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How competent are nursing, midwifery, and biomedical technician educators in Ethiopia on key education tasks? An institution-based cross sectional study

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Title Page

Title: How competent are nursing, midwifery, and biomedical technician educators in Ethiopia on key education tasks? An institution-based cross sectional study

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ABSTRACT:

Introduction: Ethiopia scaled up health professional education. However, training institutions experienced shortages of qualified educators. Understanding the competency of educators is key to informing faculty development, recruitment, and performance monitoring. This study aimed to assess teaching competency levels of nursing, midwifery, and biomedical educators.

Methods: We conducted a cross-sectional study at two colleges and nine student practice sites in January 2020. We adapted the WHO's nurse and midwifery educator competencies to develop data collection tools. Using a census sampling strategy, all educators self-rated their competencies on a Likert scale of 1 to 5. Graduating students also rated the performance of educators. We computed descriptive statistics. Average composite competency scores were calculated. We calculated proportions in teaching skills and performance gaps by combining responses. Chi-square tests with P-values and Cramer's V coefficients were used.

Results: Most educators were not trained in teaching methods (82 %). The competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. Competency gaps were found in using active learning methods, performance assessment, digital learning, and feedback. Clinical preceptors had lower competency levels. Profession type of classroom instructors was strongly associated with their competency level (P-value = 0.004; Cramer's V coefficient of 0.507). Age, sex, and teaching experience of clinical instructors had a mild to moderate association with their competency level (P-values <0.025; Cramer's V coefficient ≤ 0.325). Male and female students had different perceptions on being treated as adult learners, and how well the educators create a conducive learning environment, provide orientations, and give education resources (P <0.035; Crammer's V coefficient <0.325).

Conclusions: Nursing, midwifery, and biomedical educators lacked the competency to undertake significant proportions of education tasks. The competency gaps might affect the quality of

education. More attention should be given to strengthening faculty recruitment, development, and retention.

Strengths and limitations:

- In this study, we adapted validated educators' competency frameworks into the local contexts for assessing a wide range of educator competencies.
- Multiple perspectives from classroom instructors, clinical preceptors, and students improved the validity of the findings.
- Although competency is better assessed using performance tests, we used a self-report of educators to assess confidence levels to undertake competency areas.
- Acknowledging that responses could be subject to under-or over-reporting due to memory lapse, inattention, differing interpretations, and sociocultural contexts, adequate orientation given to educators during data collection improved the quality of the data.
- Since there was no nurse and midwifery graduating class during the study period, health extension workers (HEWs) graduating students were included instead who were taught by the same educators and could give similar judgments.

INTRODUCTION:

A stronger health workforce is a vital determinant for improving population health outcomes. The world is currently facing health workforce shortages as the result of challenges in the education, deployment, retention, and performance of health professionals.[1, 2] Globally, eighteen million more health professionals are needed by 2030; mainly in developing countries, to achieve universal health coverage (UHC).[1] And nine million more nurses and midwives are required to reach sustainable development goal (SDG) 3 on health.[1] Biomedical engineering professionals are required to a great extent to optimize the development and use of medical equipment.[2,3] Substantial health workforce investments are; therefore, required to achieve UHC and SDG health targets.

Ethiopia has suffered from a critical shortage of competent, motivated, and well-performing nurses, midwives, and biomedical technicians.[4] The 2018 national health workforce density was 10 doctors, nurses, and midwives per 10,000 populations; which was far below the World Health Organization's (WHO's) threshold of 45 for achieving the UHC.[5] Few biomedical engineering professionals were available in 2017 (0.002 per 10,000 populations).[6] The shortage of health professionals affected access to quality care. The national health indicators had undesirable measures. For instance, in 2019, maternal mortality (353/100,000) and under-five mortality rates (59/1,000) were unacceptably high.[5]

To address the health workforce shortages, WHO recommended countries rapidly scale up and transform health professional education.[7] Hence, Ethiopia expanded preservice education (PSE) leading to the burgeoning of the health workforce graduation capacity.[8, 9] But, the education quality received less attention. Scaling up education and graduating more professionals only might not address the health challenges. It might further deteriorate education quality unless the institutions had congruent commitment and resources to adequately support the expansion. In reality, the massive expansion in the face of inadequate teaching faculty exacerbated Ethiopia's education quality concerns.[9, 10] Assuring that health graduates in Ethiopia are competent needs a lot of work.[11-13] Availability of qualified educators are key to ensuring the production of competent graduates.[7, 15] Educators need to master relevant core competencies for effective facilitation of classroom sessions and student clinical practice, developing learning materials, assessing student

learning, and providing supports to students.[15-18] Skills in one's health profession, communication, leadership, and research make one an effective health professional educationist.[7, 15, 16] On top of that, large student size, epidemiological transition, advancing medical knowledge, and technology have required educators to improve their teaching skills.[14] However, the current status of teaching competency levels of health professional educators in Ethiopia is not well studied. Understanding the capabilities of educators provides essential inputs to guide faculty development, recruitment, performance monitoring, and other quality enhancement interventions. Such evidence expands the global knowledge base and informs health professional education practices in other countries having similar challenges. The aim of this study was to assess teaching competency levels and associated factors of nursing, midwifery, and biomedical educators in Ethiopia.

METHODS

Study design and participants

We conducted an institution-based quantitative cross-sectional study in January 2020 that was used as a baseline survey for the faculty development project (FDP). Our study questions were focusing on teaching competency levels and gaps of the educators and the associated factors. The aim of the FDP project was to improve the quality of level IV vocational nursing and midwifery training at Nekemte Health Science College (NHSC), and biomedical technician training at Addis Ababa Tegebareid Polytechnic College (AATPTC). NHSC, located in western Ethiopia of Nekemte city, was providing vocational nursing, midwifery, and other midlevel health professional training. AATPTC, found in Addis Ababa city administration, was providing vocational biomedical technician training and others. The colleges worked with 14 student practice sites. Based on convenience, we selected 5 hospitals, 2 health centers, and 2 biomedical equipment workshops. The biomedical equipment workshops were workplaces for biomedical technicians and engineers where medical equipment was stored, tested, calibrated, and maintained. In 2019, there were 154 educators and 125 graduating students of the nursing, midwifery, and biomedical technician level IV training programs. Of the educators, there were 57 classroom instructors and 97 clinical preceptors. We used a census sampling strategy to include all classroom instructors, clinical preceptors, and graduating students. Classroom instructors are teaching staff hired by and work in the colleges to teach and support students. Clinical preceptors are health workers hired by a health facility or medical equipment workshops to primarily provide patient care or medical equipment

services. We decided to include graduating students as they had adequate exposures and experiences enough to make valid judgments on the educators' performances. We obtained lists of the classroom instructors, clinical preceptors, and graduating students from the deans and registrar offices of the colleges. The educators and graduating class students who were present at work during the data collection period, willing and able to participate in the study were included as study participants.

Data collection:

We developed three structured data collection tools based on the WHO midwifery and nurse educator competencies[15, 16] The first tool (with 63 variables) was a self-administered questionnaire aimed at exploring perceptions of classroom instructors on their capabilities to implement tasks related to classroom teaching, clinical practice, student assessment, student support functions, learning material development, and organizational management. The second tool (with 45 variables) was a self-administered questionnaire for assessing perceptions of clinical preceptors on their clinical teaching, student assessment, student support, infection prevention, and patient safety skills. The third tool (with 49 variables) was also a self-administered questionnaire for graduating class students aiming to obtain information on the current teaching performances of their educators. All three tools had variables about the background characteristics of the study participants. In collaboration with five national health professional education experts, we validated and piloted the tools at 2 institutions. To assure data quality, we selected 7 data collectors who had an education level of master's degree and relevant experience. We trained the data collectors for 2 days on data collection procedures, contents of the tools, REDCap application, and ethics. The data collectors orientated and supported study participants to fill out the questionnaires correctly. The responding educators rated their perceptions on their competencies for each of the teaching tasks on a 5 point Likert scale, where "1" meant not capable; and "5" meant proficient on the task. The graduating students rated the performance of the educators on the teaching tasks on a 5 point Likert scale. Where "1" meant no educator applies the skill consistently. And "5"meant that all instructors apply the skill consistently. The data collectors were closely supported by 3 supervisors. Errors and omissions found during data collection were corrected timely. The data collection period was on January 14 – 22, 2020.

Data management and analysis

Electronic data were collected using the REDCap application that was used for checking completeness, consistency of responses, and cleaning data. We then exported the data to SPSS version 25 to conduct analysis. We conducted data analysis by computing proportions, means, standard deviations, and other descriptive statistics. Aggregate scores were calculated as necessary. To assess the competency levels, average composite scores were calculated for each competency area. Total composite scores were also calculated to determine their overall competency levels. Composite scores were calculated using weighted averages which combined multiple items and avoided information overload. The composite scores enabled us to convert the ordinal data we obtained from Likert scales into numerical data for further statistical tests. To calculate the proportions of educators with skill gaps, we combined the responses of all educators who rated themselves not capable, novice, and advanced beginners, and considered them as incompetent. Similarly, we considered responses from all students who rated most, and all of their educators apply the teaching skills as well-performing while calculating the proportion of performing educators. Chi-square tests with P–values and Cramer's V coefficients were computed to assess the strengths of associations. As per the higher education system in Ethiopia, the minimum qualification of educators to teach level IV vocational students is a bachelor's degree.[19] And a sixty percent cutoff is an agreed pass score for bachelor of education programs.[20] Hence, we defined a competency score of 60 as a cutoff point to classify the educators as "competent" or "not competent"

Ethical consideration:

We obtained ethical clearance from Johns Hopkins Bloomberg School of Public Health Institutional Review Board with IRB number **16606**. The Oromia regional health bureau and the training institutions approved the study protocol and provided support letters to conduct the study. The study team met with deans, department heads, and facility managers of the target institutions to explain the purpose of the study and data collection processes. Data collectors obtained informed oral consent from each study participant before data collection. Data on study participants' names and other personal identifiers were not collected. We also placed the study datasets on a secured organization platform for keeping participants' information confidential.

Patient and public involvement:

No patients or members of the public were involved in the research design, analysis, and dissemination of the findings. Deans, educators, and experts from the ministry of health, regional health bureau, professional associations, and implementing partners were involved in the interpretation and utilization of the findings.

RESULTS:

Background characteristics of study participants:

A total of 147 educators and 112 graduating students participated in the study with response rates of 95 % and 90 %, respectively. The mean age of the educators was 32 years with a range of 19 – 54 years. More than half of the educators were below 30 years of age (54%). Nearly half of the respondents were female (48 %) and had less than 5 years of teaching experience (45%). The mean period of the educators' work experience was 7 years. The majority of the educators were not trained on teaching skills courses in the last two years (82 %). See table 1. The graduating students were mostly health extension workers (HEW) by department (70 %), in the age group of 20 – 22 years (64%), and females by sex (80 %). See figure 1.

Table 1: Background characteristics of educators participating in the study, Ethiopia, Jan 2020 (N= 147)

Background Characteristics	NHSC N (%)	AATPTC N (%)	Total N (%)
Type of educators			
Classroom instructors	37 (30)	14 (64)	51 (35)
Clinical preceptors	88 (70)	8 (36)	96 (65)
Age in years			
<30	60 (48)	19 (86)	79 (54)
30 – 39	48 (38)	2 (9)	50 (34)
>39	17 (14)	1 (5)	18 (12)
Sex			
Male	63 (50)	14 (64)	77 (52)
Female	62 (50)	8 (36)	70 (48)
Education			
TVET level 4	9 (7)	4 (18)	13 (9)
BSc degree	112 (90)	18 (82)	130 (88)
MSc & above	4 (3)	0 (0)	4 (3)
Profession			
Nurse	76 (61)	0	76 (52)
Midwife	27 (22)	0	27 (18)
Biomedical technician	0 (0)	22 (100)	22 (15)
Others	22 (18)	0	22 (15)
Teaching experience in years			
<5	50 (40)	17 (77)	67 (45)
5 – 10	37 (30)	5 (23)	42 (29)
>10	38 (30)	0	38 (26)

Trained on teaching skills course in the past 2 years			
Yes	18 (14)	9(41)	27 (18)
No	107 (6)	13 (59)	120 (82)

*NHSC = Nekemte Health Science College
*AATPTC – Addis Ababa Tegbareid Polytechnic College

Teaching competency score of the educators

The overall average composite competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. The classroom instructors had less than 60.0 % scores in two competency domains; namely, developing and using education materials (55.4 %), and providing management and leadership functions (58.4 %). However, clinical preceptors scored less than 60.0 % in all four competency domains: clinical teaching skills (52.7 %), student assessment and evaluation (47.3 %), student support functions (51.2 %), and infection prevention and patient safety (58.8 %). See tables 2 and 3.

Table 2: Teaching mean competency scores of the classroom instructors, Ethiopia, Jan 2020 (N= 51)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Facilitate theoretical learning in classroom	12	67.9 (14.4)	51.3 (13.0)	63.7 (15.8)
Facilitate student clinical practicum	7	73.0 (14.4)	61.9 (17.0)	70.2 (15.9)
Conduct student assessment and evaluation	18	67.5 (14.8)	55.6 (13.1)	64.4 (15.2)
Develop and use education materials/resources	10	57.3 (13.1)	49.9 (12.7)	55.4 (13.3)
Provide student support functions	3	63.5 (7.9)	51.8 (14.7)	60.5 (17.7)
Provide management & leadership functions	3	61.9 (18.1)	48.2 (12.2)	58.4 (17.7)
Overall composite average competency score		**65.2 (13.2)**	**53.1 (12.4)**	**61.1 (13.9)**

SD means standard deviation

Table 3: Teaching mean competency scores of the clinical preceptors, Ethiopia, Jan 2020 (N=96)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Clinical teaching skills	10	52.3 (20.9)	57.0 (18.7)	52.7 (20.7)
Student assessment and evaluation	15	47.5 (18.0)	45.0 (14.6)	47.2 (17.8)
Student support functions	4	51.4 (21.3)	53.8 (20.3)	51.5 (21.3)
Infection prevention and patient safety	5	58.7 (24.4)	59.5 (22.9)	58.7 (24.2)
Overall composite average competency score		**52.4 (19.8)**	**53.8 (17.9)**	**52.5 (19.6)**

SD means standard deviation

Top teaching competency gaps of the educators

More than two-thirds of classroom instructors perceived that they had gaps in developing and using student performance assessment (portfolios, objective structured clinical/practical examinations (OSCE/OSPE), logbooks), and digital learning solutions. And more than three-quarters of clinical preceptors perceived that they had gaps in developing and using student performance assessment, active learning methods (case study, role play, discussion, and group assignment), and providing constructive feedback. See table 4.

Table 4: Top competency gaps of classroom instructors on the left and clinical preceptors on the right, Ethiopia, Jan 2020.

Teaching competency of classroom instructors Skill area	% of not competent (N=51)	Teaching competency of clinical preceptors Skill area	% of not competent (N=96)
Develop and use portfolio	82.4	Administer the short and long exam	93.8
Use of digital solutions for learning	80.4	Administer global rating	90.6
Develop and use of logbook	72.5	Use portfolio	82.3
Develop and administer OSCE/OSPE	72.5	Develop and use a logbook	81.3
Conduct education program evaluation	72.5	Use 360 evaluation	81.3
Create a conducive learning environment	70.6	Support unsuccessful students	79.2
Develop and use course syllabi	70.6	Provide constructive feedback	78.1
Support educational QA processes	70.6	Use discussion & group assignment	78.1
Provide student support functions	68.6	Crease conducive learning environment	76.0
Provide gender supports to female students	66.7	Develop and use case study	76.0
		Create and use role play	76.0

Factors associated with the competency level of educators

The professional background of classroom instructors was significantly associated with their competency level (P-value = 0.004) with a strong association (Cramer's V coefficient of 0.507). Age, sex, and years of teaching experience of the clinical preceptors were also significantly associated with their competency levels (P-values = <0.025) with weak to medium degrees of association (Cramer's V coefficient ≤ 0.325). See table 5.

Table 5: Factors associated with competency level of class room instructors (above) and Clinical preceptors (below), Ethiopia, Jan 2020.

Background Characteristics	Teaching competency score (N=51)		Pearson Chi square	
Instructors	**<60 N (%)**	**60+ N (%)**	**P-value**	**Degree of association (Crammer V coefficient)**
Age in Years				
<30	12 (54.5)	17 (58.6)	0.528	0.158
30 - 39	8 (36.4)	7 (24.2)		
>39	2 (9.1)	5 (17.2)		
Sex				
Male	17 (77.3)	24 (82.8)	0.625	0.068
Female	5 (22.7)	5 (17.2)		
Profession				
Nurse	9 (40.9)	5 (17.2)	**0.004***	**0.507**
Midwife	0	1 (3.5)		
Biomedical	9 (40.9)	4 (13.8)		
Others	4 (18.2)	19 (65.5)		
Level of education				
TVET level	1 (4.5)	2 (6.9)	0.907	0.062
BSc degree	19 (86.4)	25 (86.2)		
MSc degree above	2 (9.1)	2 (6.9)		
Teaching experience in years)				
<5	16 (72.7)	18 (62.1)	0.518	0.161
5 – 10	1 (4.6)	4 (13.8)		
>10	5 (22.7)	7 (24.1)		
Trained on Teaching skills courses in the past 2 years				
Yes	8 (36.4)	6 (20.7)	0.214	0.174
No	14 (63.6)	23 (79.3)		
Preceptors (N=96)				
Age in years				
<30	29 (43.3)	21 (72.4)	**0.023***	0.280
30 – 39	27 (40.3)	7 (24.1)		
>39	11 (16.4)	1 (3.5)		
Sex			**0.019***	**0.240**
Male	20 (29.8)	16 (55.2)		
Female	47 (70.2)	13 (44.8)		
Profession				
Nurse	45 (67.1)	17 (56.6)	0.715	0.084
Midwife	17 (25.4)	9 (31.0)		
Biomedical	5 (7.5)	3 (10.4)		
Education				
TVET	7 |(10.5)	2 (6.9)	0.584	0.056
BSc degree	60 (89.5)	27 (93.1)		
Teaching experience in years				
<5	17 (25.4)	16 (55.2)	**0.007***	0.323
5 – 10	26 (38.8)	10 (34.5)		
>10	24 (35.8)	3 (10.3)		
Trained on teaching skills courses in past 2 years				
Yes	6 (8.9)	6 (20.7)	0.110	0.163
No	61(91.1)	23 (79.3)		

Students' perception about the application of teaching skills by their educators

Significant proportions of graduating students perceived that most of their educators did not consistently use digital learning solutions (81%), create a conducive and safe learning environment for students (50%), provide counseling and psychosocial support to students (50%), use a variety of student assessment methods (49%), and apply active and engaging learning methods (43 %). See figure 2.

Factors associated with students' perception about the application of teaching skills by educators

Female and male students had different perceptions on how the educators respect and treat students as adult learners (p-value =0.031), orientate students (p=0.022), provide appropriate education materials (P=0.000), and create a conducive learning environment (P=0.035) with weak to moderate degree of associations (Cramer's V coefficient = < 0.325) see tables 6

Table 6: Association between background characteristics of graduating students and their perception on the performance of educators, Ethiopia, Jan 2020.

Tasks of Educators	Sex (N=112)		Pearson Chi-square	
	Male N(%)	Female N(%)	P-value	Degree of association (Crammer V)
Respect as adult learners				
Yes	13 (56.5)	70 (78.7)	**0.031***	**0.204**
No	10 (43.5)	19 (21.3)		
Orientate Students				
Yes	12 (52.2)	68 (76.4)	**0.022***	**0.217**
No	11 (47.8)	21 (23.6)		
Apply interactive lectures				
Yes	13 (56.5)	53(59.5)	0.792	0.025
No	10 (43.5)	36 (40.5)		
Use digital solutions for learning				
Yes	5 (21.7)	16 (17.9)	0.680	0.039
No	18 (78.3)	73 (82.1)		
Provide appropriate educational materials				
Yes	4 (17.4)	62 (69.7)	**0.000***	**0.429**
No	19 (82.6)	27 (30.3)		
Ensure conducive learning environment				
Yes	16 (69.57)	40 (44.94)	**0.035***	**0.199**
No	7 (30.43)	49 (55.06)		
Facilitate in a gender-responsive manner				
Yes	14 (60.9)	56 (62.9)	0.856	0.017
No	9 (39.3)	33 (37.1)		

Facilitate practical learning session				
Yes	1 (4.4)	19 (21.4)	0.058	0.179
No	22 (95.6)	70 (78.6)		
Provide good feedback				
Yes	13 (56.5)	51 (57.3)	0.946	0.006
No	10 (43.5)	38 (42.7)		
Provide counseling & psychosocial support				
Yes	8 (34.8)	48 (53.9)	0.102	0.149
No	15 (65.2)	41(46.1)		
Manage time and resources				
Yes	9 (39.1)	50 (56.2)	0.144	0.138
No	14 (60.9)	39 (43.8)		

DISCUSSION:

In almost every country in the world, there were health workforce shortages, skill mix imbalances, and uneven geographical distribution, leaving millions without access to healthcare.[1, 2, 7] A need to scale up PSE has intensified not only to train more health professionals, but also transform training quality to improve population health outcomes.[7] Being one of the 57 countries with severe health workforce crisis[7], Ethiopia scaled up health professional education. But, it was challenged to uphold PSE quality.[9 - 11] Other low and middle-income countries (LMICs) faced similar challenges due to a shortage of qualified educators and other factors whilst addressing the workforce challenges.[12, 23 - 25]

In this study, we found out that the educators felt competent on essential teaching tasks, but not on all the relevant ones. We identified competency gaps among the significant proportion of educators in using active learning methods, student performance assessment, digital learning solutions, gender-responsive pedagogy, and performance-based feedback. The findings may not be surprising as health professions education in Ethiopia was not well developed. The educators lacked formal teachers' education opportunities.[19, 21] Health professionals were recruited for the complex tasks without demanding skills and experiences in teaching.[22] Faculty recruitment focused mainly on the academic achievements of new graduates. Similar faculty recruitment and development challenges were reported in many LMICs.[23 – 26] However, educators in a developed world are required to have teaching qualifications and experiences before their deployments.[27 - 30] One contributing factor for the suboptimal teaching competency might be the limited professional development opportunities to the faculty in Ethiopia.[22] On the contrary, faculty development on a

wide range of educational activities is recommended to educators.[31 -33] The rapid PSE scale-up in the country might exacerbate the shortage of qualified educators.[9 - 11]

Since many educators in our study were less than 30 years of age and had less than five years of work experience, they might not be able to use practice-based improvement opportunities to build their teaching competency. A WHO report corresponded with our findings that only 6.6% of educators in LMICs were adequately prepared and had sufficient teaching qualifications.[16] From an optimistic point of view, one could argue that the educators were doing good, given they had no formal education, inadequate faculty development opportunities, and fewer teaching experiences. Another point of concern is that the competency levels of the clinical preceptors were lower than classroom instructors. This might be due to the differences in the work arrangement. Clinical preceptors were hired by practice sites mainly to provide services with no explicit preceptorship roles. They had rarer faculty development opportunities. This might mean that it is difficult to realize Ethiopia's vocational education strategy.[21] Reports also claimed that vocational trainers in Ethiopia lacked teaching skills.[19, 21]

The significant difference between male and female students' perceptions on the use of adult learning principles, student orientation, conducive learning environment, and education materials by educators might be related to unfavorable gender skills of educators. The gender audit that was conducted in Ethiopia's higher education showed comparable findings.[34] Competency-based education programs need to use non-traditional teaching and assessment techniques. Case study, role-play, group assignment, and discussion are proven active learning methods.[35, 36] Since the educators had the skill gaps in using them, teaching critical thinking, problem-solving, communication, teamwork, and collaboration skills will be problematic.[36] The limited ability to use OSCE/OSPE, logbook, portfolio, 360-degree evaluation, and global rating might prompt the use of traditional assessments.[37] Hence, assessing clinical skills, practical procedures, patient management, communication skills, and professional behaviors of the students might be difficult.[38] The educators lacked the skills to provide quality feedback which is the vital cog in the wheel of competency-based education.[39] The educators in our study had learning technology skill gaps that might diminish the power of digital learning for transforming PSE.[40, 41]

To ensure the availability of competent educators, the colleges are advised to revisit faculty recruitment, development, and retention policies. The teaching experiences and skills of candidate

educators should be considered as faculty recruitment criteria. Faculty development programs on active learning methods, performance assessments, digital learning, feedback, and gender-responsive pedagogy should be designed. Strengthening education development units at the colleges can catalyze systematic faculty development programs. In addition, academic programs in health profession education should be expanded. Concerted efforts to recognize health profession education as a noble career require attention by all stakeholders. More researches are required to understand the causes and effects of low teaching competency among educators. Access and effectiveness of the existing faculty development programs should be explored.

CONCLUSIONS:

Classroom instructors and clinical preceptors had sub-optimal teaching competency scores. Skills gaps were reported in using active learning methods, performance assessment tools, feedback, digital learning, and gender functions. The educators largely were young, had limited years of teaching experience, and were not recently trained in teaching. Clinical preceptors had lower competency scores across the competency domains. With the skills gaps, the quality of education was most likely affected. Continuous faculty development opportunities are critical. Attention should be given to the recruitment and retention of experienced faculty. More research on the causes and effects of low teaching competency is needed.

Contributors:

Daniel Dejene, the first author, contributed to the study concept and design, statistical analysis, results interpretation, and drafting and revision of the manuscript. Jelle Stekelenburg and Marco Versluis contributed to the study concept and design, drafting and revision of the manuscript. Firew Ayalew and Yohannes Molla contributed to the study concept and design, results interpretation, and manuscript revision. JG contributed to the study concept and design. All authors read and approved the final version of the manuscript.

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- Mintwab Gelagay (MPH) contributed conducting data collection and write up of the study
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Figure 1: Background characteristics of graduating students participated in the study, Ethiopia, Jan 2020 (N= 112)

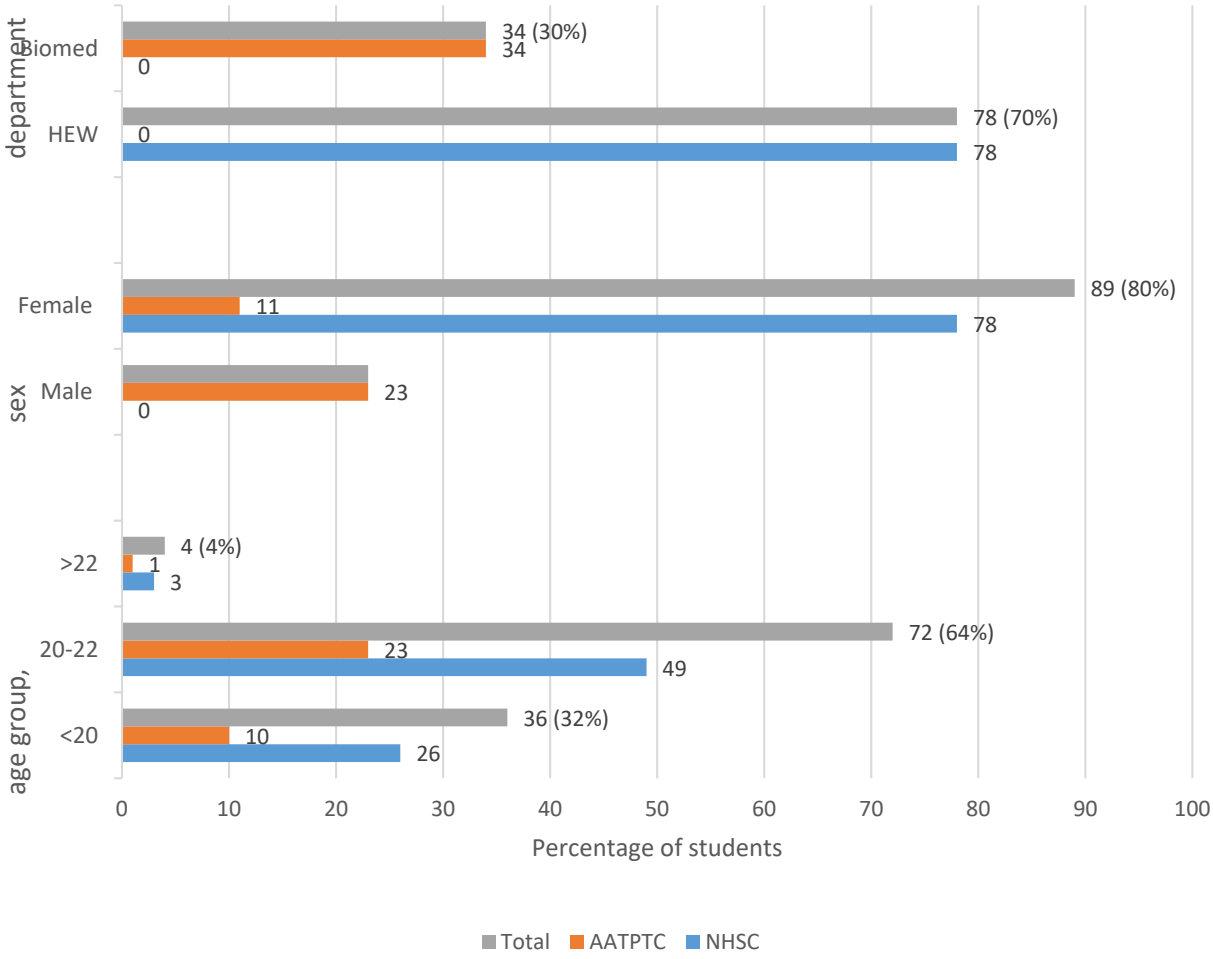
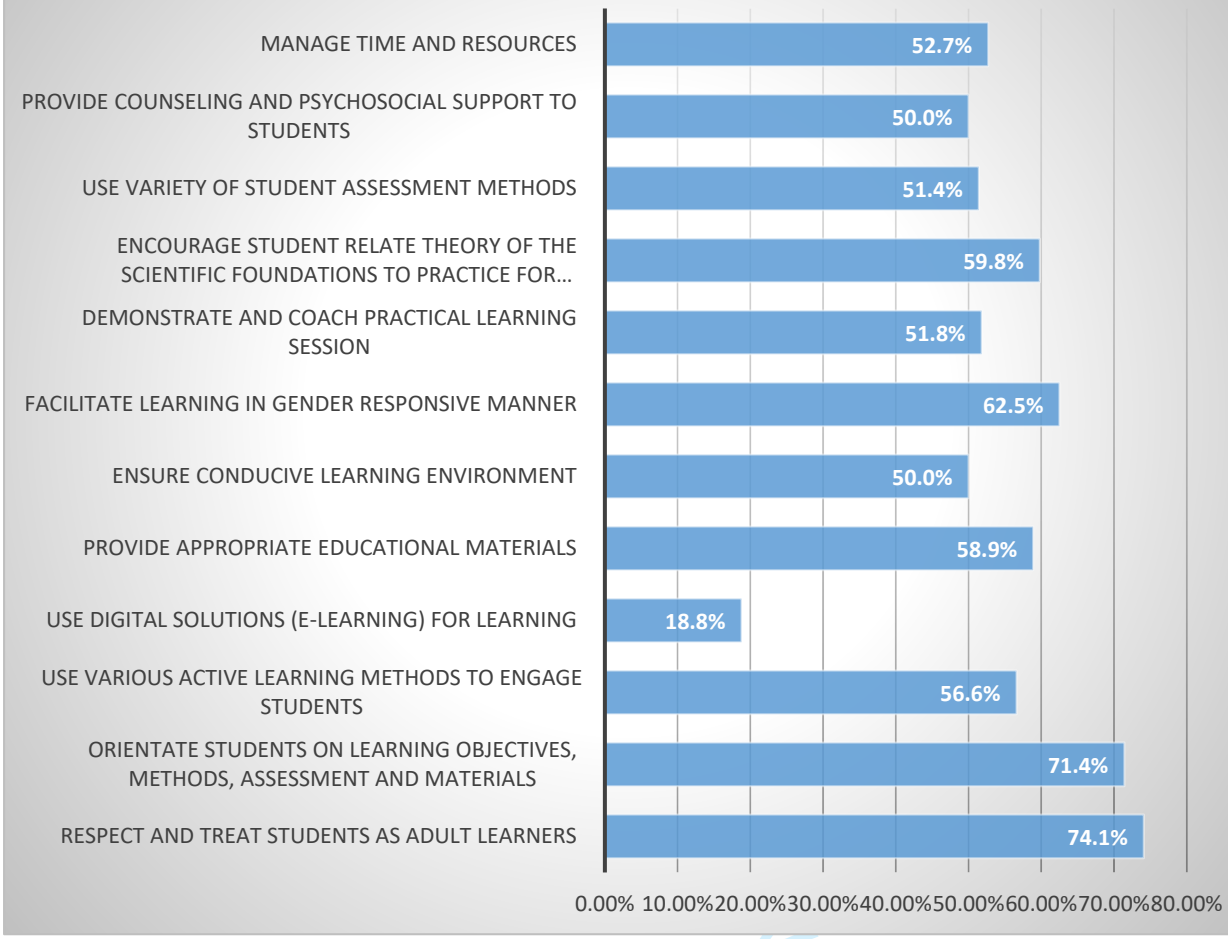


Figure 2: Percent of graduating students who perceived educators perform task consistently, Ethiopia, Jan 2020. (N=112)



The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes this is found in the abstract section at page 3 of the main manuscript.	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Located in the methods section of the abstract at page 3 of main manuscript document Located at the title and methods section of the abstract at the page 3 Yes, this is shown in the abstract at the page 3.
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes, this is explained in 1 -3 paragraphs of the introduction section (see page 6 of the main manuscript document)		
Objectives	3	State specific objectives, including any pre-specified hypotheses	Yes, this is clearly shown at the last paragraph of the introduction (see		

			page 7 of the main manuscript)		
Methods					
Study Design	4	Present key elements of study design early in the paper	Yes, we presented it at page 7.		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes, we described the setting and all relevant contexts at the pages 7 & 8 of main manuscript document.		
Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	Yes we explained how we selected study participants (see page 8 of manuscript document)	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect	Yes, we defined (see page 8 of main	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and	

		modifiers. Give diagnostic criteria, if applicable.	manuscript document)	effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes, we gave data sources for the variables (see page 8)		
Bias	9	Describe any efforts to address potential sources of bias	Yes, we described (see page 9)		
Study size	10	Explain how the study size was arrived at	yes, we explained (see page 7)		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Yes , we explained (see page 9)		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy	Yes, we described the statistical tests we employed (see page 9)		

		(e) Describe any sensitivity analyses			
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population. RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	Yes
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	Yes
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Not applicable	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Yes
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest	Yes, we gave (See page 9)		

		(c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)			
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures	Yes, we gave. (See pages 9 & 10)		
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Yes, we gave (see page 9 & 10		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses			
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes we summarized (see page 12)		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	Yes we discussed (see pages 4 & 13)	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include	Yes we discussed

		Discuss both direction and magnitude of any potential bias		discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes we interpreted the findings cautiously. (see page 12)		
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes (see page 12)		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes we gave (see page 2)		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Yes we gave (see page 2)

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Title Page

Title: Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

ABSTRACT:

Introduction: Ethiopia has scaled up health professional education. However, training institutions experienced shortages of qualified educators. Understanding the competency of educators is key to informing faculty development, recruitment, and performance monitoring. This study aimed to assess the core teaching competency of nursing, midwifery, and biomedical educators.

Methods: We conducted a cross-sectional study at two colleges and nine student practice sites in January 2020. We adapted the WHO's nurse and midwifery educator competencies to develop data collection tools. Using a census sampling strategy, all educators self-rated their competencies on a Likert scale of 1 to 5. Graduating students also rated their educators' performances. We computed descriptive statistics including composite competency scores. We calculated proportions in teaching skills and performance gaps. Chi-square tests with P-values were used. Cramer's V coefficients (V) were calculated to assess the strength of associations among the variables.

Results: Most educators were not trained in teaching methods (82 %). The teaching competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. Competency gaps were found in using active learning methods, performance assessment, feedback, and digital learning. Professional background of classroom instructors had a significant and strong association with their competency score (P-value = 0.004; V = 0.507). Age and teaching experience of clinical preceptors had significant associations with their competency score (P-values = 0.023, and 0.007; respectively); and had strong associations (V = 0.280 and 0.323; respectively). Sex of students and their perceptions of how well the educators give education resources had a significant and strong association (P-value = 0.000; and V= 0.429).

Conclusions: Nursing, midwifery, and biomedical educators lacked the competency to undertake important teaching roles which could contribute to the low quality of education. More attention should be given to strengthening faculty development.

Strengths and limitations:

- In this study, we adapted validated competency frameworks and developed locally relevant data collection tools for assessing a wide range of teaching competencies among the educators.
- Multiple perspectives from classroom instructors, clinical preceptors, and students improved the validity of the study findings.
- We used the self-reports of educators in this study which are not the best methods of competency assessment. However, we believe that self-assessments are reliable and efficient assessment techniques that can help us to obtain critical findings in guiding continuing professional development and self-regulation of educators. In addition, the orientation given to the educators on the study purposes, tools, and how to rate their competencies improved the self-assessment process and data quality.
- Since we did not take representative samples from all colleges, the findings of our study cannot be generalized to all nursing, midwifery, and biomedical educators in Ethiopia. It is important to note that the contexts of the health training colleges in the country are similar. Therefore, other colleges can learn from the methodological approaches, tools, key result areas, and recommendations of this study.
- Since there was no nurse and midwifery graduating class during the study period, health extension workers (HEWs) graduating students who were taught by the same educators were included. The HEW students could give valid judgments about the performance of the educators.

INTRODUCTION:

A stronger health workforce is a vital determinant for improving population health outcomes. The world is currently facing health workforce shortages as the result of challenges in health professional education among others.[1, 2] Globally, eighteen million more health professionals are needed by 2030; mainly in developing countries, to achieve universal health coverage (UHC).[1] And nine million more nurses and midwives are required to reach sustainable development goal (SDG) 3 on health.[1] Biomedical equipment professionals are required to a great extent to optimize the development and use of medical equipment.[2,3] Substantial health workforce investments are; therefore, required to achieve UHC and SDG health targets.

Ethiopia has suffered from a critical shortage of competent nurses, midwives, and biomedical technicians.[4] The 2018 national health workforce density was a total of 10 doctors, nurses, and midwives per 10,000 populations; which was far below the World Health Organization's (WHO's) threshold of 45 for achieving the UHC.[5] Few biomedical engineering professionals were available in 2017 (0.002 per 10,000 populations).[6] The shortage of health professionals affected the access to quality healthcare and contributed to the undesirable health outcomes.[5]

To address the shortages, WHO recommended countries rapidly scale up and transform health professional education.[7] Hence, Ethiopia expanded preservice education (PSE) leading to the burgeoning of the graduation capacity.[8, 9] In addition to the 46 universities, Ethiopia opened 23 public regional colleges, 45 private institutions, and 4 biomedical institutions using technical vocational education, and training (TVET) system which enabled the country to produce the majority of nurses, midwives, and biomedical technicians. As a result, Ethiopia was able to address the sharp rise in HRH needs that occurred as a result of the primary healthcare expansion in the last two to three decades.[10]

However, the education quality received less attention. Scaling up of the education has further deteriorated quality since there were no congruent commitment and resources to support the expansion. In reality, the massive expansion in the face of the shortages of faculty exacerbated Ethiopia's quality concerns.[9, 11] Ethiopia needs a lot of work to ensure that graduates are competent.[12-14] Qualified educators who mastered teaching competencies for effective facilitation

of classroom sessions and student clinical practice, developing learning materials, assessing student learning, and providing support to students are critical.[15-18] Effective educators should have adequate professional, communication, leadership, and research skills .[7, 15, 16] In addition, large student size, epidemiological transition, advancing medical knowledge, and technology have required educators to improve their teaching.[19] However, the teaching competency among health professional educators in Ethiopia is not well studied. Understanding the competency of educators guides faculty development, and other quality enhancement interventions. Such evidence expands the global knowledge and informs health professional education practices in other countries having similar challenges. This study aimed to assess core teaching competency and associated factors of nursing, midwifery, and biomedical educators in Ethiopia.

METHODS

Study design and participants

We conducted an institution-based quantitative cross-sectional study in January 2020 to serve as a baseline survey for the faculty development project (FDP). Our study questions focused on core teaching competency levels and gaps among the educators, and the associated factors. The FDP aimed to improve the teaching and learning process of vocational nursing and midwifery programs at Nekemte Health Science College (NHSC), and the biomedical training program at Addis Ababa Tegebareid Polytechnic College (AATPTC). NHSC, located in western Ethiopia of Nekemte city, was providing vocational nursing, midwifery, health extension, and other midlevel health professional training. AATPTC, found in Addis Ababa city administration, was providing vocational biomedical technician training and others. The colleges worked with 14 student practice sites. Based on convenience, we selected 5 hospitals, 2 health centers, and 2 biomedical equipment workshops. The biomedical equipment workshops were workplaces for biomedical technicians and engineers where medical equipment was stored, tested, calibrated, and maintained. There was a total of 154 educators for the nursing, midwifery, and biomedical technician programs and 125 graduating class students. Of the educators, there were 57 classroom instructors and 97 clinical preceptors. We used a census sampling technique to include all classroom instructors, clinical preceptors, and graduating students. Classroom instructors were teaching staff hired by and work in the colleges to teach and support students. Health workers hired by health facilities or medical equipment workshops to provide patient care or medical equipment services were regarded as

clinical preceptors. We decided to include graduating students as they had adequate exposure and experience enough to make valid judgments on the performance of the educators. We obtained lists of the classroom instructors, clinical preceptors, and graduating students from the deans' and registrars' offices. The educators and students who were present at work during the data collection period, willing and able to participate in the study were included as study participants. To evaluate the effectiveness of the FDP, an end-line assessment was planned to be conducted at the end of the project using the same methods and data collection tools.

Data collection:

We adapted the WHO midwifery and nurse educator competency frameworks to develop three structured data collection tools[16, 17] Since we were interested to assess teaching competencies only; but not the profession-specific competencies, we used the same data collection tools across the three academic programs. The first tool (with 63 variables) was a self-administered questionnaire aimed at exploring the perceptions of classroom instructors on their capabilities to implement specific teaching tasks related to six competency domains, namely; facilitating theoretical learning in classrooms using engaging methods, supporting student clinical practice through a conducive learning environment, establishing an effective relationship with patients and applying practical training methods, using student assessment, developing teaching and learning materials, providing guidance, counseling and gender-related support to students with academic, psychosocial and economic problems, and providing education management & leadership functions.

The second tool (with 45 variables) was a self-administered questionnaire for assessing the perceptions of clinical preceptors on four competency domains. The three competency domains on clinical teaching, student assessment, and student support are similar to those of the classroom instructors. The fourth domain is about the ability of clinical preceptors to apply infection prevention and patient safety principles, and protocols during patient care. The third tool (with 49 variables) was also a self-administered questionnaire for graduating class students aiming to obtain information on the current teaching performances of their educators. All three tools had variables about the background characteristics of the study participants. In collaboration with five national health professional education experts, we validated and piloted the tools at 2 health training institutions. To assure data quality, we selected 7 data collectors who had an education level of master's degree and relevant experience. We trained the data collectors for 2 days on data collection procedures, contents of the tools, REDCap application, and ethics. The data collectors

orientated and supported study participants to fill out the questionnaires correctly. The responding educators rated their perceptions of competencies for each teaching task on a 5-point Likert scale, where "1" meant not capable; and "5" meant proficient. The graduating students rated the performance of the educators on a 5-point Likert scale. Where "1" meant no educator applies the skill consistently. And "5"meant that all instructors apply the skill consistently. The data collectors were closely supported by 3 supervisors. Errors and omissions found during data collection were corrected timely. The data collection period was from January 14 – 22, 2020.

Data management and analysis

Electronic data were collected using the REDCap application that was used for checking completeness, consistency of responses, and cleaning data. We then exported the data to SPSS version 25. We conducted data analysis by computing proportions, means, standard deviations, and other descriptive statistics. Aggregate scores were calculated as necessary. To assess the competency scores, average composite scores were calculated using weighted averages for each competency domain. Total composite scores were similarly calculated to determine overall competency scores. To calculate the proportions of educators with skill gaps, we combined the responses of all educators who rated themselves as not capable, novice, and advanced beginners and considered them incompetent. Similarly, we considered responses from all students who rated most, and all of their educators apply the teaching skills as well-performing while calculating the proportion of performing educators. Pearson's chi-square test with P–values were computed to assess the significance of associations among the variables. Cramer's V coefficients (V) were calculated to assess the strength of associations. We considered the values of V less than 0.100; in the range of 0.100 – O.250; and greater than 0.25 weak, medium, and strong associations; respectively.[20] As per the policy of the Ministry of Education (MOE) of Ethiopia, any level IV TVET educator needs to have university education with a minimum of a Bachelor's Degree.[19] The MOE also set a 60% pass mark to allow the educators graduate with a Bachelor's Degree.[21] Hence, we adopted the MOE 60% competency score as a cutoff point in our study to classify the educators as "competent" or "not competent".[21-22]

Ethical consideration:

We obtained ethical clearance from Johns Hopkins Bloomberg School of Public Health Institutional Review Board with IRB number **16606**. The Oromia regional health bureau and the

training institutions approved the protocol and provided support letters to conduct the study. The study team met with deans, department heads, and facility managers of the target institutions to explain the purpose of the study and data collection processes. Data collectors obtained informed oral consent from each study participant. Data on study participants' names and other personal identifiers were not collected. We also placed the datasets in a secure place for keeping participants' information confidential.

Patient and public involvement:

No patients or members of the public were involved in the research design, analysis, and dissemination of the findings. Deans and educators of the health colleges, and experts from the ministry of health, the regional health bureau, professional associations, and implementing partners were involved in the interpretation and utilization of the findings.

RESULTS:

Background characteristics of study participants:

A total of 147 educators and 112 students participated in the study with response rates of 95 % and 90 %, respectively. The mean age of the educators was 32 years with a range of 19 – 54 years. More than half of the educators were below 30 years of age (54%). Nearly half of them were female (48 %) and had less than 5 years of teaching experience (45%). The mean period of the educators' work experience was 7 years. The majority of them were not trained in teaching skills courses in the last two years (82 %). Table 1.

The graduating students were mostly health extension workers (HEW) by department (70 %), in the age group of 20 – 22 years (64%), and females by sex (80 %). Supplemental material 1.

Table 1: Background characteristics of educators, Ethiopia, Jan 2020 (N= 147)

Background Characteristics	NHSC N (%)	AATPTC N (%)	Total N (%)
Type of educators			
Classroom instructors	37 (30)	14 (64)	51 (35)
Clinical preceptors	88 (70)	8 (36)	96 (65)
Age in years			
<30	60 (48)	19 (86)	79 (54)
30 – 39	48 (38)	2 (9)	50 (34)
>39	17 (14)	1 (5)	18 (12)
Sex			
Male	63 (50)	14 (64)	77 (52)
Female	62 (50)	8 (36)	70 (48)
Education			
TVET level 4	9 (7)	4 (18)	13 (9)
BSc degree	112 (90)	18 (82)	130 (88)

MSc & above	4 (3)	0 (0)	4 (3)
Profession			
Nurse	76 (61)	0	76 (52)
Midwife	27 (22)	0	27 (18)
Biomedical technician	0 (0)	22 (100)	22 (15)
Others	22 (18)	0	22 (15)
Teaching experience in years			
<5	50 (40)	17 (77)	67 (45)
5 – 10	37 (30)	5 (23)	42 (29)
>10	38 (30)	0	38 (26)
Trained on teaching skills course in the past 2 years			
Yes	18(4)	9(41)	27 (18)
No	107 (6)	13 (59)	120 (82)

*NHSC = Nekemte Health Science College
*AATPTC – Addis Ababa Tegbareid Polytechnic College
* TVET – Technical Vocational Education Training

Teaching competency score of the educators

The overall average composite competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. The classroom instructors had less than 60.0 % scores in two competency domains, namely; developing and using education materials (55.4 %) and providing management and leadership functions (58.4 %). However, clinical preceptors scored less than 60.0 % in all four competency domains. Tables 2 and 3.

Table 2: Mean teaching competency scores of classroom instructors, Ethiopia, Jan 2020 (N= 51)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Facilitate theoretical learning in the classroom	12	67.9 (14.4)	51.3 (13.0)	63.7 (15.8)
Facilitate student clinical practicum	7	73.0 (14.4)	61.9 (17.0)	70.2 (15.9)
Conduct student assessment and evaluation	18	67.5 (14.8)	55.6 (13.1)	64.4 (15.2)
Develop and use education materials/resources	10	57.3 (13.1)	49.9 (12.7)	55.4 (13.3)
Provide student support functions	3	63.5 (7.9)	51.8 (14.7)	60.5 (17.7)
Provide management & leadership functions	3	61.9 (18.1)	48.2 (12.2)	58.4 (17.7)
Overall average composite competency score		**65.2 (13.2)**	**53.1 (12.4)**	**61.1 (13.9)**

SD means standard deviation

Table 3: Mean teaching competency scores of clinical preceptors, Ethiopia, Jan 2020 (N=96)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Clinical teaching skills	10	52.3 (20.9)	57.0 (18.7)	52.7 (20.7)
Student assessment and evaluation	15	47.5 (18.0)	45.0 (14.6)	47.2 (17.8)
Student support functions	4	51.4 (21.3)	53.8 (20.3)	51.5 (21.3)
Infection prevention and patient safety	5	58.7 (24.4)	59.5 (22.9)	58.7 (24.2)

Overall average composite competency score	**52.4 (19.8)**	**53.8 (17.9)**	**52.5 (19.6)**

SD means standard deviation

Teaching competency gaps of the educators

More than two-thirds of classroom instructors perceived that they had gaps in developing and using student performance assessments: portfolios, logbooks, objective structured clinical/practical examinations (OSCE/OSPE), and digital learning solutions. And more than three-quarters of clinical preceptors perceived that they had gaps in developing and using student performance assessments, active learning methods (case study, role play, discussion, and group assignment), and providing constructive feedback. Table 4.

Table 4: Top competency gaps of classroom instructors on the left and clinical preceptors on the right, Ethiopia, Jan 2020.

Teaching competency of classroom instructors Skill area	**% of not competent (N=51)**	**Teaching competency of clinical preceptors Skill area**	**% of not competent (N=96)**
Develop and use portfolio	82.4	Administer the short and long exam	93.8
Use of digital solutions for learning	80.4	Administer global rating	90.6
Develop and use of logbook	72.5	Use portfolio	82.3
Develop and administer OSCE/OSPE	72.5	Develop and use a logbook	81.3
Conduct education program evaluation	72.5	Use 360 evaluation	81.3
Create a conducive learning environment	70.6	Support unsuccessful students	79.2
Develop and use course syllabi	70.6	Provide constructive feedback	78.1
Support educational QA processes	70.6	Use discussion & group assignment	78.1
Provide student support functions	68.6	Crease conducive learning environment	76.0
Provide gender support to female students	66.7	Develop and use a case study	76.0
		Create and use role play	76.0

Factors associated with the competency score of educators

The professional background of classroom instructors had a significant and strong association with their competency scores (P-value = 0.004; and V = 0.507). The age of clinical preceptors had a significant and strong association with their competency scores (P-value = 0.023; and V = 0.280). The teaching experience of clinical preceptors had also a significant and strong association with their competency scores (P-value = 0.007; and V = 0.323). In addition, the sex of the clinical preceptors had a significant and medium-strength association with their competency scores (P-values = 0.019; and V = 0.240). Table 5.

Table 5: Factors associated with competency score of classroom instructors (above) and clinical preceptors (below), Ethiopia, Jan 2020.

Background Characteristics	Teaching competency score (N=51)		Pearson Chi-square	
Instructors	**<60 N (%)**	**60+ N (%)**	**P-value**	**Strength of association (Crammer V coefficient)**
Age in Years				
<30	12 (54.5)	17 (58.6)	0.528	0.158
30 - 39	8 (36.4)	7 (24.2)		
>39	2 (9.1)	5 (17.2)		
Sex				
Male	17 (77.3)	24 (82.8)	0.625	0.068
Female	5 (22.7)	5 (17.2)		
Professional background				
Nurse	9 (40.9)	5 (17.2)	**0.004***	**0.507**
Midwife	0	1 (3.5)		
Biomedical	9 (40.9)	4 (13.8)		
Others	4 (18.2)	19 (65.5)		
Level of education				
TVET level	1 (4.5)	2 (6.9)	0.907	0.062
BSc degree	19 (86.4)	25 (86.2)		
MSc degree above	2 (9.1)	2 (6.9)		
Teaching experience in years)				
<5	16 (72.7)	18 (62.1)	0.518	0.161
5 – 10	1 (4.6)	4 (13.8)		
>10	5 (22.7)	7 (24.1)		
Trained in teaching skills courses in the past 2 years				
Yes	8 (36.4)	6 (20.7)	0.214	0.174
No	14 (63.6)	23 (79.3)		
Preceptors (N=96)				
Age in years				
<30	29 (43.3)	21 (72.4)	**0.023***	**0.280**
30 – 39	27 (40.3)	7 (24.1)		
>39	11 (16.4)	1 (3.5)		
Sex			**0.019***	**0.240**
Male	20 (29.8)	16 (55.2)		
Female	47 (70.2)	13 (44.8)		
Professional background				
Nurse	45 (67.1)	17 (56.6)	0.715	0.084
Midwife	17 (25.4)	9 (31.0)		
Biomedical	5 (7.5)	3 (10.4)		
Education				
TVET	7 |(10.5)	2 (6.9)	0.584	0.056
BSc degree	60 (89.5)	27 (93.1)		
Teaching experience in years				
<5	17 (25.4)	16 (55.2)	**0.007***	**0.323**
5 – 10	26 (38.8)	10 (34.5)		
>10	24 (35.8)	3 (10.3)		
Trained on teaching skills courses in past 2 years				
Yes	6 (8.9)	6 (20.7)	0.110	0.163
No	61(91.1)	23 (79.3)		

Students' perception of the application of teaching skills by their educators

Significant proportions of graduating students perceived that most of their educators did not consistently use digital learning solutions (81%), create a conducive learning environment (50%), provide counseling and psychosocial support (50%), use a variety of student assessment methods (49%), and apply active learning methods (43 %). Supplemental material 2.

Factors associated with students' perception of the application of teaching skills by educators

The sex of students had a significant and strong association with their perceptions of how well the educators provide appropriate education materials (P = 0.000; and V = 0.429). In addition, the sex of students had a significant and medium strength association with their perception of how well their educators respect them as adult learners (P-value = 0.031; and V = 0.204), orientate them (P-value = 0.022; and V = 0.217), and ensure a conducive learning environment (P-value = 0.035; and V = 0.199). Supplemental material 3.

DISCUSSION:

In almost every country in the world, there are health workforce shortages, skill mix imbalances, and uneven geographical distributions, leaving millions without access to healthcare.[1, 2, 7] A need to scale up PSE has intensified to train more health professionals and transform training quality.[7] Being one of the 57 countries with severe health workforce crisis[7], Ethiopia scaled up health professional education. However, it was challenged to uphold the PSE quality.[9 - 12] Other low and middle-income countries (LMICs) faced similar challenges due to a shortage of qualified educators and other factors whilst addressing the workforce challenges.[13, 23 - 25]

In this study, we found out that the educators felt competent on essential teaching tasks, but not on all relevant ones. We identified competency gaps among the educators in using active learning methods, performance assessments, digital learning solutions, gender-responsive pedagogy, and performance-based feedback. The findings were not surprising as health professions education in Ethiopia was not well developed a career. The educators lacked formal teachers' education opportunities.[19, 22] Health professionals were recruited for the complex tasks without demanding skills and experiences in teaching.[26, 27] Faculty recruitment focused mainly on the academic achievements of new graduates. Similar faculty recruitment and development challenges were reported in many LMICs.[23 – 25, 28] On the contrary, educators in a developed world are required to have teaching qualifications and experiences before deployments.[29 - 32] One contributing factor to

the suboptimal teaching competency was the limited faculty development opportunities in Ethiopia.[27] Meanwhile, faculty development on a wide range of educational activities is recommended to educators.[33 -35] The rapid PSE scale-up in the country exacerbated the shortage of qualified educators.[9 - 12] Many educators were less than 30 years of age and had less than five years of work experience which could limit their use of practice-based improvement opportunities. A WHO report corresponded with our findings that only 6.6% of educators in LMICs were adequately prepared and had sufficient teaching qualifications.[17] From an optimistic point of view, one could argue that the educators were doing good, given they had no formal education, inadequate faculty development opportunities, and limited experiences. Although we used distinct data collection tools for the classroom instructors and clinical preceptors, it is good to note that the competency scores of the clinical preceptors were lower. This might be due to the differences in their training, duties, and work arrangement. Clinical preceptors were hired by the practice sites mainly to provide services with no explicit preceptorship roles. This meant that it is difficult to realize Ethiopia's TVET education strategy.[26] Reports also claimed that TVET trainers in Ethiopia lacked teaching skills.[19, 21]

The significant difference between male and female students' perceptions of the performances of educators on key tasks could be due to the low gender skills among the educators. The gender audit that was conducted in Ethiopia's higher education showed comparable findings.[36] Competency-based education programs need to use non-traditional teaching and assessment techniques. Case study, role-play, group assignment, and discussion are proven active learning methods for teaching critical thinking, problem-solving, communication, teamwork, and collaboration skills,[37, 38] However, the educators had the skill gaps in using them. The educators had limited ability to use OSCE/OSPE, logbook, portfolio, 360-degree evaluation, and global rating. Hence, assessing and teaching clinical skills, practical procedures, patient management, communication skills, and professional behaviors of the students might be difficult.[39, 40] It is known that feedback is the vital cog in the wheel of competency-based education.[41] However, the educators lacked the skills to provide quality feedback. The educators had learning technology skill gaps that might diminish the power of digital learning for transforming PSE in Ethiopia.[42, 43]

To ensure the availability of competent educators, the colleges are advised to revisit faculty recruitment, development, and retention policies. Teaching experiences and skills of educators

should be considered as faculty recruitment criteria. Faculty development programs on active learning methods, performance assessments, digital learning, feedback, and gender-responsive pedagogy should be designed. Strengthening education development units in the colleges can catalyze faculty development programs. In addition, academic programs in health profession education should be expanded. More studies are required to understand the causes and effects of low teaching competency among educators.

CONCLUSIONS:

Classroom instructors and clinical preceptors had sub-optimal teaching competency. Skills gaps were reported in using active learning methods, performance assessments, feedback, digital learning, and gender among the significant proportions of educators. Many educators were young and had limited experience and training in teaching. Faculty development opportunities are critical. More studies on the causes and effects of low teaching competency are needed.

Contributors:

The following were author-contributors of the study.

Dr. Daniel Dejene (MD, MPH, FMER) was the first author who contributed to the study concept and design, statistical analysis, result interpretation, and drafting, development, and revision of the manuscript.

The co-authors, Professor Dr. Jelle Stekelenburg (Ph.D., MD) and Professor Marco Versluis (Ph.D., MD) contributed to the statistical analysis, result interpretations, and drafting and revision of the manuscript. Dr. Firew Ayalew (Ph.D. MSc., MA, BSc) and Yohannes Molla (MSc, BSc) who are the co-authors contributed to the study design, result interpretation, and manuscript revision. All authors read and approved the final version of the manuscript.

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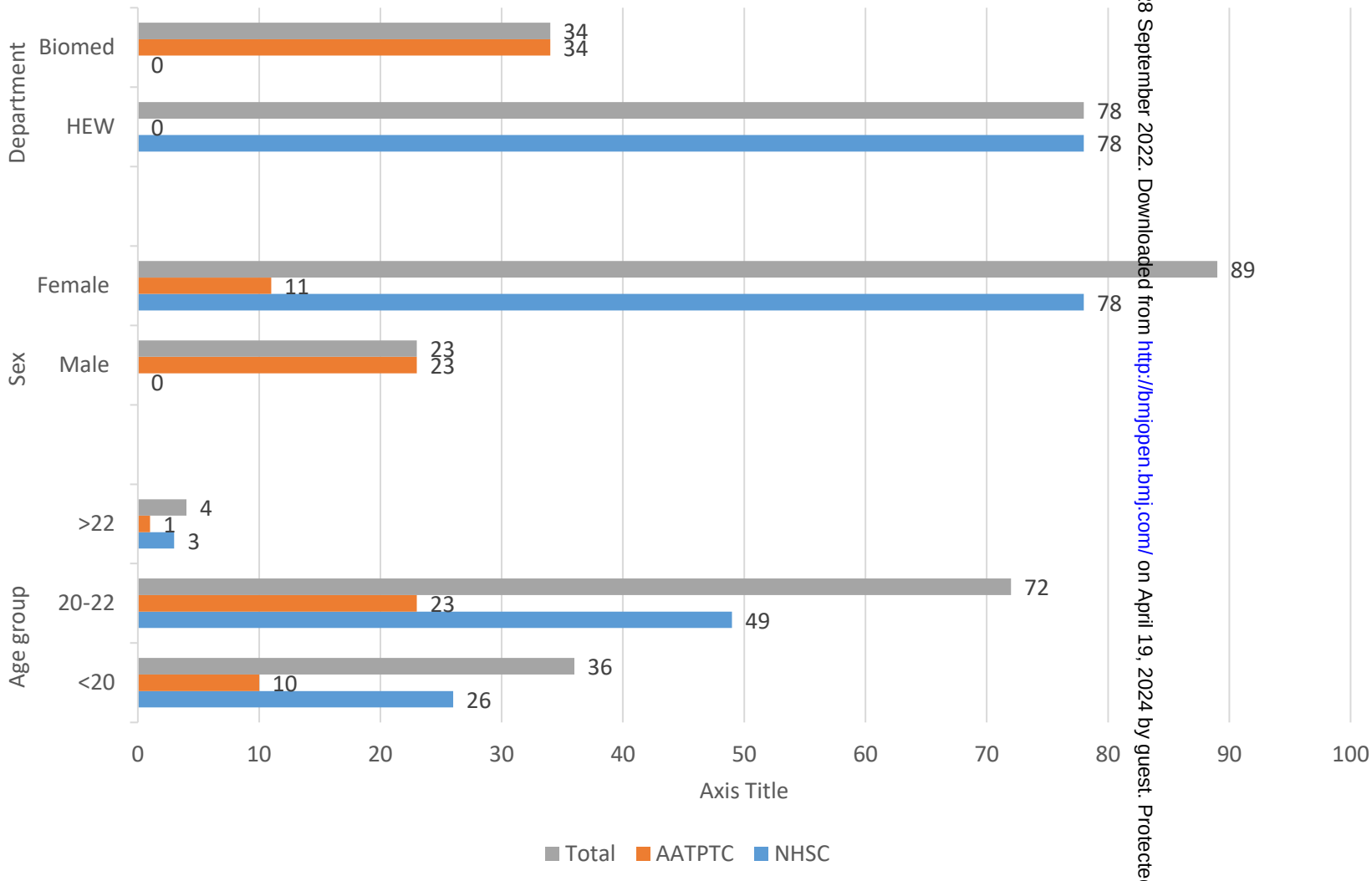
Figure 1: percent of graduating students who percieved educators performed the teaching tasks consistently, Ethiopia, Jan 2020 (N= 112)



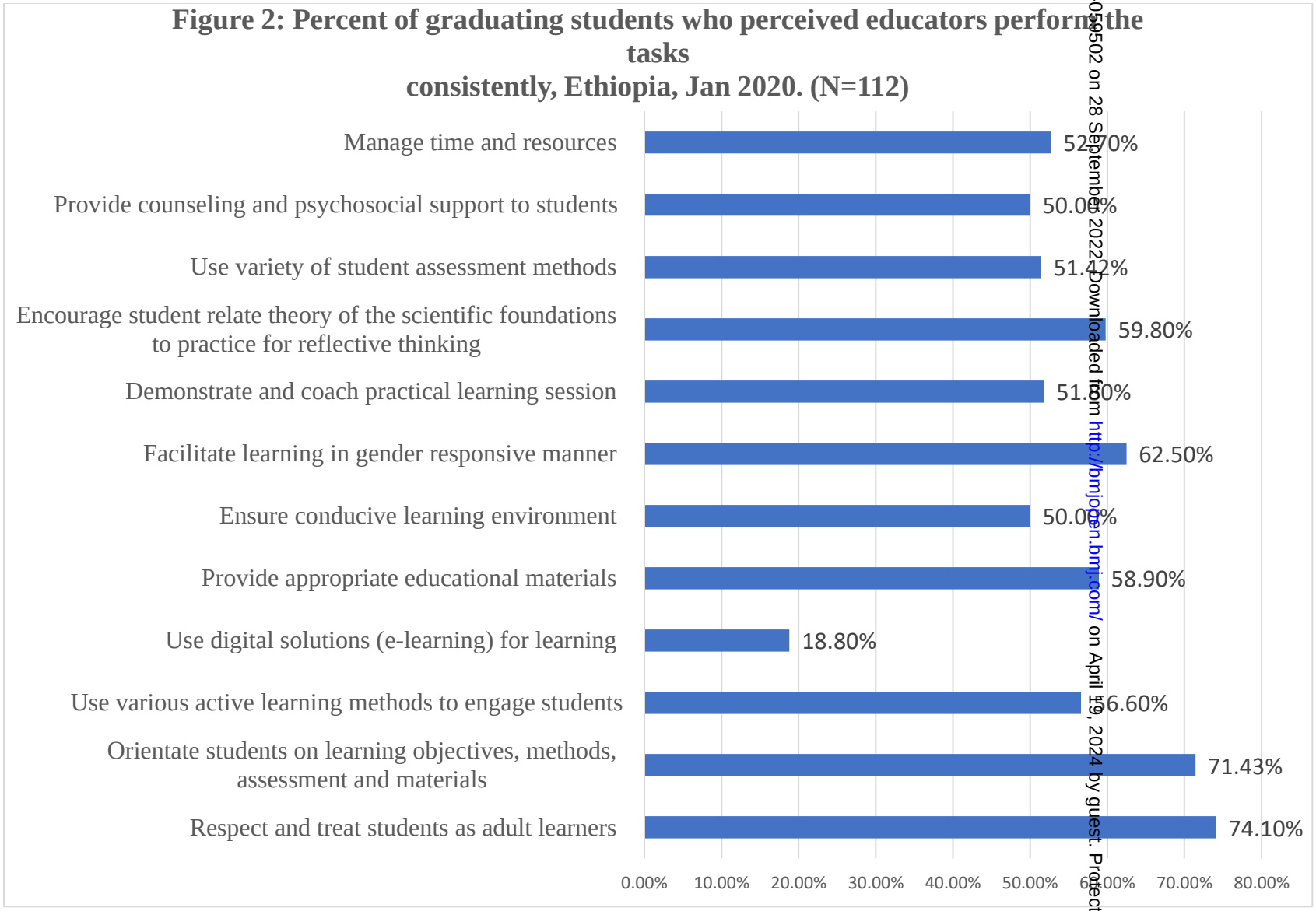


Table 6: Association between background characteristics of graduating students and their perception of the performance of educators, Ethiopia, Jan 2020.

Tasks of Educators	Sex (N=112)		Pearson Chi-square	
	Male N (%)	Female N (%)	P-value	Strength of association (Crammer V)
Respect as adult learners				
Yes	13 (56.5)	70 (78.7)	**0.031***	**0.204**
No	10 (43.5)	19 (21.3)		
Orientate Students				
Yes	12 (52.2)	68 (76.4)	**0.022***	**0.217**
No	11 (47.8)	21 (23.6)		
Apply interactive lectures				
Yes	13 (56.5)	53(59.5)	0.792	0.025
No	10 (43.5)	36 (40.5)		
Use digital solutions for learning				
Yes	5 (21.7)	16 (17.9)	0.680	0.039
No	18 (78.3)	73 (82.1)		
Provide appropriate educational materials				
Yes	4 (17.4)	62 (69.7)	**0.000***	**0.429**
No	19 (82.6)	27 (30.3)		
Ensure a conducive learning environment				
Yes	16 (69.57)	40 (44.94)	**0.035***	**0.199**
No	7 (30.43)	49 (55.06)		
Facilitate in a gender-responsive manner				
Yes	14 (60.9)	56 (62.9)	0.856	0.017
No	9 (39.3)	33 (37.1)		
Facilitate practical learning session				
Yes	1 (4.4)	19 (21.4)	0.058	0.179
No	22 (95.6)	70 (78.6)		
Provide good feedback				
Yes	13 (56.5)	51 (57.3)	0.946	0.006
No	10 (43.5)	38 (42.7)		
Provide counseling & psychosocial support				
Yes	8 (34.8)	48 (53.9)	0.102	0.149
No	15 (65.2)	41(46.1)		
Manage time and resources				
Yes	9 (39.1)	50 (56.2)	0.144	0.138
No	14 (60.9)	39 (43.8)		

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes this is found in the abstract section at page 3 of the main manuscript.	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Located in the methods section of the abstract at page 3 of main manuscript document Located at the title and methods section of the abstract at the page 3 Yes, this is shown in the abstract at the page 3.
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes, this is explained in 1 -3 paragraphs of the introduction section (see page 6 of the main manuscript document)		
Objectives	3	State specific objectives, including any pre-specified hypotheses	Yes, this is clearly shown at the last paragraph of the introduction (see		

			page 7 of the main manuscript)		
Methods					
Study Design	4	Present key elements of study design early in the paper	Yes, we presented it at page 7.		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes, we described the setting and all relevant contexts at the pages 7 & 8 of main manuscript document.		
Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	Yes we explained how we selected study participants (see page 8 of manuscript document)	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect	Yes, we defined (see page 8 of main	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and	

		modifiers. Give diagnostic criteria, if applicable.	manuscript document)	effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes, we gave data sources for the variables (see page 8)		
Bias	9	Describe any efforts to address potential sources of bias	Yes, we described (see page 9)		
Study size	10	Explain how the study size was arrived at	yes, we explained (see page 7)		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Yes , we explained (see page 9)		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy	Yes, we described the statistical tests we employed (see page 9)		

		(e) Describe any sensitivity analyses			
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population. RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	Yes
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	Yes
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Not applicable	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Yes
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest	Yes, we gave (See page 9)		

		(c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)			
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures	Yes, we gave. (See pages 9 & 10)		
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Yes, we gave (see page 9 & 10		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses			
Discussion					
Key results	18	Summarise key results with reference to study objectives	Yes we summarized (see page 12)		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	Yes we discussed (see pages 4 & 13)	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include	Yes we discussed

		Discuss both direction and magnitude of any potential bias		discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes we interpreted the findings cautiously. (see page 12)		
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes (see page 12)		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes we gave (see page 2)		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Yes we gave (see page 2)

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Title Page

Title: Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

ABSTRACT:

Objectives: Understanding the competency of educators is key to informing faculty development, recruitment, and performance monitoring. This study aimed to assess the core teaching competency of nursing, midwifery, and biomedical educators, and associated factors.

Design: An institution-based cross-sectional study was conducted in January 2020 using structured tools adapted from the WHO's nurse and midwifery educator competency frameworks.

Setting: Two health science colleges and nine student practice sites in Ethiopia.

Participants: All classroom instructors and clinical preceptors of nursing, midwifery, and biomedical technician training programs, and the graduating students.

Measures: Overall teaching competency scores, teaching domain competency scores, competency gaps, and performance gaps of educators were outcome measures. Past training on teaching skills courses, teaching experiences, and sociodemographic characteristics of educators are associated factors.

Results: Most educators were not trained in teaching methods (82 %). The teaching competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. Competency gaps were found in using active learning methods, performance assessment, feedback, and digital learning. Professional background of classroom instructors had a significant and strong association with their competency score (P-value = 0.004; V = 0.507). Age and teaching experience of clinical preceptors had significant associations with their competency score (P-values = 0.023, and 0.007; respectively); and had strong associations (V = 0.280 and 0.323; respectively). Sex of students and their perceptions of how well the educators give education resources had a significant and strong association (P-value = 0.000; and V= 0.429).

Conclusions: Nursing, midwifery, and biomedical educators lacked the competency to undertake important teaching roles which could contribute to the low quality of education. More attention should be given to strengthening faculty development.

Strengths and limitations:

- The use of validated nurse and midwifery educators' competency frameworks improved the quality of data in this study.
- We considered multiple data sources from classroom instructors, clinical preceptors, and students that strengthened the study findings.
- Although self-assessments are not the best methods to determine competency, we used self-assessments in our study to obtain reliable, and efficient findings for informing professional development and regulation of educators.
- Since there was no nurse and midwifery graduating class during the study period, health extension workers (HEWs) students who were taught by the same educators were included.
- Though we did not take representative samples to draw generalizable findings, our study applied feasible methodology to broaden knowledge in the health professional education field.

INTRODUCTION:

A stronger health workforce is a vital determinant for improving population health outcomes. The world is currently facing health workforce shortages as the result of challenges in health professional education among others.[1, 2] Globally, eighteen million more health professionals are needed by 2030; mainly in developing countries, to achieve universal health coverage (UHC).[1] And nine million more nurses and midwives are required to reach sustainable development goal (SDG) 3 on health.[1] Biomedical equipment professionals are required to a great extent to optimize the development and use of medical equipment.[2,3] Substantial health workforce investments are; therefore, required to achieve UHC and SDG health targets.

Ethiopia has suffered from a critical shortage of competent nurses, midwives, and biomedical technicians.[4] The 2018 national health workforce density was a total of 10 doctors, nurses, and midwives per 10,000 populations; which was far below the World Health Organization's (WHO's) threshold of 45 for achieving the UHC.[5] Few biomedical engineering professionals were available in 2017 (0.002 per 10,000 populations).[6] The shortage of health professionals affected the access to quality healthcare and contributed to undesirable health outcomes.[5]

To address the shortages, WHO recommended countries rapidly scale up and transform health professional education.[7] Hence, Ethiopia expanded preservice education (PSE) leading to the burgeoning of the graduation capacity.[8, 9] In addition to the 46 universities, Ethiopia opened 23 public regional colleges, 45 private institutions, and 4 biomedical institutions using technical vocational education, and training (TVET) system which enabled the country to produce the majority of nurses, midwives, and biomedical technicians. As a result, Ethiopia was able to address the sharp rise in HRH needs that occurred as a result of the primary healthcare expansion in the last two to three decades.[10]

However, education quality received less attention. Scaling up of the education has further deteriorated quality since there were no congruent commitment and resources to support the expansion. In reality, the massive expansion in the face of the shortages of faculty exacerbated Ethiopia's quality concerns.[9, 11] Ethiopia needs a lot of work to ensure that graduates are competent.[12-14] Qualified educators who mastered teaching competencies for effective facilitation

of classroom sessions and student clinical practice, developing learning materials, assessing student learning, and providing support to students are critical.[15, 16] In addition, large student size, epidemiological transition, advancing medical knowledge, and technology have required educators to improve their teaching.[17] Effective educators should have adequate professional, communication, leadership, and research skills .[7, 18, 19] However, the teaching competency among health professional educators in Ethiopia is not well studied. Understanding the competency of educators guides faculty development, and other quality enhancement interventions. Such evidence expands the global knowledge and informs health professional education practices in other countries having similar challenges. This study aimed to assess core teaching competency and associated factors of nursing, midwifery, and biomedical educators in Ethiopia.

METHODS

Study design and participants

We conducted an institution-based quantitative cross-sectional study in January 2020 to serve as a baseline survey for the faculty development project (FDP). Our study questions focused on core teaching competency levels and gaps among the educators, and the associated factors. The FDP aimed to improve the teaching and learning process of vocational nursing and midwifery programs at Nekemte Health Science College (NHSC), and the biomedical training program at Addis Ababa Tegebareid Polytechnic College (AATPTC). NHSC, located in western Ethiopia of Nekemte city, was providing vocational nursing, midwifery, health extension, and other midlevel health professional training. AATPTC, found in Addis Ababa city administration, was providing vocational biomedical technician training and others. The colleges worked with 14 student practice sites. Based on convenience, we selected 5 hospitals, 2 health centers, and 2 biomedical equipment workshops. The biomedical equipment workshops were workplaces for biomedical technicians and engineers where medical equipment was stored, tested, calibrated, and maintained. There was a total of 154 educators for the nursing, midwifery, and biomedical technician programs and 125 graduating class students. Of the educators, there were 57 classroom instructors and 97 clinical preceptors. We used a census sampling technique to include all classroom instructors, clinical preceptors, and graduating students. Classroom instructors were teaching staff hired by and work in the colleges to teach and support students. Health workers hired by health facilities or medical equipment workshops to provide patient care or medical equipment services were regarded as

clinical preceptors. We decided to include graduating students as they had adequate exposure and experience enough to make valid judgments on the performance of the educators. We obtained lists of the classroom instructors, clinical preceptors, and graduating students from the deans' and registrars' offices. The educators and students who were present at work during the data collection period, willing and able to participate in the study were included as study participants. To evaluate the effectiveness of the FDP, an end-line assessment was planned to be conducted at the end of the project using the same methods and data collection tools.

Data collection:

We adapted the WHO midwifery and nurse educator competency frameworks to develop three structured data collection tools[18, 19] Since we were interested to assess teaching competencies only; but not the profession-specific competencies, we used the same data collection tools across the three academic programs. The first tool (with 63 variables) was a self-administered questionnaire aimed at exploring the perceptions of classroom instructors on their capabilities to implement specific teaching tasks related to six competency domains, namely; facilitating theoretical learning in classrooms using engaging methods, supporting student clinical practice through a conducive learning environment, establishing an effective relationship with patients and applying practical training methods, using student assessment, developing teaching and learning materials, providing guidance, counseling and gender-related support to students with academic, psychosocial and economic problems, and providing education management & leadership functions.

The second tool (with 45 variables) was a self-administered questionnaire for assessing the perceptions of clinical preceptors on four competency domains. The three competency domains on clinical teaching, student assessment, and student support are similar to those of the classroom instructors. The fourth domain is about the ability of clinical preceptors to apply infection prevention and patient safety principles, and protocols during patient care. The third tool (with 49 variables) was also a self-administered questionnaire for graduating class students aiming to obtain information on the current teaching performances of their educators. All three tools had variables about the background characteristics of the study participants. In collaboration with five national health professional education experts, we validated and piloted the tools at 2 health training institutions. To assure data quality, we selected 7 data collectors who had an education level of master's degree and relevant experience. We trained the data collectors for 2 days on data collection procedures, contents of the tools, REDCap application, and ethics. The data collectors

orientated and supported study participants to fill out the questionnaires correctly. The responding educators rated their perceptions of competencies for each teaching task on a 5-point Likert scale, where "1" meant not capable; and "5" meant proficient. The graduating students rated the performance of the educators on a 5-point Likert scale. Where "1" meant no educator applies the skill consistently. And "5"meant that all instructors apply the skill consistently. The data collectors were closely supported by 3 supervisors. Errors and omissions found during data collection were corrected timely. The data collection period was from January 14 – 22, 2020.

Data management and analysis

Electronic data were collected using the REDCap application that was used for checking completeness, consistency of responses, and cleaning data. We then exported the data to SPSS version 25. We conducted data analysis by computing proportions, means, standard deviations, and other descriptive statistics. Aggregate scores were calculated as necessary. To assess the competency scores, average composite scores were calculated using weighted averages for each competency domain. Total composite scores were similarly calculated to determine overall competency scores. To calculate the proportions of educators with skill gaps, we combined the responses of all educators who rated themselves as not capable, novice, and advanced beginners and considered them incompetent. Similarly, we considered responses from all students who rated most, and all of their educators apply the teaching skills as well-performing while calculating the proportion of performing educators. Pearson's chi-square tests with P–values were computed to assess the significance of associations among the variables. Cramer's V coefficients (V) were calculated to assess the strength of associations. We considered the values of V less than 0.100; in the range of 0.100 – O.250; and greater than 0.25 weak, medium, and strong associations; respectively.[20] As per the policy of the Ministry of Education (MOE) of Ethiopia, any level IV TVET educator needs to have a university education with a minimum of a Bachelor's Degree. The MOE also set a 60% pass mark to allow educators to graduate with a Bachelor's Degree.[21] Hence, we adopted the MOE 60% competency score as a cutoff point in our study to classify the educators as "competent" or "not competent".[21-22]

Ethical consideration:

We obtained ethical clearance from Johns Hopkins Bloomberg School of Public Health Institutional Review Board with IRB number **16606**. The Oromia regional health bureau and the

training institutions approved the protocol and provided support letters to conduct the study. The study team met with deans, department heads, and facility managers of the target institutions to explain the purpose of the study and data collection processes. Data collectors obtained informed oral consent from each study participant. Data on study participants' names and other personal identifiers were not collected. We also placed the datasets in a secure place for keeping participants' information confidential.

Patient and public involvement:

No patients or members of the public were involved in the research design, analysis, and dissemination of the findings. Deans and educators of the health colleges, and experts from the ministry of health, the regional health bureau, professional associations, and implementing partners were involved in the interpretation and utilization of the findings.

RESULTS:

Background characteristics of study participants:

A total of 147 educators and 112 students participated in the study with response rates of 95 % and 90 %, respectively. The mean age of the educators was 32 years with a range of 19 – 54 years. More than half of the educators were below 30 years of age (54%). Nearly half of them were female (48 %) and had less than 5 years of teaching experience (45%). The mean period of the educators' work experience was 7 years. The majority of them were not trained in teaching skills courses in the last two years (82 %). Table 1.

The graduating students were mostly health extension workers (HEW) by department (70 %), in the age group of 20 – 22 years (64%), and females by sex (80 %). Supplemental material 1.

Table 1: Background characteristics of educators, Ethiopia, Jan 2020 (N= 147)

Background Characteristics	NHSC N (%)	AATPTC N (%)	Total N (%)
Type of educators			
Classroom instructors	37 (30)	14 (64)	51 (35)
Clinical preceptors	88 (70)	8 (36)	96 (65)
Age in years			
<30	60 (48)	19 (86)	79 (54)
30 – 39	48 (38)	2 (9)	50 (34)
>39	17 (14)	1 (5)	18 (12)
Sex			
Male	63 (50)	14 (64)	77 (52)
Female	62 (50)	8 (36)	70 (48)
Education			
TVET level 4	9 (7)	4 (18)	13 (9)
BSc degree	112 (90)	18 (82)	130 (88)

MSc & above	4 (3)	0 (0)	4 (3)
Profession			
Nurse	76 (61)	0	76 (52)
Midwife	27 (22)	0	27 (18)
Biomedical technician	0 (0)	22 (100)	22 (15)
Others	22 (18)	0	22 (15)
Teaching experience in years			
<5	50 (40)	17 (77)	67 (45)
5 – 10	37 (30)	5 (23)	42 (29)
>10	38 (30)	0	38 (26)
Trained on teaching skills course in the past 2 years			
Yes	18(4)	9(41)	27 (18)
No	107 (6)	13 (59)	120 (82)

*NHSC = Nekemte Health Science College
*AATPTC – Addis Ababa Tegbareid Polytechnic College
* TVET – Technical Vocational Education Training

Teaching competency score of the educators

The overall average composite competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. The classroom instructors had less than 60.0 % scores in two competency domains, namely; developing and using education materials (55.4 %) and providing management and leadership functions (58.4 %). However, clinical preceptors scored less than 60.0 % in all four competency domains. Tables 2 and 3.

Table 2: Mean teaching competency scores of classroom instructors, Ethiopia, Jan 2020 (N= 51)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Facilitate theoretical learning in the classroom	12	67.9 (14.4)	51.3 (13.0)	63.7 (15.8)
Facilitate student clinical practicum	7	73.0 (14.4)	61.9 (17.0)	70.2 (15.9)
Conduct student assessment and evaluation	18	67.5 (14.8)	55.6 (13.1)	64.4 (15.2)
Develop and use education materials/resources	10	57.3 (13.1)	49.9 (12.7)	55.4 (13.3)
Provide student support functions	3	63.5 (7.9)	51.8 (14.7)	60.5 (17.7)
Provide management & leadership functions	3	61.9 (18.1)	48.2 (12.2)	58.4 (17.7)
Overall average composite competency score		**65.2 (13.2)**	**53.1 (12.4)**	**61.1 (13.9)**

SD means standard deviation

Table 3: Mean teaching competency scores of clinical preceptors, Ethiopia, Jan 2020 (N=96)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Clinical teaching skills	10	52.3 (20.9)	57.0 (18.7)	52.7 (20.7)
Student assessment and evaluation	15	47.5 (18.0)	45.0 (14.6)	47.2 (17.8)
Student support functions	4	51.4 (21.3)	53.8 (20.3)	51.5 (21.3)
Infection prevention and patient safety	5	58.7 (24.4)	59.5 (22.9)	58.7 (24.2)

Overall average composite competency score	**52.4 (19.8)**	**53.8 (17.9)**	**52.5 (19.6)**

SD means standard deviation

Teaching competency gaps of the educators

More than two-thirds of classroom instructors perceived that they had gaps in developing and using student performance assessments: portfolios, logbooks, objective structured clinical/practical examinations (OSCE/OSPE), and digital learning solutions. And more than three-quarters of clinical preceptors perceived that they had gaps in developing and using student performance assessments, active learning methods (case study, role play, discussion, and group assignment), and providing constructive feedback. Table 4.

Table 4: Top competency gaps of classroom instructors on the left and clinical preceptors on the right, Ethiopia, Jan 2020.

Teaching competency of classroom instructors Skill area	**% of not competent (N=51)**	**Teaching competency of clinical preceptors Skill area**	**% of not competent (N=96)**
Develop and use portfolio	82.4	Administer the short and long exam	93.8
Use of digital solutions for learning	80.4	Administer global rating	90.6
Develop and use of logbook	72.5	Use portfolio	82.3
Develop and administer OSCE/OSPE	72.5	Develop and use a logbook	81.3
Conduct education program evaluation	72.5	Use 360 evaluation	81.3
Create a conducive learning environment	70.6	Support unsuccessful students	79.2
Develop and use course syllabi	70.6	Provide constructive feedback	78.1
Support educational QA processes	70.6	Use discussion & group assignment	78.1
Provide student support functions	68.6	Crease conducive learning environment	76.0
Provide gender support to female students	66.7	Develop and use a case study	76.0
		Create and use role play	76.0

Factors associated with the competency score of educators

The professional background of classroom instructors had a significant and strong association with their competency scores (P-value = 0.004; and V = 0.507). The age of clinical preceptors had a significant and strong association with their competency scores (P-value = 0.023; and V = 0.280). The teaching experience of clinical preceptors had also a significant and strong association with their competency scores (P-value = 0.007; and V = 0.323). In addition, the sex of the clinical preceptors had a significant and medium-strength association with their competency scores (P-values = 0.019; and V = 0.240). Table 5.

Table 5: Factors associated with competency score of classroom instructors (above) and clinical preceptors (below), Ethiopia, Jan 2020.

Background Characteristics	Teaching competency score (N=51)		Pearson Chi-square	
Instructors	**<60 N (%)**	**60+ N (%)**	**P-value**	**Strength of association (Crammer V coefficient)**
Age in Years				
<30	12 (54.5)	17 (58.6)	0.528	0.158
30 - 39	8 (36.4)	7 (24.2)		
>39	2 (9.1)	5 (17.2)		
Sex				
Male	17 (77.3)	24 (82.8)	0.625	0.068
Female	5 (22.7)	5 (17.2)		
Professional background				
Nurse	9 (40.9)	5 (17.2)	**0.004***	**0.507**
Midwife	0	1 (3.5)		
Biomedical	9 (40.9)	4 (13.8)		
Others	4 (18.2)	19 (65.5)		
Level of education				
TVET level	1 (4.5)	2 (6.9)	0.907	0.062
BSc degree	19 (86.4)	25 (86.2)		
MSc degree above	2 (9.1)	2 (6.9)		
Teaching experience in years)				
<5	16 (72.7)	18 (62.1)	0.518	0.161
5 – 10	1 (4.6)	4 (13.8)		
>10	5 (22.7)	7 (24.1)		
Trained in teaching skills courses in the past 2 years				
Yes	8 (36.4)	6 (20.7)	0.214	0.174
No	14 (63.6)	23 (79.3)		
Preceptors (N=96)				
Age in years				
<30	29 (43.3)	21 (72.4)	**0.023***	**0.280**
30 – 39	27 (40.3)	7 (24.1)		
>39	11 (16.4)	1 (3.5)		
Sex			**0.019***	**0.240**
Male	20 (29.8)	16 (55.2)		
Female	47 (70.2)	13 (44.8)		
Professional background				
Nurse	45 (67.1)	17 (56.6)	0.715	0.084
Midwife	17 (25.4)	9 (31.0)		
Biomedical	5 (7.5)	3 (10.4)		
Education				
TVET	7 |(10.5)	2 (6.9)	0.584	0.056
BSc degree	60 (89.5)	27 (93.1)		
Teaching experience in years				
<5	17 (25.4)	16 (55.2)	**0.007***	**0.323**
5 – 10	26 (38.8)	10 (34.5)		
>10	24 (35.8)	3 (10.3)		
Trained on teaching skills courses in past 2 years				
Yes	6 (8.9)	6 (20.7)	0.110	0.163
No	61(91.1)	23 (79.3)		

Students' perception of the application of teaching skills by their educators

Significant proportions of graduating students perceived that most of their educators did not consistently use digital learning solutions (81%), create a conducive learning environment (50%), provide counseling and psychosocial support (50%), use a variety of student assessment methods (49%), and apply active learning methods (43 %). Supplemental material 2.

Factors associated with students' perception of the application of teaching skills by educators

The sex of students had a significant and strong association with their perceptions of how well the educators provide appropriate education materials (P = 0.000; and V = 0.429). In addition, the sex of students had a significant and medium strength association with their perception of how well their educators respect them as adult learners (P-value = 0.031; and V = 0.204), orientate them (P-value = 0.022; and V = 0.217), and ensure a conducive learning environment (P-value = 0.035; and V = 0.199). Supplemental material 3.

DISCUSSION:

In almost every country in the world, there are health workforce shortages, skill mix imbalances, and uneven geographical distributions, leaving millions without access to healthcare.[1, 2, 7] A need to scale up PSE has intensified to train more health professionals and transform training quality.[7] Being one of the 57 countries with severe health workforce crisis[7], Ethiopia scaled up health professional education. However, it was challenged to uphold the PSE quality.[9 - 12] Other low and middle-income countries (LMICs) faced similar challenges due to a shortage of qualified educators and other factors whilst addressing the workforce challenges.[13, 23 - 25]

In this study, we found out that the educators felt competent on essential teaching tasks, but not on all relevant ones. We identified competency gaps among the educators in using active learning methods, performance assessments, digital learning solutions, gender-responsive pedagogy, and performance-based feedback. The findings were not surprising as health professions education in Ethiopia was not well developed as a career. The educators lacked formal teachers' education opportunities.[19, 22] Health professionals were recruited for the complex tasks without demanding skills and experiences in teaching.[26, 27] Faculty recruitment focused mainly on the academic achievements of new graduates. Similar faculty recruitment and development challenges were reported in many LMICs.[23 – 25, 28] On the contrary, educators in a developed world are required to have teaching qualifications and experiences before deployments.[29 - 32] One contributing factor to

the suboptimal teaching competency was the limited faculty development opportunities in Ethiopia.[27] Meanwhile, faculty development on a wide range of educational activities is recommended to educators.[33 -35] The rapid PSE scale-up in the country exacerbated the shortage of qualified educators.[9 - 12] Many educators were less than 30 years of age and had less than five years of work experience which could limit their use of practice-based improvement opportunities. A WHO report corresponded with our findings that only 6.6% of educators in LMICs were adequately prepared and had sufficient teaching qualifications.[17] From an optimistic point of view, one could argue that the educators were doing good, given they had no formal education, inadequate faculty development opportunities, and limited experiences. Although we used distinct data collection tools for the classroom instructors and clinical preceptors, it is good to note that the competency scores of the clinical preceptors were lower. This might be due to the differences in their training, duties, and work arrangement. Clinical preceptors were hired by the practice sites mainly to provide services with no explicit preceptorship roles. This meant that it is difficult to realize Ethiopia's TVET education strategy.[26] Reports also claimed that TVET trainers in Ethiopia lacked teaching skills.[19, 21]

The significant difference between male and female students' perceptions of the performances of educators on key tasks could be due to the low gender skills among the educators. The gender audit that was conducted in Ethiopia's higher education showed comparable findings.[36] Competency-based education programs need to use non-traditional teaching and assessment techniques. Case study, role-play, group assignment, and discussion are proven active learning methods for teaching critical thinking, problem-solving, communication, teamwork, and collaboration skills,[37, 38] However, the educators had the skill gaps in using them. The educators had limited ability to use OSCE/OSPE, logbook, portfolio, 360-degree evaluation, and global rating. Hence, assessing and teaching clinical skills, practical procedures, patient management, communication skills, and professional behaviors of the students might be difficult.[39, 40] It is known that feedback is the vital cog in the wheel of competency-based education.[41] However, the educators lacked the skills to provide quality feedback. The educators had learning technology skill gaps that might diminish the power of digital learning for transforming PSE in Ethiopia.[42, 43]

Although it is known that self-assessments are not the best method of competency assessment, we used it in our study to determine the teaching competency of educators. Self-assessments can have

critical values in obtaining reliable, and efficient evidence needed for the professional development and regulation of educators. To improve the quality of self-assessment data, we trained data collectors who provided orientation and guidance to educators on data collection tools and processes. Since there was no nurse and midwifery graduating class during the study period, health extension workers (HEWs) graduating students who were taught by the same educators and could give valid judgments were included. Since we did not take representative samples from all colleges, our findings cannot be generalizable. The contexts of the health training colleges in Ethiopia and other sub-Saharan African countries are more or less similar. Other colleges and researchers can learn from our methodological approaches and key findings.

To ensure the availability of competent educators, the colleges are advised to revisit faculty recruitment, development, and retention policies. Teaching experiences and skills of educators should be considered as faculty recruitment criteria. Faculty development programs on active learning methods, performance assessments, digital learning, feedback, and gender-responsive pedagogy should be designed. Strengthening education development units in the colleges can catalyze faculty development programs. In addition, academic programs in health profession education should be expanded. More studies are required to understand the causes and effects of low teaching competency among educators.

CONCLUSIONS:

Classroom instructors and clinical preceptors had sub-optimal teaching competency. Skills gaps were reported in using active learning methods, performance assessments, feedback, digital learning, and gender among the significant proportions of educators. Many educators were young and had limited experience and training in teaching. Faculty development opportunities are critical. More studies on the causes and effects of low teaching competency are needed.

Contributors:

The following were author-contributors of the study.

Dr. Daniel Dejene (MD, MPH, FMER) was the first author who contributed to the study concept and design, statistical analysis, result interpretation, and drafting, development, and revision of the manuscript.

The co-authors, Professor Dr. Jelle Stekelenburg (Ph.D., MD) and Professor Marco Versluis (Ph.D., MD) contributed to the statistical analysis, result interpretations, and drafting and revision of the manuscript. Dr. Firew Ayalew (Ph.D. MSc., MA, BSc) and Yohannes Molla (MSc, BSc) who are the co-authors contributed to the study design, result interpretation, and manuscript revision. All authors read and approved the final version of the manuscript.

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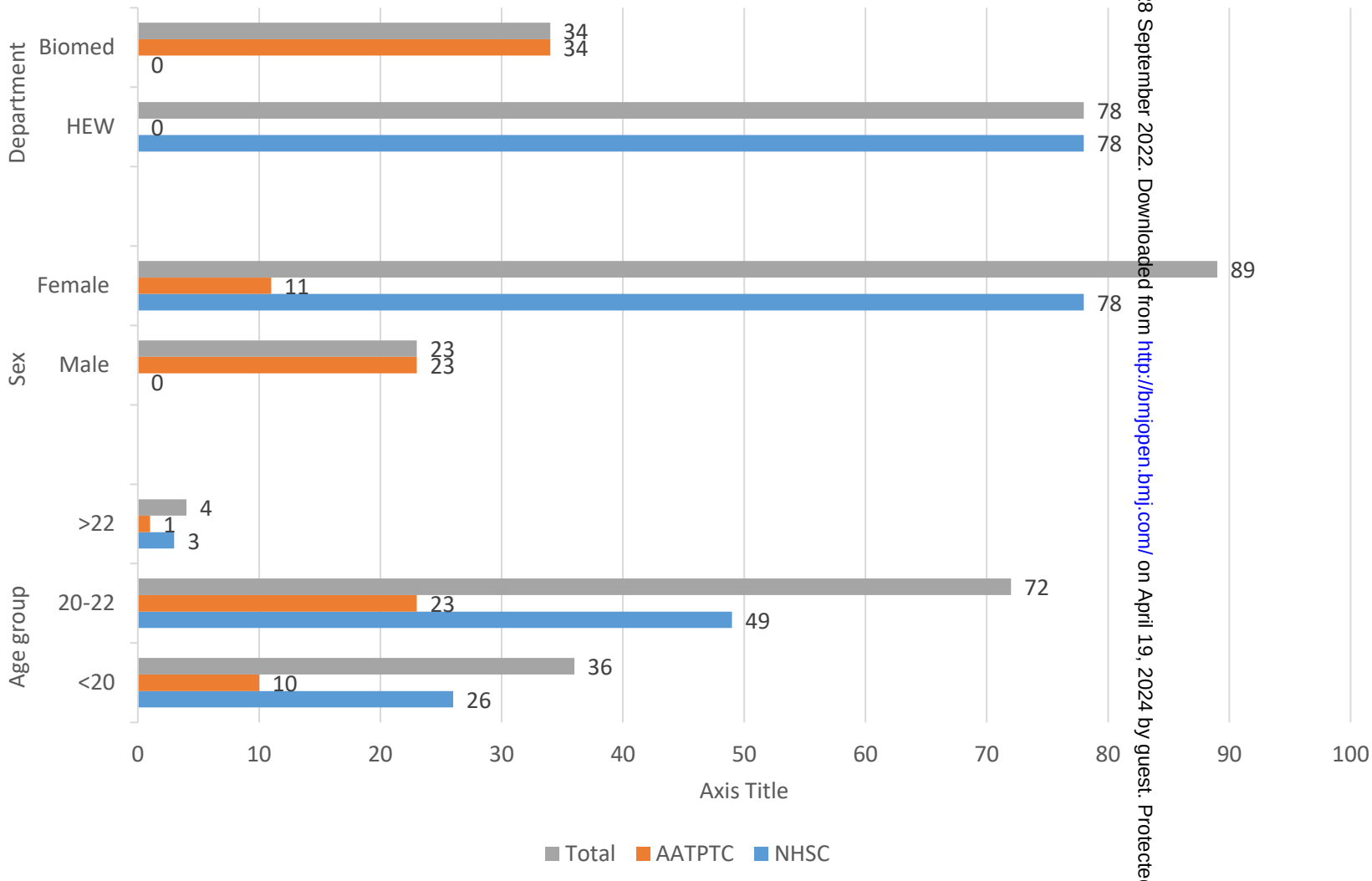
Figure 1: percent of graduating students who percieved educators performed the teaching tasks consistently, Ethiopia, Jan 2020 (N= 112)



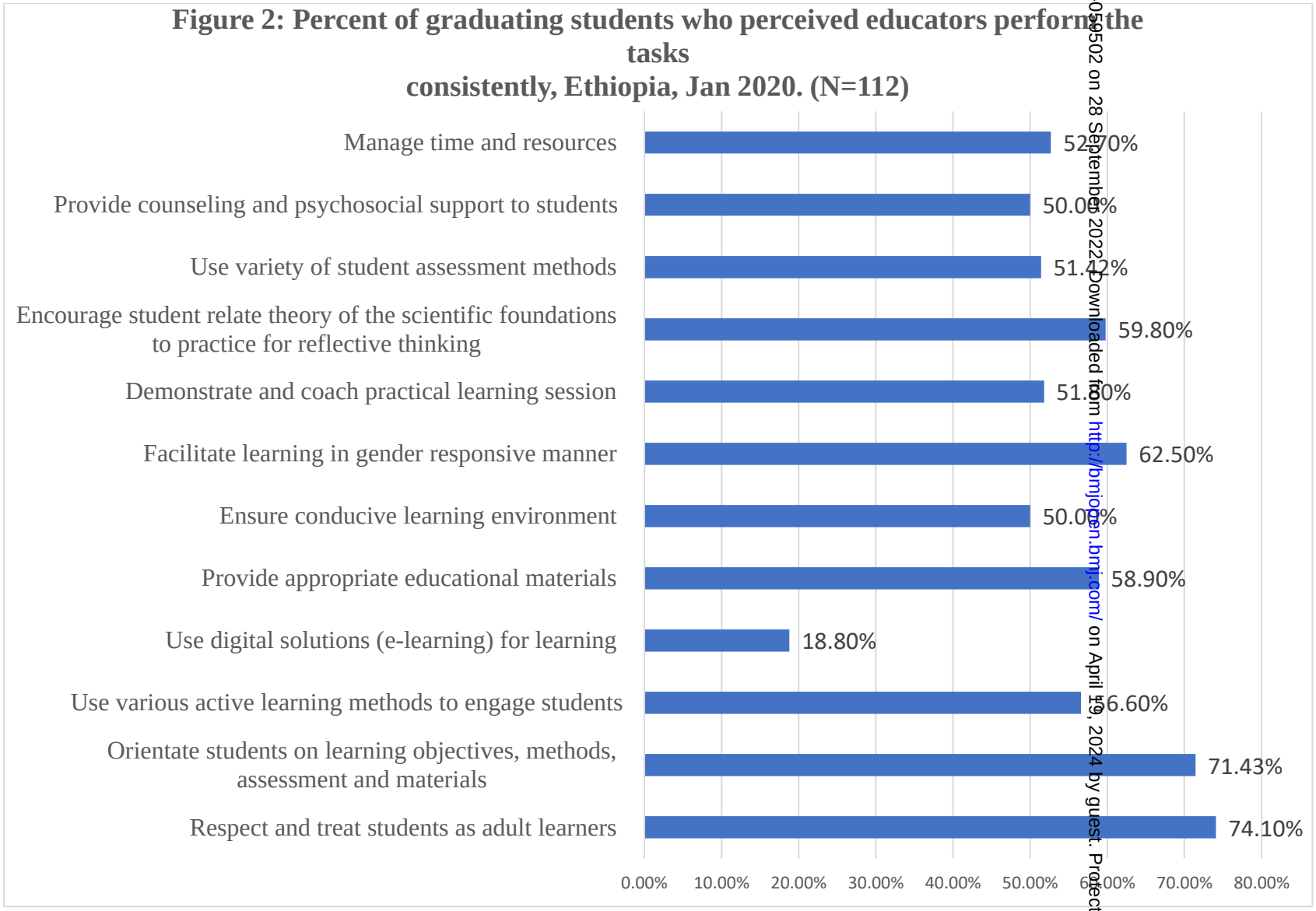


Table 6: Association between background characteristics of graduating students and their perception of the performance of educators, Ethiopia, Jan 2020.

Tasks of Educators	Sex (N=112)		Pearson Chi-square	
	Male N (%)	Female N (%)	P-value	Strength of association (Crammer V)
Respect as adult learners				
Yes	13 (56.5)	70 (78.7)	**0.031***	**0.204**
No	10 (43.5)	19 (21.3)		
Orientate Students				
Yes	12 (52.2)	68 (76.4)	**0.022***	**0.217**
No	11 (47.8)	21 (23.6)		
Apply interactive lectures				
Yes	13 (56.5)	53(59.5)	0.792	0.025
No	10 (43.5)	36 (40.5)		
Use digital solutions for learning				
Yes	5 (21.7)	16 (17.9)	0.680	0.039
No	18 (78.3)	73 (82.1)		
Provide appropriate educational materials				
Yes	4 (17.4)	62 (69.7)	**0.000***	**0.429**
No	19 (82.6)	27 (30.3)		
Ensure a conducive learning environment				
Yes	16 (69.57)	40 (44.94)	**0.035***	**0.199**
No	7 (30.43)	49 (55.06)		
Facilitate in a gender-responsive manner				
Yes	14 (60.9)	56 (62.9)	0.856	0.017
No	9 (39.3)	33 (37.1)		
Facilitate practical learning session				
Yes	1 (4.4)	19 (21.4)	0.058	0.179
No	22 (95.6)	70 (78.6)		
Provide good feedback				
Yes	13 (56.5)	51 (57.3)	0.946	0.006
No	10 (43.5)	38 (42.7)		
Provide counseling & psychosocial support				
Yes	8 (34.8)	48 (53.9)	0.102	0.149
No	15 (65.2)	41(46.1)		
Manage time and resources				
Yes	9 (39.1)	50 (56.2)	0.144	0.138
No	14 (60.9)	39 (43.8)		

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2 & 3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5 & 6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6 & 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9, 10 & 11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10 & 11
		(*b*) Report category boundaries when continuous variables were categorized	10 & 11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10 & 11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12, 13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12, 13 & 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Title Page

Title: Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

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Assessment of core teaching competency of health professional educators in Ethiopia: an institution-based cross-sectional study

ABSTRACT:

Objectives: Understanding the competency of educators is key to informing faculty development, recruitment, and performance monitoring. This study aimed to assess the core teaching competency of nursing, midwifery, and biomedical educators and associated factors in Ethiopia.

Design: An institution-based cross-sectional study was conducted in January 2020 using structured tools adapted from the WHO's nurse and midwifery educator competency frameworks.

Setting: Two health science colleges and nine student practice sites in Ethiopia.

Participants: All classroom instructors and clinical preceptors of nursing, midwifery, and biomedical technician training programs, and all the graduating class students.

Measures: Overall teaching competency scores, teaching domain competency scores, competency gaps, and performance gaps of educators were outcome measures. Past training on teaching skills courses, teaching experiences, and sociodemographic characteristics of educators are associated factors.

Results: Most educators were not trained in teaching methods (82 %). The teaching competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. Competency gaps were found in using active learning methods, performance assessment, feedback, and digital learning. Professional background of classroom instructors had a significant and strong association with their competency score (***P = .004; V = .507***). Age and teaching experience of clinical preceptors had significant associations with their competency score (***P = .023,*** and *.007*, respectively); and had strong associations (***V = .280*** and ***.323***, respectively). Sex of students and their perceptions of how well the educators give education resources had a significant and strong association (***P < .001***; and ***V= .429***).

Conclusions: Nursing, midwifery, and biomedical educators lacked the competency to undertake important teaching roles which could contribute to the low quality of education. More attention should be given to strengthening faculty development.

Strengths and limitations:

- The use of validated nurse and midwifery educators' competency frameworks improved the quality of data in this study.
- We considered multiple data sources from classroom instructors, clinical preceptors, and students to strengthen the study findings.
- Although self-assessment is not the best method to determine competency, we used it to obtain reliable, and efficient findings for informing professional development and regulation of educators.
- Since there was no nurse and midwifery graduating class during the study period, health extension workers (HEWs) students who were taught by the same educators were included.
- Though we did not take representative samples to draw generalizable findings, we applied a feasible methodology to broaden knowledge in the health professional education field.

INTRODUCTION:

A stronger health workforce is a vital determinant for improving population health outcomes. The world is currently facing health workforce shortages as the result of challenges in health professional education among others.[1, 2] Globally, eighteen million more health professionals are needed by 2030; mainly in developing countries, to achieve universal health coverage (UHC).[1] And nine million more nurses and midwives are required to reach sustainable development goal (SDG) 3 on health.[1] Biomedical engineering professionals are required to a great extent to optimize the development and use of medical equipment.[2,3] Substantial health workforce investments are; therefore, required to achieve UHC and SDG health targets.

Ethiopia has suffered from a critical shortage of competent nurses, midwives, and biomedical technicians.[4] The 2018 national health workforce density was a total of 10 doctors, nurses, and midwives per 10,000 populations; which was far below the World Health Organization's (WHO's) threshold of 45 for achieving the UHC.[5] Few biomedical engineering professionals were available in 2017 (0.002 per 10,000 populations).[6] The shortage of health professionals affected the access to quality healthcare and contributed to undesirable health outcomes.[5]

To address the shortages, WHO recommended countries rapidly scale up and transform health professional education.[7] Hence, Ethiopia expanded preservice education (PSE) leading to the burgeoning of the graduation capacity.[8, 9] In addition to the 46 universities, Ethiopia opened 23 public regional colleges, 45 private institutions, and 4 biomedical training institutions using technical vocational education, and training (TVET) system which enabled the country to produce the majority of nurses, midwives, and biomedical technicians. As a result, Ethiopia was able to address the sharp rise in HRH needs that occurred as a result of the primary healthcare expansion in the last two to three decades.[10]

However, education quality received less attention. Scaling up of the education has further deteriorated quality since there were no congruent commitment and resources to support the expansion. In reality, the massive expansion in the face of the shortages of faculty exacerbated Ethiopia's quality concerns.[9, 11] The country needs a lot of work to ensure that graduates are competent.[12-14] Qualified educators who mastered teaching competencies for effective facilitation

of classroom sessions and student clinical practice, developing learning materials, assessing student learning, and providing support to students are critical.[15-18] Effective educators should have adequate professional, communication, leadership, and research skills .[7, 15, 16] In addition, large student size, epidemiological transition, advancing medical knowledge, and technology have required educators to improve their teaching.[19] However, the teaching competency among health professional educators in Ethiopia is not well studied. Understanding the competency of educators guides faculty development, and other quality enhancement interventions. Such evidence expands the global knowledge and informs health professional education practices in other countries having similar challenges. This study aimed to assess core teaching competency and associated factors of nursing, midwifery, and biomedical educators in Ethiopia.

METHODS

Study design and participants

We conducted an institution-based quantitative cross-sectional study in January 2020 to serve as a baseline survey for the faculty development project (FDP). Our study questions focused on core teaching competency levels and gaps among the educators, and the associated factors. The FDP aimed to improve the teaching and learning process of vocational nursing and midwifery programs at Nekemte Health Science College (NHSC), and the biomedical training program at Addis Ababa Tegebareid Polytechnic College (AATPTC). NHSC, located in western Ethiopia of Nekemte city, was providing vocational nursing, midwifery, health extension, and other midlevel health professional training. AATPTC, found in Addis Ababa city administration, was providing vocational biomedical technician training and others. The colleges worked with 14 student practice sites. Based on convenience, we selected 5 hospitals, 2 health centers, and 2 biomedical equipment workshops. The biomedical equipment workshops were workplaces for biomedical technicians and engineers where varieties of medical equipment were stored, tested, calibrated, and maintained. There was a total of 154 educators for the nursing, midwifery, and biomedical technician programs and 125 graduating class students. Of the educators, there were 57 classroom instructors and 97 clinical preceptors. We used a census sampling technique to include all classroom instructors, clinical preceptors, and graduating students. Classroom instructors were teaching staff hired by and work in the colleges to teach and support students. Health workers hired by health facilities or medical equipment workshops to provide patient care or medical

equipment services were regarded as clinical preceptors. We decided to include graduating class students as they had adequate exposure and experience enough to make valid judgments on the performance of the educators. We obtained lists of the classroom instructors, clinical preceptors, and graduating students from the deans' and registrars' offices. The educators and students who were present at work during the data collection period, willing and able to participate in the study were included as study participants. To evaluate the effectiveness of the FDP, an end-line assessment was planned to be conducted at the end of the project using the same methods and data collection tools.

Data collection:

We adapted the WHO midwifery and nurse educator competency frameworks to develop three structured data collection tools[16, 17] Since we were interested to assess teaching competencies only; but not the profession-specific competencies, we used the same data collection tools across the three academic programs. The first tool (with 63 variables) was a self-administered questionnaire aimed at exploring the perceptions of classroom instructors on their capabilities to implement specific teaching tasks related to six competency domains, namely; facilitating theoretical learning using engaging methods in classrooms, supporting student clinical practice through applying effective practical training methods, using student assessment methods, developing teaching and learning materials, providing guidance, counseling and gender-related support to students, and providing education management & leadership functions. The second tool (with 45 variables) was a self-administered questionnaire for assessing the perceptions of clinical preceptors on four competency domains. The three competency domains of clinical teaching, student assessment, and student support are similar to those of the classroom instructors. The fourth domain is about the ability of clinical preceptors to apply infection prevention and patient safety principles, and protocols during patient care. The third tool (with 49 variables) was also a self-administered questionnaire for graduating class students aiming to obtain information on the current teaching performances of their educators. All three tools had variables about the background characteristics of the study participants. In collaboration with five national health professional education experts, we validated and piloted the tools at 2 health training institutions.

To assure data quality, we selected 7 data collectors who had an education level of master's degree and relevant experiences. We trained the data collectors for 2 days on data collection procedures, the contents of the tools, the REDCap application, and ethics. The data collectors orientated and

supported study participants to fill out the questionnaires correctly. The responding educators rated their perceptions of competencies for each teaching task on a 5-point Likert scale, where "1" meant not capable; and "5" meant proficient. The graduating students rated the performance of the educators on a 5-point Likert scale. Where "1" meant no educator applies the skill consistently. And "5"meant that all instructors apply the skill consistently. The data collectors were closely supported by 3 supervisors. Errors and omissions found during data collection were corrected timely. The data collection period was from January 14 – 22, 2020.

Data management and analysis

Electronic data were collected using the REDCap application that was used for checking completeness, consistency of responses, and cleaning data. We then exported the data to SPSS version 25. We conducted data analysis by computing proportions, means, standard deviations, and other descriptive statistics. Aggregate scores were calculated as necessary. To assess the competency scores, average composite scores were calculated using weighted averages for each competency domain. Total composite scores were similarly calculated to determine overall competency scores. To calculate the proportions of educators with skill gaps, we combined the responses of all educators who rated themselves as not capable, novice, and advanced beginners and considered them incompetent. Similarly, we considered responses from all students who rated most, and all of their educators apply the teaching skills as well-performing while calculating the proportion of performing educators. Pearson's chi-square test with P–values were computed to assess the significance of associations among the variables. Cramer's V coefficients (V) were calculated to assess the strength of associations. We considered the values of V less than .100; in the range of .100 – .250; and greater than .250 weak, medium, and strong associations; respectively.[20] As per the policy of the Ministry of Education (MOE) of Ethiopia, any level IV TVET educator needs to have a university education with a minimum of a Bachelor's Degree.[19] The MOE also set a 60% pass mark to allow educators to graduate with a Bachelor's Degree.[21] Hence, we adopted the MOE 60% competency score as a cutoff point in our study to classify the educators as "competent" or "not competent".[21-22]

Ethical consideration:

We obtained ethical clearance from Johns Hopkins Bloomberg School of Public Health Institutional Review Board with IRB number **16606**. The Oromia regional health bureau and the training institutions approved the protocol and provided support letters to conduct the study. The

study team met with deans, department heads, and facility managers of the target institutions to explain the purpose of the study and data collection processes. Data collectors obtained informed oral consent from each study participant. Data on study participants' names and other personal identifiers were not collected. We also placed the datasets in a secure place for keeping participants' information confidential.

Patient and public involvement:

No patients or members of the public were involved in the research design, analysis, and dissemination of the findings. Deans and educators of the health colleges, and experts from the ministry of health, the regional health bureau, professional associations, and implementing partners were involved in the interpretation and utilization of the findings.

RESULTS:

Background characteristics of study participants:

A total of 147 educators and 112 students participated in the study with response rates of 95 % and 90 %, respectively. The mean age of the educators was 32 years with a range of 19 – 54 years. More than half of the educators were below 30 years of age (54%). Nearly half of them were female (48 %) and had less than 5 years of teaching experience (45%). The mean period of the educators' work experience was 7 years. The majority of them were not trained in teaching skills courses in the last two years (82 %). Table 1.

The graduating students were mostly health extension workers (HEW) by department (70 %), in the age group of 20 – 22 years (64%), and females by sex (80 %). Supplemental material 1.

Table 1: Background characteristics of educators, Ethiopia, Jan 2020 (N= 147)

Background Characteristics	NHSC N (%)	AATPTC N (%)	Total N (%)
Type of educators			
Classroom instructors	37 (30)	14 (64)	51 (35)
Clinical preceptors	88 (70)	8 (36)	96 (65)
Age in years			
<30	60 (48)	19 (86)	79 (54)
30 – 39	48 (38)	2 (9)	50 (34)
>39	17 (14)	1 (5)	18 (12)
Sex			
Male	63 (50)	14 (64)	77 (52)
Female	62 (50)	8 (36)	70 (48)
Education			
TVET level 4	9 (7)	4 (18)	13 (9)
BSc degree	112 (90)	18 (82)	130 (88)
MSc & above	4 (3)	0 (0)	4 (3)
Profession			

Nurse	76 (61)	0	76 (52)
Midwife	27 (22)	0	27 (18)
Biomedical technician	0 (0)	22 (100)	22 (15)
Others	22 (18)	0	22 (15)
Teaching experience in years			
<5	50 (40)	17 (77)	67 (45)
5 – 10	37 (30)	5 (23)	42 (29)
>10	38 (30)	0	38 (26)
Trained on teaching skills course in the past 2 years			
Yes	18(4)	9(41)	27 (18)
No	107 (6)	13 (59)	120 (82)

*NHSC = Nekemte Health Science College
*AATPTC – Addis Ababa Tegbareid Polytechnic College
* TVET – Technical Vocational Education Training

Teaching competency score of the educators

The overall average composite competency scores of classroom instructors and clinical preceptors were 61.1 % and 52.5 %, respectively. The classroom instructors had less than 60.0 % scores in two competency domains, namely; developing and using education materials (55.4 %) and providing management and leadership functions (58.4 %). However, clinical preceptors scored less than 60.0 % in all four competency domains. Tables 2 and 3.

Table 2: Mean teaching competency scores of classroom instructors, Ethiopia, Jan 2020 (N= 51)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Facilitate theoretical learning in the classroom	12	67.9 (14.4)	51.3 (13.0)	63.7 (15.8)
Facilitate student clinical practicum	7	73.0 (14.4)	61.9 (17.0)	70.2 (15.9)
Conduct student assessment and evaluation	18	67.5 (14.8)	55.6 (13.1)	64.4 (15.2)
Develop and use education materials/resources	10	57.3 (13.1)	49.9 (12.7)	55.4 (13.3)
Provide student support functions	3	63.5 (7.9)	51.8 (14.7)	60.5 (17.7)
Provide management & leadership functions	3	61.9 (18.1)	48.2 (12.2)	58.4 (17.7)
Overall average composite competency score		**65.2 (13.2)**	**53.1 (12.4)**	**61.1 (13.9)**

SD means standard deviation

Table 3: Mean teaching competency scores of clinical preceptors, Ethiopia, Jan 2020 (N=96)

Competency domain	**Number of items**	**Average composite score**		
		NHSC Mean (SD)	**AATPTC Mean (SD)**	**All colleges Mean (SD)**
Clinical teaching skills	10	52.3 (20.9)	57.0 (18.7)	52.7 (20.7)
Student assessment and evaluation	15	47.5 (18.0)	45.0 (14.6)	47.2 (17.8)
Student support functions	4	51.4 (21.3)	53.8 (20.3)	51.5 (21.3)
Infection prevention and patient safety	5	58.7 (24.4)	59.5 (22.9)	58.7 (24.2)
Overall average composite competency score		**52.4 (19.8)**	**53.8 (17.9)**	**52.5 (19.6)**

SD means standard deviation

Teaching competency gaps of the educators

More than two-thirds of classroom instructors perceived that they had gaps in developing and using student performance assessments: portfolios, logbooks, objective structured clinical/practical examinations (OSCE/OSPE), and digital learning solutions. And more than three-quarters of clinical preceptors perceived that they had gaps in developing and using student performance assessments, active learning methods (case study, role play, discussion, and group assignment), and providing constructive feedback. Table 4.

Table 4: Top competency gaps of classroom instructors on the left and clinical preceptors on the right, Ethiopia, Jan 2020.

Teaching competency of classroom instructors Skill area	% of not competent (N=51)	Teaching competency of clinical preceptors Skill area	% of not competent (N=96)
Develop and use portfolio	82.4	Administer the short and long exam	93.8
Use of digital solutions for learning	80.4	Administer global rating	90.6
Develop and use of logbook	72.5	Use portfolio	82.3
Develop and administer OSCE/OSPE	72.5	Develop and use a logbook	81.3
Conduct education program evaluation	72.5	Use 360 evaluation	81.3
Create a conducive learning environment	70.6	Support unsuccessful students	79.2
Develop and use course syllabi	70.6	Provide constructive feedback	78.1
Support educational QA processes	70.6	Use discussion & group assignment	78.1
Provide student support functions	68.6	Crease conducive learning environment	76.0
Provide gender support to female students	66.7	Develop and use a case study	76.0
		Create and use role play	76.0

Factors associated with the competency score of educators

The professional background of classroom instructors had a significant and strong association with their competency scores (***P = .004***; and ***V = .507***). The age of clinical preceptors had a significant and strong association with their competency scores (***P = .023***; and ***V = .280***). The teaching experience of clinical preceptors had also a significant and strong association with their competency scores (***P = .007***; and ***V = .323***). In addition, the sex of the clinical preceptors had a significant and medium-strength association with their competency scores (***P = .019***; and ***V = .240***). Table 5.

Table 5: Factors associated with competency score of classroom instructors (above) and clinical preceptors (below), Ethiopia, Jan 2020.

Background Characteristics	Teaching competency score (N=51)		Pearson Chi-square	
Instructors	**<60 N (%)**	**60+ N (%)**	**P-value**	**Strength of association (Crammer V coefficient)**
Age in Years				
<30	12 (54.5)	17 (58.6)	.528	.158
30 - 39	8 (36.4)	7 (24.2)		
>39	2 (9.1)	5 (17.2)		
Sex				
Male	17 (77.3)	24 (82.8)	.625	.068
Female	5 (22.7)	5 (17.2)		
Professional background				
Nurse	9 (40.9)	5 (17.2)	**.004***	**.507**
Midwife	0	1 (3.5)		
Biomedical	9 (40.9)	4 (13.8)		
Others	4 (18.2)	19 (65.5)		
Level of education				
TVET level	1 (4.5)	2 (6.9)	.907	.062
BSc degree	19 (86.4)	25 (86.2)		
MSc degree above	2 (9.1)	2 (6.9)		
Teaching experience in years)				
<5	16 (72.7)	18 (62.1)	.518	.161
5 – 10	1 (4.6)	4 (13.8)		
>10	5 (22.7)	7 (24.1)		
Trained in teaching skills courses in the past 2 years				
Yes	8 (36.4)	6 (20.7)	.214	.174
No	14 (63.6)	23 (79.3)		
Preceptors (N=96)				
Age in years				
<30	29 (43.3)	21 (72.4)	**.023***	**.280**
30 – 39	27 (40.3)	7 (24.1)		
>39	11 (16.4)	1 (3.5)		
Sex			**.019***	**.240**
Male	20 (29.8)	16 (55.2)		
Female	47 (70.2)	13 (44.8)		
Professional background				
Nurse	45 (67.1)	17 (56.6)	.715	.084
Midwife	17 (25.4)	9 (31.0)		
Biomedical	5 (7.5)	3 (10.4)		
Education				
TVET	7 |(10.5)	2 (6.9)	.584	.056
BSc degree	60 (89.5)	27 (93.1)		
Teaching experience in years				
<5	17 (25.4)	16 (55.2)	**.007***	**.323**
5 – 10	26 (38.8)	10 (34.5)		
>10	24 (35.8)	3 (10.3)		
Trained on teaching skills courses in past 2 years				
Yes	6 (8.9)	6 (20.7)	.110	.163
No	61(91.1)	23 (79.3)		

Students' perception of the application of teaching skills by their educators

Significant proportions of graduating students perceived that most of their educators did not consistently use digital learning solutions (81%), create a conducive learning environment (50%), provide counseling and psychosocial support (50%), use a variety of student assessment methods (49%), and apply active learning methods (43 %). Supplemental material 2.

Factors associated with students' perceptions of the application of teaching skills by educators

The sex of students had a significant and strong association with their perceptions of how well the educators provide appropriate education materials (***P < 0.001***; and ***V = .429***). In addition, the sex of students had a significant and medium strength association with their perception of how well their educators respect them as adult learners (***P = 0.031***; and ***V = .204***), orientate them (***P = 0.022;*** and ***V = .217***), and ensure a conducive learning environment (***P = 0.035***; and ***V = .199***). Supplemental material 3.

DISCUSSION:

In almost every country in the world, there are health workforce shortages, skill mix imbalances, and uneven geographical distributions, leaving millions without access to healthcare.[1, 2, 7] A need to scale up PSE has intensified to train more health professionals and transform training quality.[7] Being one of the 57 countries with severe health workforce crisis[7], Ethiopia scaled up health professional education. However, it was challenged to uphold the PSE quality.[9 - 12] Other low and middle-income countries (LMICs) faced similar challenges due to a shortage of qualified educators and other factors whilst addressing the workforce challenges.[13, 23 - 25]

In this study, we found out that the educators felt competent on essential teaching tasks, but not on all relevant ones. We identified competency gaps among the educators in using active learning methods, performance assessments, digital learning solutions, gender-responsive pedagogy, and performance-based feedback. The findings were not surprising as health professions education in Ethiopia was not well developed as a career. The educators lacked formal teachers' education opportunities.[19, 22] Health professionals were recruited for the complex tasks without demanding skills and experiences in teaching.[26, 27] Faculty recruitment focused mainly on the academic achievements of new graduates. Similar faculty recruitment and development challenges were

reported in many LMICs.[23 – 25, 28] On the contrary, educators in a developed world are required to have teaching qualifications and experiences before deployments.[29 - 32] One contributing factor to the suboptimal teaching competency was the limited faculty development opportunities in Ethiopia.[27] Meanwhile, faculty development on a wide range of educational activities is recommended to educators.[33 -35] The rapid PSE scale-up in the country exacerbated the shortage of qualified educators.[9 - 12] Many educators were less than 30 years of age and had less than five years of work experience which could limit their use of practice-based improvement opportunities. A WHO report corresponded with our findings that only 6.6% of educators in LMICs were adequately prepared and had sufficient teaching qualifications.[17] From an optimistic point of view, one could argue that the educators were doing good, given they had no formal education, inadequate faculty development opportunities, and limited experiences. Although we used distinct data collection tools for the classroom instructors and clinical preceptors, it is good to note that the competency scores of the clinical preceptors were lower. This might be due to the differences in their training, duties, and work arrangement. Clinical preceptors were hired by the practice sites mainly to provide services with no explicit preceptorship roles. This meant that it is difficult to realize Ethiopia's TVET education strategy.[26] Reports also claimed that TVET trainers in Ethiopia lacked teaching skills.[19, 21]

The significant difference between male and female students' perceptions of the performances of educators on key tasks could be due to the low gender skills among the educators. The gender audit that was conducted in Ethiopia's higher education showed comparable findings.[36] Competency-based education programs need to use non-traditional teaching and assessment techniques. Case study, role-play, group assignment, and discussion are proven active learning methods for teaching critical thinking, problem-solving, communication, teamwork, and collaboration skills,[37, 38] However, the educators had skill gaps in using them. The educators had limited ability to use OSCE/OSPE, logbook, portfolio, 360-degree evaluation, and global rating. Hence, assessing and teaching clinical skills, practical procedures, patient management, communication skills, and professional behaviors of the students might be difficult.[39, 40] It is known that feedback is the vital cog in the wheel of competency-based education.[41] However, the educators lacked the skills to provide quality feedback. The educators had learning technology skill gaps that might diminish the power of digital learning for transforming PSE in Ethiopia.[42, 43]

It is known that self-assessments are not the best method of competency assessment. However, we mainly used self-reports of educators on their competencies in our study to generate reliable and efficient evidence needed for the professional development and regulation of educators. To improve the quality of self-assessment data, the views of students were considered. We also trained data collectors on data collection tools and processes. We did not take representative samples from all colleges. Therefore, the study findings cannot be generalizable. Given the similar contexts of the health training colleges in Ethiopia and other sub-Saharan African countries, it is clear that other colleges and researchers can learn from these pieces of work.

To ensure the availability of competent educators, the colleges are advised to revisit faculty recruitment, development, and retention policies. Teaching experiences and skills of educators should be considered as faculty recruitment criteria. Faculty development programs on active learning methods, performance assessments, digital learning, feedback, and gender-responsive pedagogy should be designed. Strengthening education development units in the colleges can catalyze faculty development programs. In addition, academic programs in health profession education should be expanded. More studies are required to understand the causes and effects of low teaching competency among educators.

CONCLUSIONS:

Classroom instructors and clinical preceptors had sub-optimal teaching competency. Skills gaps were reported in using active learning methods, performance assessments, feedback, digital learning, and gender among the significant proportions of educators. Many educators were young and had limited experience and training in teaching. Faculty development opportunities are critical. More studies on the causes and effects of low teaching competency are needed.

Contributorship statement: The following were author-contributors of the study. Dr. Daniel Dejene (MD, MPH, FMER) was the first author who contributed to the study concept and design, statistical analysis, result interpretation, and drafting, development, and revision of the manuscript. The co-authors, Professor Dr. Jelle Stekelenburg (Ph.D., MD) and Professor Marco Versluis (Ph.D., MD) contributed to the statistical analysis, result interpretations, and drafting and revision of the manuscript. Dr. Firew Ayalew (Ph.D. MSc., MA, BSc) and Yohannes Molla (MSc, BSc) who are the co-authors contributed to the study design, result interpretation, and manuscript revision. All authors read and approved the final version of the manuscript.

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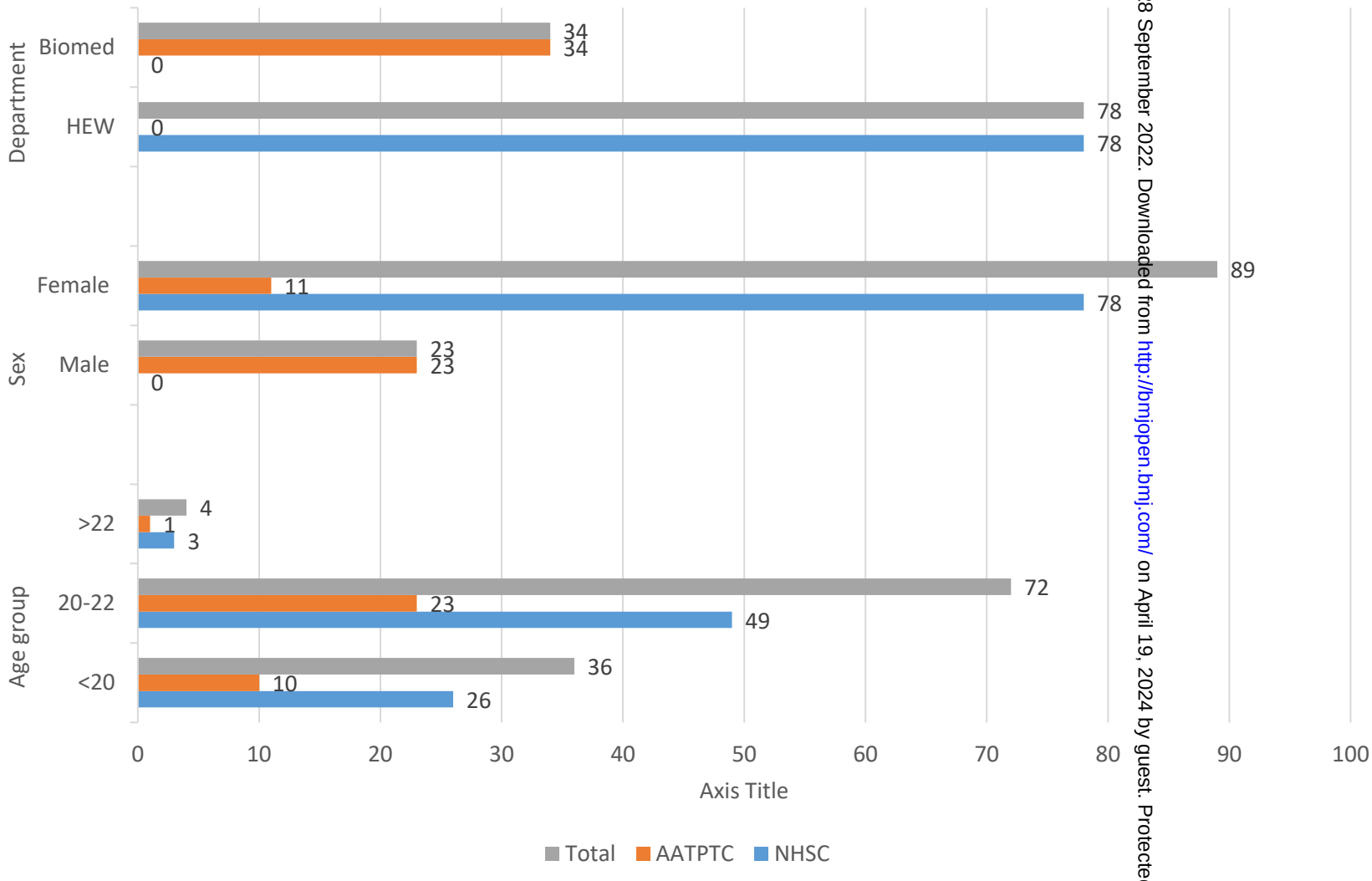
Figure 1: percent of graduating students who percieved educators performed the teaching tasks consistently, Ethiopia, Jan 2020 (N= 112)



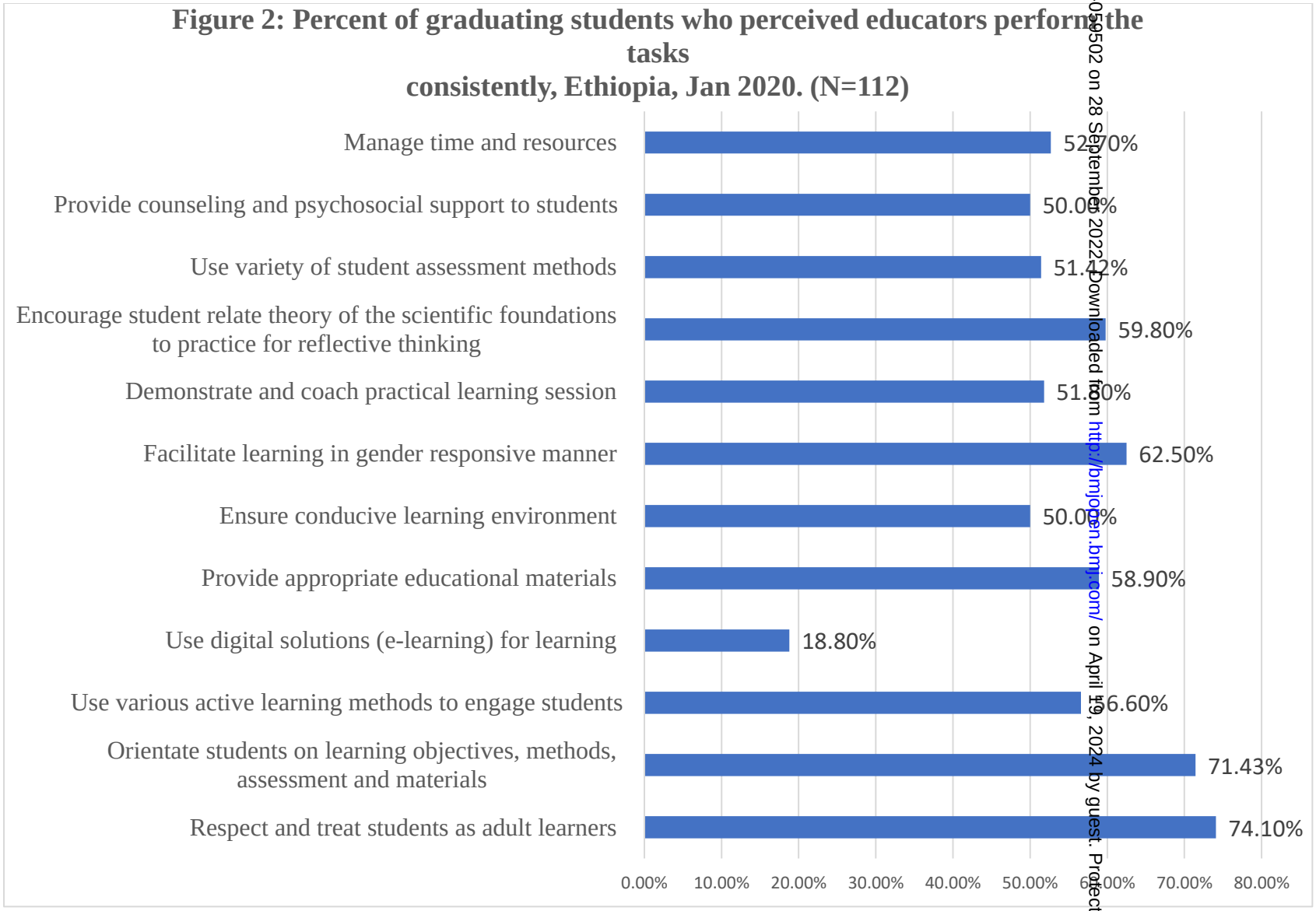


Table 6: Association between background characteristics of graduating students and their perception of the performance of educators, Ethiopia, Jan 2020.

Tasks of Educators	Sex (N=112)		Pearson Chi-square	
	Male N (%)	Female N (%)	P-value	Strength of association (Crammer V)
Respect as adult learners				
Yes	13 (56.5)	70 (78.7)	**.031***	**.204**
No	10 (43.5)	19 (21.3)		
Orientate Students				
Yes	12 (52.2)	68 (76.4)	**.022***	**.217**
No	11 (47.8)	21 (23.6)		
Apply interactive lectures				
Yes	13 (56.5)	53(59.5)	.792	.025
No	10 (43.5)	36 (40.5)		
Use digital solutions for learning				
Yes	5 (21.7)	16 (17.9)	.680	.039
No	18 (78.3)	73 (82.1)		
Provide appropriate educational materials				
Yes	4 (17.4)	62 (69.7)	**.000***	**.429**
No	19 (82.6)	27 (30.3)		
Ensure a conducive learning environment				
Yes	16 (69.57)	40 (44.94)	**.035***	**.199**
No	7 (30.43)	49 (55.06)		
Facilitate in a gender-responsive manner				
Yes	14 (60.9)	56 (62.9)	.856	.017
No	9 (39.3)	33 (37.1)		
Facilitate practical learning session				
Yes	1 (4.4)	19 (21.4)	.058	.179
No	22 (95.6)	70 (78.6)		
Provide good feedback				
Yes	13 (56.5)	51 (57.3)	.946	.006
No	10 (43.5)	38 (42.7)		
Provide counseling & psychosocial support				
Yes	8 (34.8)	48 (53.9)	.102	.149
No	15 (65.2)	41(46.1)		
Manage time and resources				
Yes	9 (39.1)	50 (56.2)	.144	.138
No	14 (60.9)	39 (43.8)		

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2 & 3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5 & 6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6 & 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9, 10 & 11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10 & 11
		(*b*) Report category boundaries when continuous variables were categorized	10 & 11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10 & 11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12, 13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12, 13 & 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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