diagnostic tests, RCT: randomized controlled trial, Coho: cohorts, Meta: meta-analysis, Surv: Survival. [&]: Kruskal-Wallis, *Wilcoxon <0.05.

Table 3 shows a difference in grade averages, favoring university 1. There were no significant differences in the overall result before the course among the students from the three universities, but they were significant in the final results.

Table 3. Comparison of before and after overall medians, according to university.

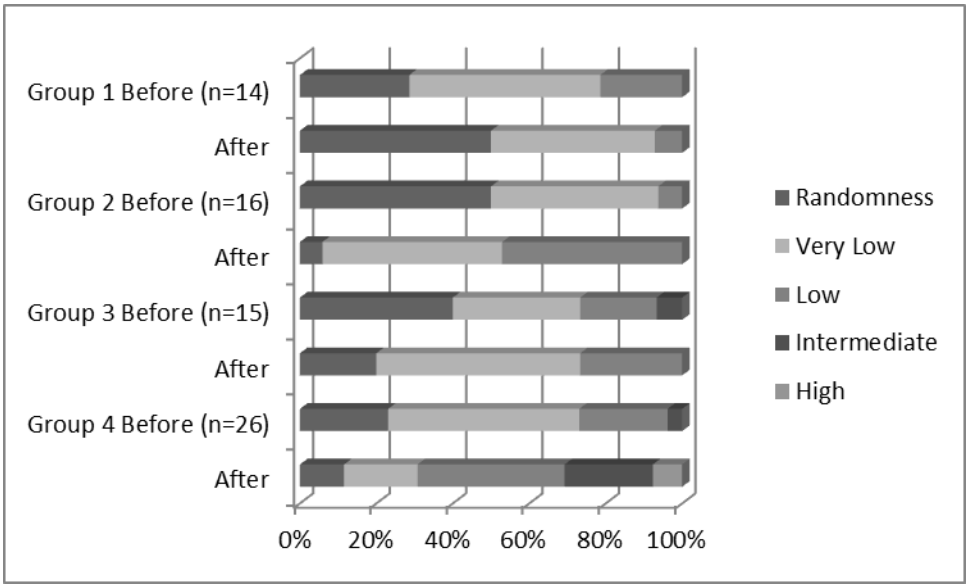
University	Average (SD)	Gl1	Gl2
1 (n:57)	86.6 (4.1)	22 (-6 a 53)	32[&] (3-71)
2(n:12)	82.7 (2.7)	24 (-2 a 36)	21 (2-52)
3(n: 2)	84 (5.7)	16 (13 a 18)	20 (14-25)
p*	0.001**	NS	0.05

*Kruskal-Wallis, **ANOVA, [&]Wilcoxon <0.05.

Figure 1 shows that random answers decrease from 50% to 5% in G_2 after the formal course and from 20% to 10% in G_4. In G_3, they decreased from 38% to 18% while in G_1 they increased from 22% to 44%. Some students reached the intermediate and even the high category only in G_4.

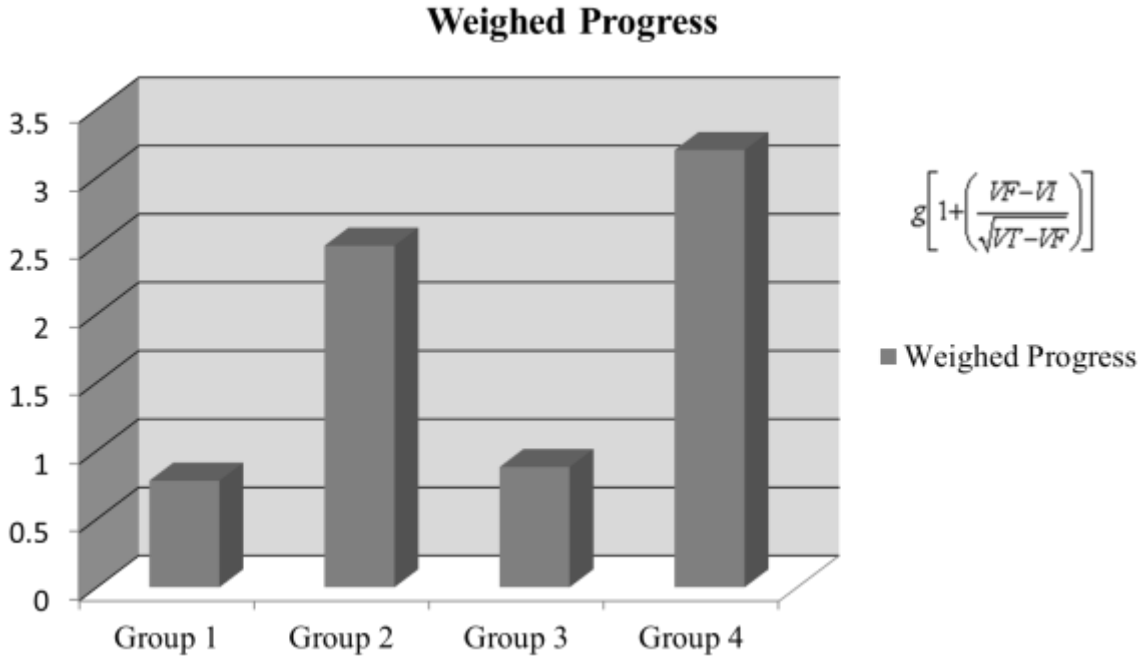
Finally, figure 2 graphically shows the students´ weighed progress, which was higher in the formal course group.

Fig.1 Comparison of initial and final results according to institution, excluding random answers.



Randomness: 16 or below, Very low: 17-32, Low: 33-48, Intermediate: 49-64, High: 65-80, Very high: 81-96

Fig. 2. Weighed progress by institution in the initial and final overall evaluation.



VI: initial value, VF: final value, VT: total value

Discussion.

These results reflect the positive impact on critical reading when taught in a formal course associated to a participative educational strategy and supported by the previously presented results.

Likewise, they underscore the relevance of obtaining measurements at the beginning and end of a course. Without these, the students´ acquired learning cannot be evaluated, A reflective teacher must always consider them in order to verify the students´ progress or detect the obstacles hindering the development of this complex ability.

An informal course has no impact on student learning, since they do not have to complete the homework nor do they engage in the discussions that the students in the formal course sustained. Also, students in the informal group referred that not all sessions were met and this precluded their ability to acquire this indispensable ability; in current times,

information must be critically screened in order to elaborate the concept of knowledge.

Research is not considered an ability that must be developed during medical undergraduate studies or internship, although most university programs have included this module. The subject is also not included in the internship programs as a necessary ability. This confers an informal character to the subject and its teaching tends to depend on the professors´ and students´ time schedules once practical activities have been completed.

However, interventions conducted in different studies suggest that the incorporation of research to clinical activities is possible, particularly since this is a crucial period in which the student develops more complex abilities such as clinical aptitude; although initially incipient, this aptitude will flourish with the ability to critique information in medical reports, and this attitude will become an integral part of the students´ activities throughout their professional lives.

Linking the critique of medical information to daily clinical practice leads to deep reflection on one´s own professional activities which are in permanent transformation, as we question routine practices through empirical references screened through methodological rigor and that in the end, allow us to make better medical decisions in the patient´s benefit.

Therefore, the formality of a research course with the added value of critically appraising published reports, hinges on its incorporation into a study plan that will make this ability relevant to all health professionals[19]; it will allow them to identify institutional barriers in educational strategies and even those obstacles within the students themselves, and help them overcome them through different experiences.[20] The internship year can be greatly enriched with this important methodological resource.

The progress shown in the formal course groups confers this ability to critique different research method designs, which will provide students the means to analyze the numerous and overwhelming amount of information that appears daily

in medical journals. Groups that displayed no progress are at a clear disadvantage in the conduction of these analyses, although they could have helped them improve their clinical decision-making. Although only the development of critical appraisal of medical reports was evaluated, medical decision-making hinges on updated medical information that nevertheless, needs to be critically evaluated.

When comparing universities, initial results had no statistical significance, but did confirm that this subject is an ability that is not developed during the undergraduate years, although some reports have referred a positive attitude toward research worldwide21; significant obstacles remain, including the lack of support and time.[22]

Professors in the formal courses had more experience in the teaching of participative educational strategies but this advantage was balanced by group randomization; still, the participative strategy yielded the encouraging results.

Limitations of the study: the formal groups completed the program while the informal groups did not. Among them, their presence in the sessions, homework or discussion abilities could not be evaluated. But this was not possible due to their corresponding institutional organization that actually reflects the real-life environment in which they complete their internship in our setting. A strength of the study is the availability of a valid and consistent instrument that yields reliable results.

A previous report published in 2009 by Carranza et al., [23] studying medical students, revealed that in those in whom there was no intervention and their knowledge of research was scarce, although the group consisted of select students. In spite of the time that has passed, the results of our study show that non-intervened students are at a disadvantage in the mastering of research concepts when compared with students that completed a formal research course, particularly in terms of critical reading.

The formal inclusion of courses focusing on the development of research at the undergraduate level, stimulates their learning as observed in different reports with baseline and final measurements;[24] the institutional setting must also promote this subject, as in the case of the Medical Education Journal Club at the UNAM,[25] with research professors that support the students,[26] and adjuvant programs that

will further reinforce the relevance of research in the student´s daily tasks and even encourage them to be included in publications in which they have participated.[27]

Strategies such as peer-teaching of research critical appraisal have been implemented in our *milieu* and results have been encouraging[28]; this strategy was based on the results of peer-teaching in the development of clinical aptitudes.[29]

Finally, it appears that the consequences of not completing a formal course are irrelevant but we believe that it puts these students at a disadvantage, since this is a currently irreplaceable ability; not being able to critique new medical information will negatively impact their clinical practice and the students themselves will become aware of the limitations posed to their profession, once they acknowledge this an indispensable ability.[30]

References

1. L Manju, Beevi V, Rawat R, Bindhu A. A study to assess the attitude of under graduate medical students towards research. Int J Com Health and Med Res 2017;3(2):60-65.

2. Al-Halabi B, Marwan Y, Hasan M, Alkhadhari S. Extracurricular research activities among senior medical students in Kuwait: experiences, attitudes, and barriers. Adv Med Educ Pract 2014:5; 95–101.

3. Stockfelt M, Karlsson L, Finizia C. Research interest and activity among medical students in Gothenburg, Sweden, a cross-sectional study. BMC Med Educ (2016) 16:226. DOI 10.1186/s12909-016-0749-3

4. Taype-Rondán Á, Huaccho-Rojas J, Pereyra-Elías R, Mejia CR, Mayta-Tristán P. Research courses' characteristics in Peruvian medical schools. Arch Med 2015;11(2).

5. Meo SA, Hassan A, Aqil M, Usmani AM. Medical education research in GCC countries. BMC Med Educ 2015 Feb 1;15:8. doi: 10.1186/s12909-015-0293-6.

6. Ortega-Loubon C, Zúñiga-Cisneros J, Castro F, Barría-Castro JM, Lalyre A, Silva S, et al. Capacitación en investigación brindada a los estudiantes de medicina de la facultad de medicina de la Universidad de Panamá. Archivos de Medicina [Internet]. [cited September 17, 2016]. (2013;9(3):1-10. En http://www.archivosdemedicina.com/medicina-de-familia/conocimientosy-actitudes-acercade-la-investigacincientfica-en-losestudiantes-demedicina-de-launiversidad-depanam.php?aid=613

7. Mayta-Tristán P, Cartagena-Klein R, Pereyra-Elías R, Portillo A, Rodríguez-Morales AJ. Apreciación de estudiantes de Medicina latinoamericanos sobre la capacitación universitaria en investigación científica. Rev Med Chile 2013; 141: 716-722.

8. Carranza-Lira S, Arce-Herrera RM, Leyva-Salas RI, Leyva-González FA. Lectura crítica de informes de

investigación clínica en estudiantes de pregrado. Rev Med Inst Mex Seguro Soc 2009; 47 (4): 431-438.

9. Kharraz R, Hamadah R, Alfawaz D, Attasi J, Obeidat AS, Alkattan W et al. Perceived barriers towards participation in undergraduate research activities among medical students at Alfaisal University - College of Medicine: A Saudi Arabian perspective. (2016) Med Teach 2016;38:S12-S18.

10. Cabrera-Enríquez JA, Cruzado-Mendoza C, Purizaca-Rosillo N, López-Samanamú RO, Lajo-Aurazo Y, Peña-Sánchez ER, et al. Factores asociados con el nivel de conocimientos y la actitud hacia la investigación en estudiantes de medicina en Perú, 2011. Rev Panam Salud Publica. 2013;33(3):166–73.

11. Jimmy R, Palatty PL, D'Silva P, Baliga MS, Singh A. "¿Are Medical Students Inclined to do Research?" J Clin Diagn Res 2013;7(12): 2892-2895.

12. Seaburg LA, Wang AT, West CP, Reed DA, Halvorsen AJ, Engstler G, et al. Associations between resident physicians' publications and clinical performance during residency training. BMC Med Educ (2016) 16:22 DOI 10.1186/s12909-016-0543-2

13. Cobos AH, Pérez CP, Viniegra VL. Role of creative discussion in the learning of critical reading of scientific articles. Rev Invest Clin 2011;63(3):268-278.

14. Cobos-Aguilar H, Pérez-Cortés P, Bracho-Vela LA' Garza-Garza MA, Dávila-Rodríguez G, López-Juárez DO, Maldonado-González E, Zapata-Aguirre L. Habilidades docentes en alumnos tutores en lectura crítica de investigación médica durante el internado de pregrado. Inv Ed Med 2014;3(10):92-99

15. Cobos Aguilar H, Pérez Cortés P, Vázquez Álvarez MZ, Garcialuna Martinez E. Lectura crítica de investigación en el internado médico de pregrado SIIC *En Internet* www.siicsalud.com, Sección Expertos Invitados, URL www.siicsalud.com/dato/experto.php/137883, septiembre 2014.

16. Viniegra-Velázquez L. Las aptitudes para leer críticamente la información, prioridades ignoradas en la formación de los médicos. Inv Ed Med 2012;1(4):199-209.

17. Cobos AH, Pérez CP, De la Garza QH, Ochoa CCE. Proceso de validación de un instrumento para medir la lectura crítica de informes de investigación médica. Inv Ed Med.2015;4(16):200-206.

18. Pérez–Padilla JR, Viniegra VL. Método para calcular la distribución de las calificaciones esperadas por azar en un examen del tipo falso, verdadero, no sé. Rev. Invest. Clin 1989; 41: 375-9

19. Overholser BR, Foster DR, Henry JR, Plake KS, Sowinski KM. Am J Phram Educ 2010; 74 (9)165:1-9.

20. Laidlaw A, Aiton J, Struthers J, Guild S. Developing research skills in medical students: AMEE Guide No. 69. Med Teach 2012; 34: 754–771.

21. Manju L, Beevi V, Rawat R, Bindhu A. A study to assess the attitude of under graduate medical students towards research. Int J Com Health and Med Res 2017;3(2):60-65.

22. Memarpour M, Ferd AP, Ghasemi R. Evaluation of attitude to, knowledge of and barriers toward research among medical science students. Asia Pac Fam Med 2015 Feb 11;14(1):1. doi: 10.1186/s12930-015-0019-2. eCollection 2015.

23. Carranza-Lira S, Arce-Herrera RM, Leyva-Salas RI, Leyva-González FA. Lectura crítica de informes de investigación clínica en estudiantes de pregrado. Rev Med Inst Mex Seguro Soc 2009; 47 (4): 431-438.

24. Sánchez-Mendiola M, Martínez-Franco AI, Lobato-Valverde M, Fernández-Saldívar F, Vives-Varela T, Martínez-González A. Evaluation of a Biomedical Informatics course for medical students: a Pre-posttest study at UNAM, Faculty of Medicine in Mexico. BMC Med Educ (2015) 15:64. DOI 10.1186/s12909-015-0349-7.

25. Sánchez-Mendiola M, Morales-Castillo D, Torruco-García U, Varela-Ruiz M. Eight years' experience with a Medical Education Journal Club in Mexico: a quasi-experimental

one-group study. Sánchez-Mendiola et al. BMC Med Educ (2015) 15:222. DOI 10.1186/s12909-015-0499-7

26. Bonilla-Escobar FJ, Bonilla-Velez J, Tobón-García D, Ángel-Isaza AM. Medical student researchers in Colombia and associated factors with publication: a cross-sectional study. BMC Med Educ (2017) 17:254 DOI 10.1186/s12909-017-1087-9.

27. Rosenkranz SK, Wang S, Hu W. Motivating medical students to do research: a mixed methods study using Self-Determination Theory. BMC Med Educ (2015) 15:95. DOI 10.1186/s12909-015-0379-1.

28. Cobos Aguilar H, et al. Alumnos tutores y el aprendizaje de la lectura crítica en internado de pregrado. Inv Ed Med. 2017. http://dx.doi.org/10.1016/j.riem.2017.05.006

29. Alkhail BA. Near-peer-assisted learning (NPAL) in undergraduate medical students and their perception of having medical interns as their near peer teacher. Med Teach 2015, 37: S33–S39.

30. Hess DA, Frantz J. Self-assessment of final-year undergraduate physiotherapy students' literature-searching behaviour, self-perceived knowledge of their own critical appraisal skills and evidence-based practice beliefs. Afr J Health Professions Educ 2016;8(2):174-177.