

Effectiveness of Innovative Instructional Module for Professional Competence in Health Literacy in Medical Students

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Research Article

Keywords: Health literacy, Professional competence, Medical education, Medical student

Posted Date: July 13th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-681619/v1>

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Version of Record: A version of this preprint was published at BMC Medical Education on March 28th, 2022. See the published version at <https://doi.org/10.1186/s12909-022-03252-7>.

Abstract

Backgrounds

Physicians in medical environments should be equipped with abilities to acquire better understanding, strengthen autonomy, and support their self-management of patients, which will in turn enhance their health literacy. In this study, we developed an innovative instructional module that targeted medical students and measured their professional competence in terms of health literacy. We then implemented the module to investigate whether the intervention helped medical students improve their professional competence in health literacy.

Methods

We adopted a quasi-experimental design and selected three medical schools from northern Taiwan. For the intervention group ($n = 98$), we assigned fifth-year medical students serving internship at the department of family medicine. Students received a three-hour innovative teaching intervention including teaching materials such as medical simulation videos, role playing, and board games. For the control group ($n = 99$), we recruited same-level fifth-year medical students from other medical schools. Both groups answered pre-test and post-test questions, and then applied generalized estimating equation (GEE) to measure the effect of teaching intervention.

Results

In comparing progress margin, there was significant difference ($p = 0.001$) between the intervention and control groups for knowledge questions, with the intervention group improving 12% more than the control group. In attitude questions, the progress difference was also significant ($p = 0.007$), with the intervention group improving on average 0.27 more points per question than the control group. In skill questions, the progress difference was likely significant ($p = 0.001$), with the intervention group improving on average 0.35 more points per question than the control group. The study indicates that the innovative instructional module intervention had significant effect on professional competence in health literacy in all three aspects.

Conclusion

The proposed innovative instructional module significantly improved fifth-year medical students' professional competence in health literacy, which should in turn benefit their future medical practice.

Background

In investigating the Taiwanese people's experience with health information and healthcare communication, clinical healthcare professionals and health education experts should take note of the public's health literacy and have the ability to attend people with low health literacy and work towards health promotion, healthcare quality improvement, and effective communication between patients and

healthcare professionals.[1] Many studies have suggested a general lack of health literacy in people across different countries. The WHO Regional Office for Europe (WHO/Europe) conducted a large-scale adult health literacy survey between 2009–2012 and discovered that 29–62% of adults, varying by country, had insufficient or problematic health literacy.[2] Meanwhile, in Taiwan, 51.6% of adults have inadequate or problematic health literacy.[3] Studies have also established strong association between low health literacy and poor health outcomes, such as increased hospitalization, higher utilization of emergency care, poorer use of preventative health services, inappropriate medication use, poorer comprehension of medical information, and poorer health status.[4] Low health literacy can also lead to decreased self-care ability, higher risk for chronic disease, unstable physical and psychological conditions, poor prognosis in chronic diseases such as obesity, cardiovascular diseases, and diabetes.[5–7] By contrast, many studies posit that higher health literacy will help patients better comprehend medical information, better utilize social and medical resources, and more adequately organize self-management of health.[8]

During the COVID-19 pandemic in 2020, Taiwan took active measures in utilizing information and communication technologies to help improve the public's level of health literacy. One measure included frequent health education messaging via mass media and schools to promote proper knowledge of disease prevention. Another effort was hosting regularly scheduled daily briefings to share official reports and updates on COVID-19 to correct misconceptions and prevent misinformation. Amid the storm of pandemic, these efforts were fruitfully effective in improving the public's self-management of health.[9] However, at the same time, Taiwan's internationally praised, domestically endorsed health insurance system makes healthcare so accessible and affordable to the public that it has been ceaselessly plagued by troubles of medical resource utilization. Such problems include high frequency of emergency or outpatient visits, duplicated medical attention, and waste of prescription drugs.[10–12] For instance, in 2019, a Taiwanese person made an average of 17.6 visits to emergency or outpatient facilities.[13] Additionally, people's dismissal and disrespect towards healthcare professionals have led to constant report of medical disputes, aggravating patient–healthcare relationship in general.[14] In light of the above, physicians in medical environments should be equipped with abilities to acquire better understanding, strengthen autonomy, and support their self-management of patients, which will in turn enhance their health literacy.[15–18] By means of using a dynamic approach to communication in teaching health literacy and facilitating the autonomy of the patient, these can help health professionals to improve autonomy-supportive communication in such a way that patient and doctor both involved in a long-term learning process of health issue.[19]

Research projects in Taiwan and across the globe all suggest that health literacy curriculum in current medical education has yet to be refined. In 2010, Coleman et al. investigated 61 medical schools in the U.S. and found that 70% of them had introduced health literacy to their medical education curriculum, with content emphasis on “oral transmission of knowledge in health literacy” and “association among literacy, health literacy, and patient health status”. [20] A 2015 intervention study into healthcare professionals' professional competence in health literacy assigned 45 healthcare providers comprised of physicians, social workers, nurses, and medical assistants to a 3.5-hour course in health literacy focused

on patient–healthcare professional relationship. The study affirmed the course’s effectiveness in raising the participants’ self-awareness towards professional competence in health literacy and behavioral intention.[21] Upon examining the training process of medical residents in family medicine, the survey into the course’s effect on professional competence in health literacy discovered that medical residents were able to easily learn contents in health literacy and engage in clear communication. Nevertheless, despite adopting an experiential learning approach, it was difficult to integrate the variegated trained skills with clinical practice.[22, 23] A 2017 study by three European countries – Italy, the Netherlands, and Northern Ireland – also asserted the positive effect of providing professional healthcare providers with comprehensive training in health literacy competence.[24] In sum, earlier public health policies and empirical research focused on enhancing health literacy in patients; nowadays, the focus has shifted towards professional competence in health literacy of healthcare professionals, stressing the education of physicians and other healthcare professionals.

A crucial issue at the moment is how physicians can play a better role in providing health literacy. However, awareness and courses in health literacy issues are scarce in Taiwan’s medical education, so there is indeed pressing immediacy and significance to developing innovative teaching and empowerment dedicated towards physician’s professional competence in health literacy. COVID-19’s impact on the global public health scene has brought by unprecedented challenge to medical education and our healthcare systems.[25, 26] This study advocates implementing an innovative instructional module in medical school curriculum to teach medical students how to observe and assess a patient’s health literacy, understand its significance, and provide suitable doctor-patient interaction pattern to patients with different levels of health literacy. Furthermore, this study hopes to serve referential to future reforms and innovation in medical ethics or humanities education. Our research team developed a set of indicators for physician’s professional competence in health literacy, designed an innovative instructional module, and recruited medical school students for our intervention study and performance analysis.

Methods

Subject and Method of Study

We adopted a quasi-experimental design with a population consisting of fifth-year medical students from 12 medical schools in Taiwan. For the intervention group, we employed purposive sampling and assigned 98 fifth-year medical students serving internship at the department of family medicine from three teaching hospitals in northern Taiwan. They received a three-hour course in professional competence in health literacy, completing pre-test questions before the course and post-test questions after it. For the control group, we recruited 106 fifth-year medical students from other medical schools. They completed pre-test via online questionnaire and post-test via mailed-in questionnaire two weeks later, receiving no treatment at all in between times. Our team informed all participants about our research goal and execution method and acquired signed consent from all of them. Teaching intervention and data collection were conducted between December 2019 and May 2020. All 98 participants in the intervention group completed the “Innovative Instructional Module for Professional Competence in Health Literacy”

course as well as both pre-test and post-test; the valid response rate was 100%. Of the 106 participants in the control group, 99 completed pre-test and post-test; the valid response rate was 93.4%.

Research Instruments

We developed our questionnaire based on the indicators of physician's professional competence in health literacy proposed by Liu et al.[27] We referred to Coleman et al.[28] for health literacy teaching and practices and looked into Objective Structured Clinical Examination (OSCE) curriculum implemented across Taiwanese medical schools for clinical teaching,[29] and then designed medical simulations of doctor-patient interactions for pre-test and post-test evaluation. The questionnaire comprises of 47 items, including 7 knowledge items, 8 attitude items, and 32 skill items. Knowledge items were multiple choice questions with a singular correct answer; higher correct response rate indicates higher level of understanding towards health literacy. Both attitude and skill items took form of 5-point Likert scale. Attitude items offered the answer options of "strongly disagree," "disagree," "no comment," "agree," and "strongly agree," scored 1–5 points respectively, while skill items were answered in "very unconfident," "unconfident," "somewhat confident," "confident," and "very confident," scored 1–5 points respectively.

We also submitted our questionnaire for content validity evaluation by applying the Content Validity Index (CVI). We invited six field experts to review the questionnaire content and evaluate the items and simulations in terms of adequacy, significance, and clarity. For each item, CVI was calculated by dividing the number of experts giving a rating of 3 or higher by the total number of experts. As a result, the average CVI value was 0.8 or higher, with a Cronbach's α value of 0.944, which demonstrate that our proposed questionnaire is an evaluation measure of good content validity.

The Instructional Module, Teaching Curriculum, and Instructor

Our proposed innovative instructional module and intervention strategies were developed on the basis of Spreitzer's Psychological Empowerment Scale.[30] The intervention course module included two parts – two 80-minute instructional sessions and two 10-minute sessions for pre-test and post-test survey – for a total of 180 minutes. Teaching strategies involved approaches such as didactic teaching, observational learning, inquiry-based learning, role play, and game-based learning. We also created simulation videos using original content and invited practicing physicians to demonstrate appropriate and inappropriate doctor-patient interactions to inspire student reflection on health literacy competence. Additionally, we developed a set of card-based board game, in which students acted out roles of physician, patient, and observer. By performing in groups, students practiced teach-back and making shared decisions. Highlights of the teaching contents are shown in Table 1. The teaching instructors were three senior attending physicians in family medicine from three different hospitals who are all qualified to teach in universities. They all participated in curriculum development and teaching design; they also performed pilot teaching and attended evaluation meetings, which created consistency between the teaching module's curriculum and teaching execution.

Table 1
Overview of the Intervention Program

Session	Learning objectives	Contents	Teaching methods
<p>1. Physician's professional competence in health literacy (80 minutes)</p>	<ul style="list-style-type: none"> -Concepts of physician's professional competence in health literacy -Importance and value of physician's professional competence in health literacy -Awareness and evaluation of patient's health literacy -Empathy and acceptance -Respect and support 	<ol style="list-style-type: none"> 1. Present charts and figures on the problem with insufficient health literacy; illustrate common signs of insufficient health literacy in patients. 2. Use slide decks to introduce evaluation tools for health literacy that are used in Taiwan and other countries. <hr/> <ol style="list-style-type: none"> 1. Show videos that help students understand the sense of insecurity or embarrassment that patients may experience when receiving medical attention; encourage students to acknowledge a patient's emotional reactions and express empathy so the patient feels supported and on the same front as their healthcare provider; evaluate a patient's health literacy and accordingly adopt an adequate interaction pattern and offer social support. 2. Utilize videos with storylines centered around a crisis conceptual model on health literacy to help students see different medical scenarios that result from different levels of a physician's professional competence on health literacy. The purpose is for students to acknowledge the importance of a physician's ability to observe and assess a patient's health literacy. <hr/> <ol style="list-style-type: none"> 1. Present slide decks to summarize and conclude key points to help students acknowledge the importance of a physician's ability to observe and assess a patient's health literacy. 	<ul style="list-style-type: none"> -Didactics - Observation learning -Group discussion -Problem solving - Inquiry-based learning
<p>2. New guideline for doctor-patient communication (80 minutes)</p>	<ul style="list-style-type: none"> -Empathy and acceptance -Respect and support - Communication environment -Relationship building -Verbal and non-verbal communication -Easy-to-understand 	<ol style="list-style-type: none"> 1. Divide students into groups for quiz competition and role play, in which students will choose cards corresponding to the story plot; the purpose is to emphasize how different communication patterns will lead to different doctor-patient interaction and help students acquire adequate communication skills. 2. Present slide decks to conclude that good doctor-patient communication is the most important step towards a good doctor-patient relationship; practice applying "teach back" and "shared decision-making" to help patients obtain adequate medical services and the best healthcare outcomes. 	<ul style="list-style-type: none"> -Didactics - Observation learning -Group discussion -Game-based learning -Role play

Session	Learning objectives	Contents	Teaching methods
	patient education materials and human resources -Teach-back -Medical purpose and needs -Shared decision-making -Confirm medical decision	1. Have students act out exemplary doctor-patient interaction scenes; the student who plays the observer role follow the checklist items to conduct evaluation and offer feedback; topics include “teach back,” “shared decision-making,” and “communication and interaction.” <hr/> 1. Use slide decks to summarize learning objectives for physician’s professional competence in health literacy; students should be able to apply relating principles in future medical scenarios to improve doctor-patient relationship and healthcare quality.	

Data Analysis

After collecting and filing the pre-test and post-test questionnaires, we used SPSS version 22 (IBM SPSS Statistics for Window Armonk, NY: IBM Corp) for statistical analysis, utilizing mean values and standard deviation to describe distribution of variables and basic information. Knowledge items are expressed in terms of average correct response rate while attitude and skill items are expressed in terms of average score per item. In our statistical analysis, we performed analysis of covariance (ANCOVA) with pre-test score as the covariate and post-test score as the dependent variable to test for within-group homogeneity of regression coefficient. We found significant effect in “group*pre-test” interaction, suggesting that the two groups are not homogeneous. Then, we applied GEE to compare treatment effects between different groups.

Results

A total of 197 medical school students participated in this study, including 98 in the intervention group and 99 in the control group. Among them, 136 (69.0%) were male and 61 (31.0%) were female; in terms of educational background, 159 (80.7%) were enrolled in public schools and 38 (19.3%) in private schools. The study did not find statistically significant difference in the distribution of gender or educational background between the two groups.

Tables 2 and 3 illustrate the descriptive statistic and analysis results on the two groups’ pre-test and post-test. In terms of knowledge, the average correct response rate for the intervention group was 63% (SD = 18%) in pre-test and 79% (SD = 20%) in post-test; for the control group, it was 57% (SD = 16%) in pre-test and 61% (SD = 19%) in post-test. We applied GEE to analyze variables that impact effect of intervention; after controlling for “group” and “test type” variables, the progress margin for the intervention group was

12% higher than the control group, with significant difference ($p = 0.001$). This suggests that the treatment significantly elevated the research subjects' professional competence in health literacy (Fig. 1-A).

Table 2
Mean proportion of correct answers and scores of professional competence in health literacy for post-test and pre-test of two groups

	Experimental group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
	M(SD)	M(SD)	M(SD)	M(SD)
Knowledge	0.63 (0.18)	0.79 (0.20)	0.57 (0.16)	0.61 (0.19)
Attitude	4.30 (0.47)	4.62 (0.42)	4.38 (0.49)	4.44 (0.56)
Skill	3.87 (0.43)	4.38 (0.49)	4.17 (0.54)	4.33 (0.61)
M = Mean, SD = standard deviation				

Table 3
GEE Analyses with comparisons of post-test and pre-test between two groups

	β	95% CI	<i>p</i> value
Knowledge			
Group (EG vs. CG)	0.06	0.01 ~ 0.10	0.018
Time (Post-test vs. Pre-test)	0.04	-0.01 ~ 0.09	0.134
Group*Time #	0.12	0.05 ~ 0.19	0.001
Attitude			
Group (EG vs. CG)	-0.09	-0.22 ~ 0.05	0.207
Time (Post-test vs. Pre-test)	0.06	-0.09 ~ 0.20	0.437
Group*Time #	0.27	0.08 ~ 0.46	0.007
Skill			
Group (EG vs. CG)	-0.31	-0.44 ~ -0.17	< 0.001
Time (Post-test vs. Pre-test)	0.16	0.001 ~ 0.32	0.049
Group*Time #	0.35	0.14 ~ 0.55	0.001
EG: Experimental group, CG: Control group			
# Reference is "CG x Pre-test". Interaction between Group*Time means compare the degree of change between two groups			

In attitude questions, the average score for the intervention group was 4.30 (SD = 0.47) in pre-test and 4.62 (SD = 0.42) in post-test; for the control group, it was 4.38 (SD = 0.49) in pre-test and 4.44 (SD = 0.56) in post-test. We applied GEE to analyze variables that impact effect of intervention; after controlling for “group” and “test type” variables, the progress margin for the intervention group was 0.27 points higher than the control group, with significant difference ($p = 0.007$). This suggests that the treatment significantly elevated the research subjects’ professional competence in health literacy (Fig. 1-B).

In skill questions, the average score for the intervention group was 3.87 (SD = 0.43) in pre-test and 4.38 (SD = 0.49) in post-test; for the control group, it was 4.17 (SD = 0.54) in pre-test and 4.33 (SD = 0.61) in post-test. We applied GEE to analyze variables that impact effect of intervention; after controlling for “group” and “test type” variables, the progress margin for the intervention group was 0.35 points higher than the control group, with significant difference ($p = 0.001$). This also suggested that the treatment significantly elevated the research subjects’ professional competence in health literacy (Fig. 1-C).

Discussion

We found in this study that, after receiving teaching intervention, medical students in the intervention group showed better knowledge, attitude, and skills than the control group in professional competence in health literacy. This study is the first research project in Taiwan to target medical students in an intervention study into professional competence in health literacy that applies scale-based evaluation instrument, conducts teaching intervention, and achieves significant results. It is a pioneering advocate for future reference in innovating medical education curriculum.

There are several possible attributes to such effect. First of all, the proposed curriculum adopted multi-dimensional indicators such as conception and evaluation, empathy and acceptance, communication and interaction, as well as medical information and decision-making. Secondly, we applied variegated student-centric teaching methods and created interesting material for innovative teaching, including inquiry-based learning, observational learning, group discussion, game-based learning, and role play. Strategies like inquiry-based learning and role play inspire students to think critically about a physician’s professional competence in health literacy. Original simulation videos and intriguing board games inspire interest and motivation. Third, we employed game-based learning in our doctor-patient interaction curriculum to highlight how different communication patterns lead to different doctor-patient interaction. Students acquire appropriate communication skills that help improve doctor-patient relationship and healthcare quality. Meanwhile, the teach-back approach checks if patients have fully comprehended a medical diagnosis or report. The teaching explains when and how to apply teach-back, teaching back information and demonstrating technical procedures, and how to clarify information. Fourth, according to Nutbeam’s model, there are three levels of health literacy – functional, interactive, and critical health literacy.[31] On the healthcare professional’s part, physicians should consider a patient’s reading and writing abilities and whether they can exercise functional health literacy in regular doctor-patient interactions. In the course, the program teaches students about available measurements for assessing a patient’s health literacy and common signs of insufficient health literacy.

Interactive health literacy helps physicians and patients extract information from different communication channels, understand its significance, apply the information, and improve doctor-patient communication patterns. Our educational videos are physician centric. They present outcomes in two-sided arguments to teach students about the consequences of having (positive) and neglecting (negative) professional competence in health literacy. It reinforces students' concerns and impressions towards the issue. We also introduced the concept of shared decision-making for best healthcare outcomes.[32] As for the highest level – critical health literacy – physicians provide patient-tailored teach-back approaches, provide readable materials and social support resources, and help patients execute self-management and disease management.[33]

Coleman et al. surveyed U.S. medical schools for how they were implementing health literacy courses. Of the 61 schools that responded, 72% listed health literacy as a required course, with an average of three class hours, similar to our study's teaching time. Most were taught during freshman or sophomore year and employed multiple teaching methods such as lecture, medical simulation, workshop, role play, literature review, video, and learning through practice with patients of low health literacy. They evaluated students using objective structured clinical examination (OSCE), clinical observation, and written tests. [20] In this study, our evaluation was carried through survey on physicians' professional competence in health literacy, which not only offers quantified representation of teaching effect but also echoes the U.S. Institute of Medicine's (IOM) 2004 report, "Health Literacy: A Prescription to End Confusion," which urged all healthcare professional training programs to include courses in effective communication with low health literacy patients.[34] Ever since the COVID-19 pandemic outbreak in early 2020, healthcare professionals and the common people have been receiving disease information that, whether correct or not, cast swift and fundamental influence. In a time like this, health literacy has become more important than ever.[35, 36] Misinformation threats have impacted all aspects of our social ecological model. In terms of medical field organizational hierarchy, this study emphasizes the importance of teaching and intervention effects of health literacy courses in healthcare professional education.[37–42] In clinical and community fields, there have been studies on professional competence in health literacy with variegated practicing healthcare professionals or medical students as subjects; after implementing comprehensive teaching intervention on functional, interactive, and critical health literacy, the study found significant progress in knowledge, attitude, and skills.[24, 33, 43] Our study applied a similar curriculum design concept; we can see that comprehensive teaching module is a reliable and cogent teaching method in both clinical and school settings.

As for research limitations, first of all, since our control group recruited free-willed participants, it is possible that they were students interested in the subject matter, which could have given them better pre-test scores in attitude and skills in comparison to the intervention group. Second, post-test surveys were filled out immediately after teaching intervention, so long-term effects have yet to be observed. Third, since our evaluation survey was self-administered, it is possible for self-reported errors to impact performance analysis.

Based on our findings, regarding curriculum reform of liberal arts courses for medical students, we noted that although our current medical education offers extensive liberal art courses, they fall short in issues concerning physicians' professional competence in health literacy. We recommend transforming our proposed innovative instructional module into themed micro-teaching activities or dividing them into different sessions to streamline class time. We plan to conduct teaching in relevant courses at Taiwanese medical schools. For the clinical field, we suggest hosting educational training in health literacy to raise physician awareness towards low health literacy phenomenon in Taiwan. Government departments and academic institutes can also join in developing teaching material that physicians across specialties may take advantage of during healthcare services or health education scenarios to improve and raise awareness towards patient's health literacy. They will provide suitable medical information to enhance doctor-patient professional and elevate quality of care.

Conclusions

The proposed innovative instructional module significantly improved fifth-year medical students' professional competence in health literacy, which should in turn benefit their future medical practice. They should be able to more acutely observe a patient's health literacy to help them obtain, understand, evaluate, and apply medical information, achieving efficient utilization of medical resources and improvement in healthcare quality.

Abbreviations

COVID-19: Coronavirus disease 2019; OSCE: Objective Structured Clinical Examination; CVI: Content validity index; ANCOVA: Analysis of covariance; GEE: Generalized estimating equation; SD: Standard deviation

Declarations

Ethical approval and consent to participate

Ethical approval for this study was obtained from National Taiwan Normal University Ethical Review Board(201809HS007). Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated during and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

Funding

This study is a partial research result of a Taiwan's Ministry of Science and Technology research project. (107-2511-H-003-051-MY2) The founder had no role in this study.

Authors' Contributions

Conception or design of the work: H.F.Y., C.C.C. and C.Y.T.

Acquisition, analysis, or interpretation of data: H.F.Y., C.C.C. and P.L.T.

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Revising it critically for important intellectual content: H.R.L., J.S.T., W.H.H., Y.H.F., C.X.W. and C.Y.T.

Final approval of the version: C.Y.T.

Acknowledgements

The authors would like to thank Dr. Chunag-Yen Huang for his support and thank the study participants for their time.

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Figures

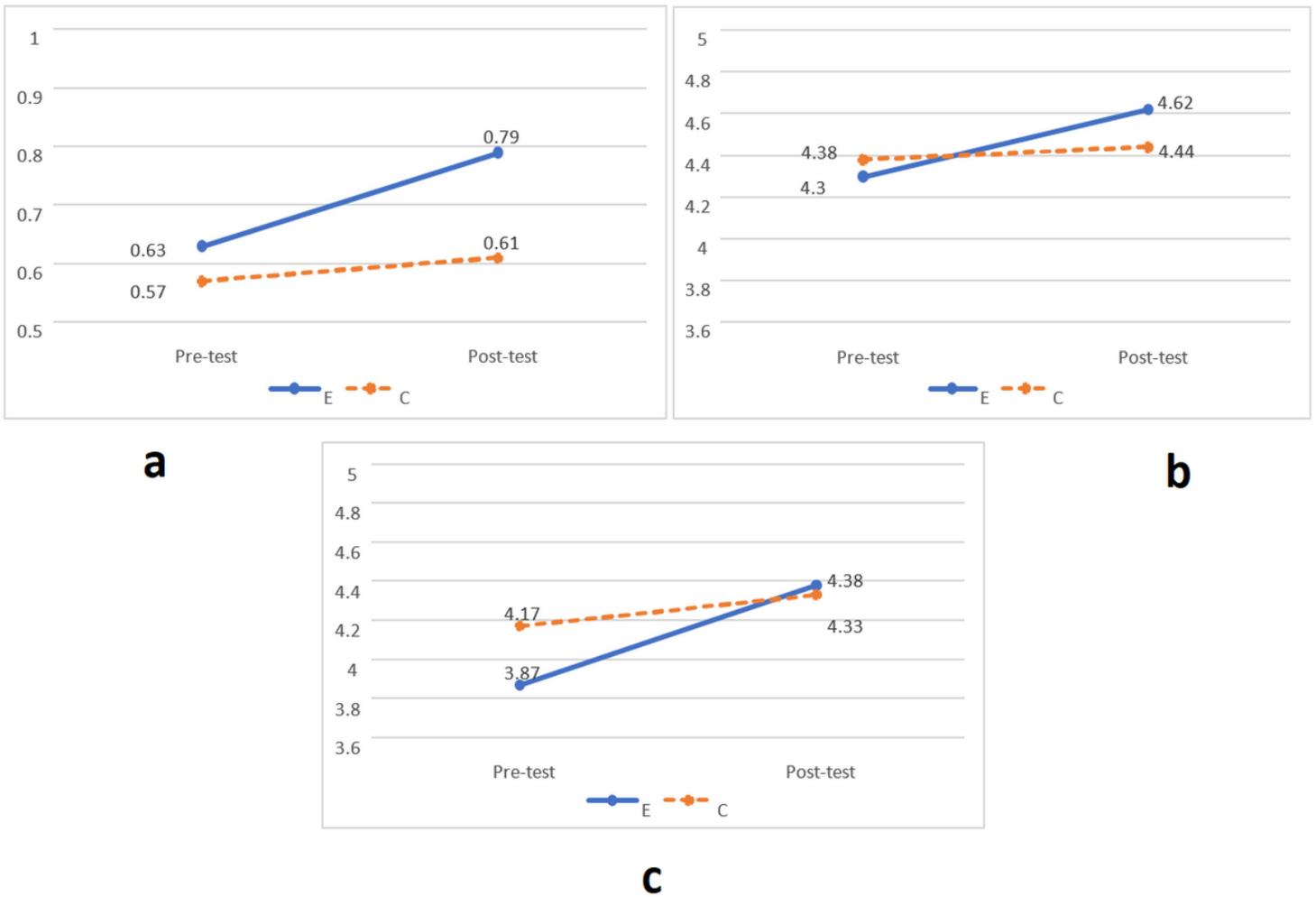


Figure 1

Figure 1-A Change in the mean proportion of correct answers for knowledge aspect in health literacy competence between the two groups Figure 1-B Change in the mean scores of attitude aspect in health literacy competence between the two groups Figure 1-C Change in the mean scores of skill aspect in health literacy competence between the two groups