

**EFFECTIVENESS OF ONLINE LEARNING IN MEDICAL  
EDUCATION: Case of Chest X-ray reading.  
Accelerating Detection of TB in Ghana project.**

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## ABSTRACT

**Objective:** The overarching objective of this study is to evaluate the effects of e-learning on knowledge of chest x-ray reading as compared to seminar-based learning and blended learning for medical practitioners.

**Design:** This study was designed to follow the principles of a descriptive survey due to pivotal elements such as time, deductive inference, and cost in the line of reasoning. The use of quantitative analysis reduces judgmental errors on the part of the researcher.

**Setting:** Participants are mostly doctors and physician assistants from 52 project benefitting hospitals across 12 regions in Ghana. The largest e-health project in Ghana themed “Accelerating Case Detection of Tuberculosis in Ghana” was launched in 2016 which installed digital x-ray systems across major hospitals in all regions of Ghana in cooperating with Ghana Health Service and Ministry of Health. Chest x-ray reading training was a major component.

**Methods:** Findings are based on sample evidence derived from the administration of questionnaires across 6 seminars, 4 blended and 1 exclusive e-learning edition for 401 clinicians across 13 regions. Microsoft Excel and the Statistical Product and Services Solution (SPSS) software package version 25 (2017) was applied to enhance accurate analysis and presentation of data with Pearson Product Moment Correlation Coefficient (PPMC) to establish relationships.

**Results:** In all modalities, a significant gain in knowledge on chest x-ray reading was found ( $p < 0.01$ ). Furthermore, there were significant differences in all assessment factors among all modalities. Exclusive e-learning showed the highest knowledge growth rate of 34.31%.

**Conclusion:** E-learning is beneficial for learning how to read chest x-rays. The effect of e-learning on medical practitioners’ chest x-ray reading knowledge is more comparable to seminar-based approach. The quality of the e-learning platform, use of interactive exercises

and course effectiveness for practicality must be emphasized in e-learning to improve the student's e-journey experience.

## INTRODUCTION

Over the decades medical education has shifted from traditional to internet-centred learning such as distance or electronic learning. Especially arising from the global pandemic of COVID-19, e-learning options are receiving attention. Though growing evidence indicate the positive influence of technology in medical education, we are still in the initial phase of understanding the extent of this effect in the Ghanaian medical education system.

In 2003 there was an argument if e-learning was the solution to individual learning (Tavangarian et al., 2004). This topic is still being debated, nevertheless raising points to the indispensable role of technology in education of the 21<sup>st</sup> century. Electronic learning (also called e-learning) is the use of internet technologies to enhance knowledge and performance. Recently arising from the global pandemic of Coronavirus disease (COVID-19), Larry Bacow, President, Harvard University, announced the complete transition to virtual classes for all courses by March 23<sup>rd</sup> 2020 (McGrath, 2020) and all schools in Ghana were shut down indefinitely (Arhinful, 2020). The outbreak of the COVID-19 forced more schools around the world to embrace e-learning. This short-term disruption arising from the fact that “more than 290 million students have been disrupted worldwide by COVID-19” according to ABC News (McCarthy, 2020) increases the need for e-learning, especially diagnostics courses. Major world players have encountered full transitioning into e-learning as more than 20 schools in China, Japan, and United States have moved classes online (Kamenetz, 2020). Medical education such as chest x-ray reading course is only a niche of education in general.

E-learning offer learners control to determine their learning environment, sequence, pace of learning and time. Students create their experiences to meet their personal learning objectives (Ruiz et al, 2006). The emergence of technology fixated learning in medical education is not surprising. To observe the effect of technology on other areas of medicine such as

teleradiology, telematics, telemedicine, tele-education, etc., gives an indicative signal that sooner than later, medical education will also see the radical light of technology. For the need of e-health, telemedicine, tele-education and distance learning there are various technologies and communication systems from standard telephone lines to the system of transmission digitalized signals with modem, optical fibre, satellite links, wireless technologies (Masic, 2008). E-learning has been demonstrated to be as effective as conventional didacticism and can be used to foster self-directed learning (Ruiz et al, 2016)

According to Cleef et al (2005) cost effectiveness analysis for Tuberculosis diagnosis in Kenya, chest x-ray screening was the most cost effective. The Universal Delft E-learning platform located at [www.e-learning.universaldelft.com](http://www.e-learning.universaldelft.com) was created in 2018. Prior to the first training in 2018, it was piloted with a group of 8 Doctors, Physician Assistants, and members of human resource department of the Ghana Health Service. The course was accredited by the Medical and Dental Council Ghana with 6 CPD-points. Participants are expected to complete all chapters and subchapters of the course, including the Pre-test which is taken initially and Post-test which is accessible only after completion. A certificate for the course can only be obtained by answering at least 65% of the Post-test questions correctly and after filling the evaluation form.

The seminar modality consisted of a 5-day seminar. The blended e-learning modality consisted of a 2-day seminar and 12+ hours of flexible e-learning. The e-learning exclusive modality was strictly on the e-learning platform.

### *Aims of the course*

1. Sensitize and create awareness in all participants on tuberculosis (TB) and systematic active case finding in high risk groups with chest x-ray.

2. Support medical staff in their daily practice, to accurately read and interpret chest X-rays and to diagnose tuberculosis and other chest-related diseases adequately, especially amongst people living with HIV (PLHIV) and children
3. For the e-learning modality there was an additional aim to refresh the knowledge of those who participated in the earlier organized seminars

### *Objectives of this study*

1. Compare the effects of seminar learning (SL) and blended e-learning (BL) on medical education of chest x-ray reading for TB
2. Compare the effects of seminar learning (SL) and exclusive e-learning (EL) on medical education of chest x-ray reading for TB
3. Compare the effects of blended e-learning (BL) and exclusive e-learning (EL) on medical education of chest x-ray reading for TB.

## **METHODS**

### *Research Design*

To achieve the objectives of the study, the research was designed to follow the principles of a descriptive survey due to pivotal elements such as time, deductive inference, and cost in the line of reasoning. This is quick and efficient for assessing information from a large population. More so, a usability questionnaire provides feedback from the point of view of the user. It is quick and efficient to administer and to score.

The combined use of personal interviews helped to validate the data, the fore knowledge of possible errors and a strong foundation of the theoretical and empirical framework of the study can also mitigate judgmental errors on the part of the researcher.

### *Sample & Sampling Procedure*

52 Project benefitting hospitals in the Northern and Southern sector of Ghana were invited through a letter from the Director General of Ghana Health Service to send at least one participant for the training. The training was also advertised on a digital platform of Ghana Medical Association. Participants were selected on first-come-first serve and quota sampling to ensure all beneficiary facilities are well represented. Over 70% of total participants were from beneficiary hospitals.

### *Data Gathering Instrument*

347 questionnaires were administered across 13 regions of Ghana in 11 groups, which focused on 6 exclusive seminar editions, 4 blended e-learning editions and 1 exclusive e-learning edition.

The chest x-ray reading course begins with 20 pre-test questions with 0.5 points attached to each question. The course ended with 20 post-test questions, each scored with 0.5 points. Post evaluation questionnaire analyzed student responses using a Likert scale of 1 to 4, where 1 represented 'insufficient', 2 represented 'sufficient', 3 represented 'good' and 4 represented 'excellent'.

### *Data Analysis*

Questionnaires were self-administered by the researchers. Microsoft Excel and the Statistical Product and Services Solution (SPSS) software package version 25 (2017) was applied to enhance accurate analysis and presentation of data in terms of percentages, frequencies, means and standard deviations. The Pearson Product Moment Correlation Coefficient (PPMC; adapted from the Pearson correlation analysis) was used to establish the relationship.

## RESULTS

78% of the graduates of the blended-learning (BL) and Exclusive e-learning (EL) editions, as well as 76% of the Seminar-learning (SL) graduates are from project beneficiary facilities. As shown in Figure 1, seminar learning had the highest attendance. The 100% completion rate for the seminar learning is predictable and not surprising because the certificate and transport allowance was only issued after full participation and graduation on the last day. BL and EL have a different 'completion-model' because they issue certificates upon successful completion of the e-learning program.

According to Table 1, SL had the lowest pre-test mean score of 5.3014 and BL had the highest score of 6.0700. This means the existing knowledge of students who participated in the blended e-learning was higher than SL students. As expected, BL had the highest post-test mean of 7.2250 and SL had the lowest mean score of 6.4341. However, EL showed the highest percentage increase of 34.31% between pre-test (5.3269) and post-test (7.2250). This indicates that EL students had the highest increase in knowledge of chest x-ray reading (CXR) as compared to SL (21.37% increase) and BL (19.03% increase).

More so, EL had the highest result in realization of learning objectives (mean = 3.7500) and BL had the lowest (mean = 3.6522). This further affirms the highest percentage growth in knowledge of EL students above others. EL students scored the highest mean of 3.7500 in evaluating the scope of subject. Even though all modalities used the same course content, EL students gained more from the scope. SL students found the course most practical with a highest score of 3.6644 and EL learners found it relatively least practical with a mean of 3.5417. The quality of presentation was rated highest by SL students and least by EL students. This indicates that the traditional classroom training medium was most appreciated. The organization and planning variable were assessed for only SL and therefore not compared. BL students found the e-learning course more interactive at a mean of 3.4624 against 3.4583 by

EL students. Amongst all modalities, EL students were most comfortable with the length of the course with a mean of 3.2083 whilst BL learners were least satisfied at a mean of 3.0645.

Table 2 shows a small significant positive correlation between SL students' pre-test and post-test ( $r = .217, p < 0.01$ ). This implies that the higher the previous knowledge of students, the higher the post-test result. More so, a low correlation means the existing knowledge of students was not the main cause of their success in the post-test. This gives room for the new knowledge they could have gained during their training. The SL 5-day course length was mostly predicted by its practicality ( $r = .335, p < 0.01$ ), scope ( $r = .270, p < 0.01$ ) and the quality of the course materials ( $r = .255, p < 0.01$ ). This indicates that these variables determined how long a student took to complete the course. The scope of the course and the practicality contributed most to the realization of the learning objectives at a low and moderate significant level respectively ( $r = .217, p < 0.01$ ;  $r = .362, p < 0.01$ ).

Table 3 shows a moderate significant positive correlation between BL students' pre-test and post-test ( $r = .462, p < 0.01$ ). This implies that the higher the previous knowledge of students, the higher the post-test result. More so, a moderate correlation means the existing knowledge of students was not the main cause of their success in the post-test. This gives room for the new knowledge they could have gained during their training. The length of 2-day seminar and average of 6 weeks to complete online course was mostly predicted by the scope of subject ( $r = .395, p < 0.01$ ), course practicality ( $r = .342, p < 0.01$ ), interactive nature of the course ( $r = .298, p < 0.01$ ) and the quality of the e-learning platform ( $r = .259, p < 0.01$ ). This indicates that these variables determined how long a student took to complete the course. The realization of learning objectives ( $r = .301, p < 0.01$ ), scope of subject ( $r = .407, p < 0.01$ ), practicality ( $r = .214, p < 0.01$ ) and quality of the online platform itself ( $r = .340, p < 0.01$ ) were found to be the

most important contributors to the general quality assessment of the CXR course by BL students.

Table 4 shows a moderate significant positive correlation between students of seminar learning pre-test and post-test ( $r = .481, p < 0.01$ ). This implies that the higher the previous knowledge of students, the higher the post-test result. More so, a moderate correlation means the existing knowledge of students was not the main cause of their success in the post-test.

The quality of the e-learning platform was the only significant contributor to the length of the course ( $r = .432, p < 0.05$ ). This indicates that the easier it was perceived to use the platform, the less time it took to complete the course. The scope of the subject and practicality of the course contributed largely to the realization of learning objectives for this category of learners at a moderate level respectively ( $r = .556, p < 0.01$ ;  $r = .435, p < 0.05$ ).

## **DISCUSSION**

*Objective 1: Compare the effects of seminar learning (SL) and blended e-learning (BL) on medical education of chest x-ray reading (CXR) for TB*

BL had a higher pre-test and post-test mean of 6.0700 and 7.2250 respectively which means students of this edition had more existing knowledge in CXR and higher productivity. This may be due to the re-attendance of 34 (34%) SL students for the BL editions or higher experience level of BL students. It may also be because the 'Normal Chest X-ray' lecture, one of the major modules in the e-course was given to them before they did the pre-test. More important and instructive is the percentage increase between pre-test and post-test of students. Interestingly, SL students had a higher percentage increase of 21.37% as compared to 19.03% recorded for BL students. It implies that SL students acquired more knowledge from the course than BL students. The significant gain in knowledge and in both modalities affirms the results of Nathalie et. al. (2008).

For BL learners, the interactive exercises of the course significantly contributed to students' post-test, whilst for SL students, it was the quality of trainer's presentations which is probably how interactive the presentation was. These correlations propose the invaluable role of interactive exercises for e-learning and good presentations for seminar learning. In the case of BL learners, the general quality and interactive exercises of the course also predicted their achievement. This finding also affirms that "it is necessary to enable the interaction between the learners and the content in e-learning systems in the same manner" according to Tavangarian et al (2004). This may be attributed to the replacement of physical interaction with facilitator with interactive exercises of the course. The use of chest x-ray examples in the course helped to bring their virtual experience to reality.

In terms of the realization of training objectives (refer to Introduction chapter), SL students felt they were able to achieve their objectives 2.4% more than BL students. The scope and practicality of the course contributed significantly to the achievement of both SL and BL students' learning objectives. However, these correlations were higher for BL students.

This study revealed that in both modalities, the scope of the course, practicality and course materials significantly varied the length of time needed by each student to complete. This means the higher the scope, practicality, and number of course materials, the more time needed for SL and BL to complete the course. In addition, the average of 6.2 weeks used by BL students to complete the course was shortened or extended based on students' perceived quality of the e-learning platform and interactive exercises of the course also. This indicates that for online education, the platform for teaching and the number of exercises included should be considered when providing a deadline for students.

Furthermore, the average and correlational differences of between SL and BL faced inconsistencies with Nathalie et al (2008) findings that there was no significant ( $p < 0.05$ ) difference between the 2 educational approaches as this study found a better significant level

of  $p < 0.01$ . This difference may stem from the divergent geographical and training area researched.

*Objective 2: Compare the effects of seminar learning (SL) and exclusive e-learning (EL) on medical education of chest x-ray reading (CXR) for TB*

EL students had a higher existing knowledge and post-training knowledge of CXR as compared to SL students. Only 2 students from SL editions re-attended the EL edition (8% of total EL students). A higher pre-test score may be attributed to a higher experience level of EL students as both groups did not have a pre-existing knowledge from the course before taking the pre-test. To evaluate the growth of students, the percentage increase from pre-test to post test was calculated. EL students increased by 34.31% which is the highest growth rate of all modalities (12.94% higher than SL). However, the significant gain in knowledge in both modalities affirms the results of Nathalie et. al (2008). The length of the course for SL students was partially determined by scope, quality of materials and practicality of course (as in the case of EL students also).

The scope and practicality of the course significantly contributed to the realization of learning objectives in both cases, with higher significance for EL students. In general, the result of this study lends support to Hamburg et. al (2003) that e-learning approaches particularly collaborative ones have many advantages. Additionally, it affirms that SL methods using systematic approach and a standardised form leads to a limited improvement in CXR reading ability in agreement to Seddon, et. al (2014).

*Objective 3: Compare the effects of blended e-learning (BL) and exclusive e-learning (EL) on medical education of chest x-ray reading (CXR) for TB*

BL students had a higher pre-existing knowledge of CXR as compared to EL students which may be due to the preceding 2-day seminar which taught the ‘normal chest x-ray’ lecture before introducing students to the e-learning platform to take the pre-test or probably a relatively higher experience level in CXR. However, to evaluate the growth of students, the percentage increase from pre-test to post test was calculated. EL students increased by 34.31% which is the highest growth rate of all modalities (15.28% higher than BL). The significant increase in knowledge is consistent with the findings of Nathalie et al (2008). The gain in knowledge for BL students (though relatively low) supports the findings of Zhang et al (2004) that in many cases, e-learning can significantly complement classroom.

Students’ ability to achieve the learning objectives in both modalities was aided by the scope of the subject and course effectiveness for practical purposes. However, this relationship was stronger for EL students. In addition, BL students’ ability to reach their objectives was affected length, quality, and interactive exercises of course.

### **CONCLUSION**

The use of only seminars for teaching CXR comparatively has a limited impact and students tend to attend more than once for refreshers. The inclusion or exclusive use of e-learning is more productive, and students learn better when they control their learning pace as provided in BL and EL modalities. Yielding the highest growth rate and post-test mean, exclusive e-learning proved to be the most effective method for increasing the ability of medical practitioners to read chest x-rays. Although e-learning is emerging as one of the fastest organizational uses of the internet (Harun, 2002), most e-learning programs exhibit higher dropout rates when compared with traditional instructor-led courses. There are many reasons that can explain the high dropout rates such as comfort level with technology, availability of

technical support, usability of e-learning applications. This study demonstrates that e-learning can be useful for CXR in the African health care setting. The significant improvement in the total score of assessment factors also strongly suggests a positive impact of the training course in improving the quality of CXRs (Ohkado, 2012).

In conclusion, the quality of the e-learning platform, use of interactive exercises and course effectiveness for practicality must be emphasized in e-learning to improve the student's e-journey experience.

#### *Funding & No Conflict of Interest Declaration*

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Figure 1: Student attendance and completion rate across all training editions

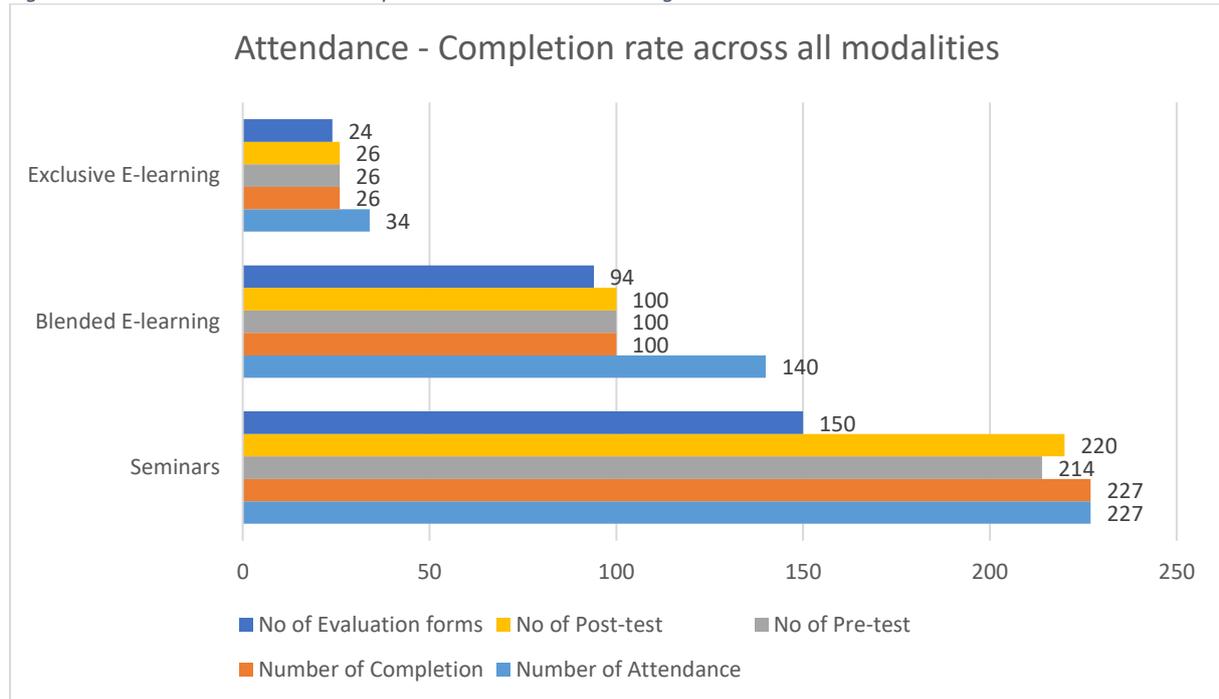


Table 1: Descriptive statistics of all training modalities

	Modality	Min	Max	Mean	Std. Dev.	Variance
Pre-test	Seminar Learning	.00	9.00	5.3014	2.13215	4.546
	Blended E-learning	2.50	9.00	6.0700	1.47028	2.162
	Excl. E-learning	2.50	9.50	5.3269	1.21465	1.679
Post test	Seminar Learning	.00	10.00	6.4341	2.16320	4.679
	Blended E-learning	1.50	10.00	7.2250	1.59129	2.532
	Excl. E-learning	5.00	9.00	7.1538	1.21465	1.475
Realization of learning objectives	Seminar Learning	2.00	4.00	3.7400	.47128	.207
	Blended E-learning	3.00	4.00	3.6522	.47889	.229
	Excl. E-learning	3.00	4.00	3.7500	.44233	.196
Scope of subject	Seminar Learning	2.00	4.00	3.7067	.47128	.222
	Blended E-learning	2.00	4.00	3.6915	.50856	.259
	Excl. E-learning	3.00	4.00	3.7500	.44233	.196
Effectiveness for practical purposes	Seminar Learning	2.00	4.00	3.6644	.48783	.238
	Blended E-learning	3.00	4.00	3.6196	.48815	.238
	Excl. E-learning	3.00	4.00	3.5417	.50898	.259
Quality of trainer presentation/ E-learning platform	Seminar Learning	2.00	4.00	3.7467	.46612	.217
	Blended E-learning	2.00	4.00	3.5435	.56282	.317
	Excl. E-learning	3.00	4.00	3.4583	.50898	.259
Quality of Course materials/ quality of course	Seminar Learning	2.00	4.00	3.5533	.52503	.276
	Blended E-learning	3.00	4.00	3.6739	.47135	.222
	Excl. E-learning	3.00	4.00	3.7500	.44233	.196
Organization & Planning	Seminar Learning	1.00	4.00	3.3667	.62837	.395
	Blended E-learning	NA	NA	NA	NA	NA
	Excl. E-learning	NA	NA	NA	NA	NA
Interactive exercises of course	Seminar Learning	NA	NA	NA	NA	NA
	Blended E-learning	2.00	4.00	3.4624	.59998	.360

	Excl. E-learning	2.00	4.00	3.4583	.58823	.346
Length of course	Seminar Learning	1.00	4.00	3.0733	.64607	.417
	Blended E-learning	1.00	4.00	3.0645	.80496	.648
	Excl. E-learning	1.00	4.00	3.2083	.93153	.868

Source: Field data, 2020.

Table 2: Correlation Analysis of Seminar Learning

	1	2	3	4	5	6	7	8	9
1. Seminar Pre-test	1								
2. Seminar Post-test	.217**	1							
3. Realization of learning objectives	.085	.057	1						
4. Scope of subject	.076	.061	.299**	1					
5. Effectiveness for practical purposes	.090	-.109	.362**	.242**	.1				
6. Quality of trainer presentation	.200*	.048	.099	.240**	.256**	1			
7. Quality of course materials	.076	.092	.157	.281**	.260**	.248**	1		
8. Organization and planning	-.185*	.018	.077	.252**	.179*	.044	.134	1	
9. Length of course	.007	.012	.157	.270**	.335**	.040	.255**	.181*	1

\*\* Correlation significant at the 0.01 level (2-tailed)

\*Correlation significant at the 0.05 level (2-tailed)

Table 3: Correlation Analysis of Blended E-Learning

	1	2	3	4	5	6	7	8	9
1. Blended Pre-test	1								
2. Blended Post-test	.462**	1							
3. Realization of learning objectives	.198	.175	1						
4. Scope of subject	.092	-.021	.355**	1					
5. Effectiveness for practical purposes	.086	.017	.306**	.211*	.1				
6. Quality of course	.118	-.063	.176	.162	.195	1			

7. Quality of course	-.018	.002	.301**	.407**	.214*	.340**	1		
8. Interactive exercise of course	.154	.223*	.438**	.213*	.299**	.266*	.195	1	
9. Length of course	.177	.098	.193	.395**	.342**	.259*	.316**	.298**	1

\*\* Correlation significant at the 0.01 level (2-tailed)

\*Correlation significant at the 0.05 level (2-tailed)

Table 4: Correlation Analysis of Exclusive E-Learning

	1	2	3	4	5	6	7	8	9
1. Excl. E-learning Pre-test	1								
2. Excl. E-learning Post-test	.481*	1							
3. Realization of learning objectives	.112	-.147	1						
4. Scope of subject	-.075	.049	.556**	1					
5. Effectiveness for practical purposes	.211	.249	.435*	.435*	.1				
6. Quality e-learning platform	.049	.127	.338	.145	.343	1			
7. Quality of course	.112	.010	.333	.333	.241	.338	1		
8. Interactive exercise of course	-.014	.287	.125	.292	.442*	-.006	.125	1	
9. Length of course	-.009	.111	.132	.343	.302	.432*	.343	.294	1

\*\* Correlation significant at the 0.01 level (2-tailed). Excl. E-learning = Exclusive e-learning

\*Correlation significant at the 0.05 level (2-tailed)

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### **Authors' Contributions**

Both authors contributed to the design of the study. Dr Maurits Verhagen was responsible for the development and the content of the e-learning platform and online tutelage. Elizabeth was responsible for coordinating the e-learning, acquisition, analysis, and interpretation of data and drafted the manuscript. Both authors helped to revise the manuscript critically, read and approved the final manuscript.

### **Authors' Information**

**Dr Maurits Verhagen** is a medical doctor with an MPH, who started his medical career as medical officer in Ghana in 1984. From 1989 he worked in the Dutch TB-control for over 25 years and chaired the Dutch TB Control Policy Committee (CPT) for 5 years , prior to coming back to Ghana to implement the “Accelerating Case Detection of Tuberculosis in Ghana”- Project for the company which won the tender to supply the equipment and the associated training. Currently he is the Managing Director of Universal Delft.

**Elizabeth Maame Esi Ewudiwa** is a graduate of Business Administration (specialized in Human resource management) from Central University, Harvard HPAIR Scholar and a certified HR associate of the Institute of Human Resource Management Practitioners (IHRMP) Ghana. She works as the Training & Development Coordinator at Universal Delft.

### **Acknowledgements**

The idea to incorporate CXR training (in seminars and in a blended modality) in the 'Accelerating Case Detection of Tuberculosis in Ghana' project was launched by Mango Consult, the firm who developed the comprehensive project proposal and did the feasibility study for this large e-health project, the first of its kind in Africa. Apart from the installation of digital X-ray equipment, system warranty and maintenance, and CXR e-health platform

development, the innovative project comprised of other training for end users like radiographers, engineers, IT-officers, and clinicians (doctors and physician assistants).

Based on an 8-day Chest X-ray reading course for Tanzania and The Gambia by Dr Etienne Leroy-Terquem and Dr Jan van den Hombergh between 2008 and 2012, a 5-day Chest X-ray reading seminar was developed for the Ghanaian clinicians by the first author. The content of the training was updated with contemporary clinical standards and developments (molecular diagnostics, digital imaging, etc). Many analogue images were changed for digital specimen and the training was tailored to the current Ghanaian setting and screening algorithms.

All 6 seminars were held in close cooperation with the Ghana National Tuberculosis Control Program and Ghana Health Service, who also delegated facilitators for explanation of the Ghanaian TB Control policy and screening algorithms. Radiologists from Korle Bu and Komfo Anokye Teaching Hospitals (Dr Samuel Asiamah and Dr Augustina Badu-Peprah, respectively facilitated a major part of the training). Dr Anthony Enimil, paediatrician specialist from Komfo Anokye TH also facilitated the module on Childhood TB. In 2017, the 5-day training was converted into an e-learning by the first author, supported by Dr Badu-Peprah and Dr Enimil with video clips. The blended modality of this training was subsequently rolled out in 2018, with 4 sessions, assisted again by both radiologists from Korle Bu and Komfo Anokye Teaching hospitals. The fully online modality was organised for comparison with the blended version.