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Chemistry lecturers' attitudes toward educational technology: Afghanistan lecturer perspective

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ABSTRACT

Teachers play important role in applying technology in teaching and learning especially their attitude towards educational technology. Therefore, this study aimed to determine Afghanistan's chemistry lecturers' attitudes and find out differences in technology attitudes based on gender. The random sampling was used to select 154 participants. The result shows the positive attitudes of Afghanistan chemistry lecturers toward using education technology in the class. Furthermore, based on the finding, there was no significant difference between male and female lecturers' toward using educational technology in the class. The result of this study can be use by the Afghanistan's Ministry of higher education (HEM) and all university managers to introduce modern education technology into the education system since Afghanistan lecturers seem ready to use it in class.

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1. INTRODUCTION

We need to develop the education system based on today's requirement to educate the young generation with 21st-century skills [1]. We also need to have education 4.0 in respond to the IR4.0. Utilizing new educational technology is emphasized as a fundamental and essential necessity of education 4.0. Fisk suggested nine directions for developing education 4.0 [2]. Most of the trend is e-learning, personalized learning, independent learning, project-based learning, hands-on learning (collaboration project, internship project, and mentoring project) acquire using new educational technology.

Chemistry is known in many schools and universities as a problematic subject worldwide. The main factor behind this difficulty is the abstract form of chemistry concepts. Furthermore, three-level of chemistry concept representation, including macro-level, symbolic level, and sub-micro level, face teachers and lecturers with a big challenge to teach this subject effectively to improve the learning meaningful learning [3]–[6]. Three representation levels of chemistry concepts were explained by Johnstone.

Many teachers have issues teaching chemistry concepts that lead to high level of alternative conception and misconception among chemistry learners, even chemistry teachers, and lecturers. For instance, the main cause behind chemistry's difficulty is the microscopic and symbolic level of its concepts, such as changing the status of a substance in a different form, chemical bonding among compound, and several atoms in the molecule such as students think the evaporated form of water consists of oxygen and hydrogen gas [7], [8]. They actually miscomprehended the law of physical change of intrastate of the mater forms.

Emerging high technology such as simulations, virtual reality, augmented reality, smartboard create opportunities for teachers and students to comprehend better the chemistry concepts by showing some principles and create a virtual environment for learners to see and experience the concepts' sub-micro and symbolic level. It can decrease the level of alternative conception and align those concepts with correct concept. Therefore, virtual reality is considered good tools for instructors to show students how to form the chemical bond between atoms and integrate the three lever of chemistry representation [8]–[13].

Furthermore, using educational technology increases the learners' interests, level of motivation, performance, and critical thinking. Suleman [14] found out that using new educational technology is effective in learners' interests, motivation, performance, learning outcome, and retention. He also reported that using new educational technology can improve chemistry students' understanding of science concepts. Similarly, other researcher also reported Chemistry-supporting AR-technologies helps teachers to teach chemistry concepts effectively and increase learning outcomes [15]. Therefore, it is important for chemistry teachers to implement educational technology in their teaching and learning.

Many countries tried to integrate new educational technology into their education system to prepare the generation with adequate knowledge and skill of the 21st century. They also spent a lot of money and allocated sufficient time to use new technology in the education system effectively [16]. But many research studies have indicated that the effective use of new educational technology is still a big challenge and issue for academic experts, school administrations, and all stakeholders of the education system worldwide. For instance, National Education Association reported that billions of dollars have been spend to prepare new technology in the education system-but unfortunately a high percentage of instructors are not using the technology tools efficiently in teaching and learning [16]. Other researcher also indicated that in many schools, there is adequate technology availability, but instructors are not using them in the class [17]. Moreover, Saudi Arabia equipped their education system with educational technology but they cannot us it effectively. Many schools in Saudi Arabia are equipped with adequate new educational technology, but the teachers are not interested in using the new technology [18]. Similarly, a study have been conducted in Khaibar Pachtoonckha to explore the role of new educational technology in Karak's primary school and found that the high percentage of school teachers are not using the available technologies in their teaching process [14].

There are many factors that can affect a user attitude toward using new technology in the class. Among the other factors, the years of teaching experiences are also can be very important to effect teacher's belief and attitude toward using a new tool in teaching and learning process [19]. This factor can impact the level of using educational technology in the class. However, some researchers have found out that the years of experience have no significant effect on teachers believe and the level of using technology in education [20]. While, the result of some other researcher highlighted the important effect of teaching experiences on teachers believe in using a new tool in the class [20], [21] So, a research study is essential among chemistry lecturers of Afghanistan university to know the role years of teaching experience on lecturers' attitude toward using educational technology in the class there.

One of the reason why teachers are reluctance to use new technology in the class is because teachers lack of knowledge and skill in utilizing the new tools in their teaching [22]. Moreover, Kenya government have provided schools in Kenya with new educational technologies but teachers are afraid to use new educational technology in the class because of their low confidence in the knowledge and skills of using the new tools in the class [23].

Since 2003, promoting and enhancing the integration of new educational technology have been one of the main focus of Afghanistan's ministry higher education [24]. Therefore, the Ministry of Communications and information technology (MoCIT) set forward an ICT arrangement that emphasized the utilize of ICTs in instructive endeavors [25]. However, the higher education administration in Afghanistan tried to encourage the lecturers to use new educational technology in the teaching process. Many research studies indicated lecturers' unwillingness to use new teaching tools during a teaching in Afghanistan universities [26]. Although chemistry is considered the subject that needs to use new educational technology to teach abstract concepts effectively, there is no research study conducted in this area. This research is indeed a small attempt to contribute to the existing research body to resolve Afghanistan's educational research in the chemistry education context. This research indeed schemed to determine Afghanistan's chemistry lecturers' attitude toward using educational technology in the class. Therefore, this study needs to be done to investigate the readiness and attitude of Afghanistan teachers to integrate new educational technology in their teaching.

2. RESEARCH METHOD

A quantitative approach has been employed in this study to address the research questions: i) How is attitudes of Afghan chemistry lecturers toward using educational technology in the class; and ii) Are there any differences between male and female attitude toward using educational technology in the class? iii) Are there any differences between years of teaching experiences attitude toward using educational technology in the class? Therefore, a descriptive and inferential statistics were used to achieve address the research questions.

This study was conducted in Afghanistan universities among chemistry lecturers. There are 154 lecturers, including males and females, have been selected randomly as respondents for this research study. The tabulation of participants is shown as in Table 1.

Table 1. Distribution of respondent based on gender

Gender		Years of teaching experiences		
Male	Female	1-5	6-10	More than 10
100 (65%)	54 (35%)	72 (46.7%)	42 (27.3%)	40 (26.0%)

The attitude survey questionnaire was used in this study. This questionnaire was adapted and has three main constructs, which are feeling, belief, and attitude. The attitude part consists of 8 items (1-8), the belief section involved 21 items (9-29), and the behavior part contained 6 items (30-35). Overall, the questionnaires consist of 35 closed questions arranged by a four-point Likert Scale; Strongly Agree (SA); Agree (A); Disagreements (D) and Strongly Disagree (SD). A four-point Likert Scale was used because it can avoid uncertainty of the responses [27] and can increase the instrument's reliability [25]. The questionnaire was validated by 4 experts. The researcher also carried out a pilot test to check reliability. The questionnaires were acceptable with high reliability for the calculation of the Cronbach alpha (a=.929).

The questionnaire was sent online to the respondents via 'Google Forms'. Once all survey questionnaires were collected, the data were coded, and the results were analyzed using descriptive and inferential statistics. The data were analyzed in terms of mean scores and standard deviations. The highest mean score that could be obtained was 4, indicating high positive attitudes, and the lowest mean score that could be obtained was 1, indicating high negative attitudes of the respondents toward using educational technology in the class. The items were analyzed based on Table 2. Furthermore, the t-test and ANOVA statistic tests were used to determine the differences between lecturers' attitudes in using technology in the class based on gender and years of experiences.

Table 2. Criteria for analyzing of feeling items [28]

Mean value	Positive items	Negative items
Less than 1.6 (M<1.6)	High negative feeling	High positive feeling
1.6 <M< 2.4)	Negative feeling	Positive feeling
2.4 <M< 3.2)	Positive feeling	Negative feeling
More than 3.2 (M>3.2)	High positive feeling	High negative feeling

3. RESULTS AND DISCUSSION

3.1. Positive lecturers' attitudes towards educational technology

The first aspect of the questionnaires for attitudes surveys is lecturers' feeling in using education technology in their teaching. Eight questionnaires (point 1,2,3,4,5,6,8) assess respondents' feelings with 35 questions related to the use of education technology inside a class. The construct feeling contain six positive and two negatives' items to determine the rate of lecturers' feelings regarding the use of educational technology in the class. Item number one until 6 is a positive statement while item seven and eight is a negative statement. Data analysis shows that Afghanistan's feeling towards chemistry teachers in the classroom are positive as shown in Table 3.

The overall results for the construct of feeling items are high agreement with these six statements. The majority of respondents, 52.01%, chose to agree, 37.33% selected strongly agree, 6.99% selected disagree, and the minority of them, and 3.5% strongly disagreed. For the positive items, the average mean value M=3.03 and the average standard deviation are SD=0.72 shows the high agreement of respondents with these items that had positive feelings toward using educational technology. Among six positive items, the second item highly scored that majority of respondents agreed to enjoy using educational technology in the classroom. While the item number 3 got a fewer score that shows respondents' excitement of using educational technology in the class.

Table 3. Lecturers' attitude toward using educational technology

No	Items	SDA f (%)	DA f (%)	A f (%)	SA f (%)	Mean (SD)
1	Feeling comfortable	7 (4.5%)	8 (5.2%)	87 (56.5%)	52 (33.8%)	3.19 (0.733%)
2	Enjoyment	5 (3.2%)	7 (4.5%)	67 (43.5%)	75 (48.7%)	3.38 (0.724%)
3	Excitement	6 (3.9%)	29 (18.8%)	70 (45.5%)	49 (31.8%)	3.05 (0.815%)
4	Interesting	6 (3.9%)	3 (1.9%)	92 (59.7%)	53 (34.4%)	3.25 (0.679%)
7	Like	6 (3.9%)	4 (2.6%)	91 (59.1%)	53 (34.4%)	3.24 (0.687%)
6	Motivation	3 (1.9%)	14 (9.1%)	74 (48.1%)	63 (40.9%)	3.28 (0.709%)
7	Afraid	55 (35.7%)	56 (36.4%)	25 (16.2%)	18 (11.7%)	2.04 (0.996%)
8	Hate	62 (40.3%)	54 (35.1%)	23 (14.9%)	15 (9.7%)	1.94 (0.972%)
	Total mean average			Positive		3.03
				Negative		1.9

In addition, data on chemistry lecturers' feelings regarding the use of educational technology in teaching are also supplied with two negative statements that involved items number seven and eight. Of those respondents, 18 (11.7%) agreed strongly, 25 (16.2%) agreed, 56 (36.4%) chose to "disagree", and 55 (35.5%) choosing to disagree strongly. The mean (M=2.04) and the standard deviation (SD=0.996) of the first negative item in this section suggest that the respondents disagreed with this statement and revealed that they don't fear using new educational technology the classroom. Furthermore, Concerning the second question concerning the negative item, 15 (9.7%) respondents were firmly agreed, 23 (14.9%) were picked the option "strongly agree", 54 (35.1%) were "disagreeable", and 62 (40.3%) were strongly disagreed. The mean value is (M=1.9), and the standard deviation is (SD=0.972). The importance stressed that more respondents disagreed and generally revealed they don't hate using educational technology in the classroom.

The second part of the feeling construct is lecturers' belief toward using educational technology in the class. This part also consists of 21 positive and one negative item to examine the lecturers' belief toward using educational technology in the chemistry classroom. Data in Table 4 shows that the respondent's belief toward using educational technology in teaching chemistry is positive.

Similarly, with the feeling section, respondents revealed their agreement with positive items and their disagreement with negatives statements. The results indicated the lecturers' belief toward using educational technology in the class positively. For the positive items, the overage results of 21 questions show that 61.4% of respondents selected the option agreement, 29.9% picked up the option "strongly agree", 6.3% disagreed, and a minority of them, 2.4% shown their strong disagreement with the statements. The overall mean value was 3.17, with the standard division of 0.64 that highlights respondents' high agreements with the 21 items.

Table 4. Lecturers' belief toward using educational technology in the class

No	Item	SDA f (%)	DA f (%)	A f (%)	SA f (%)	Mean (SD)
1	Saving time	5 (3.2%)	14 (9.1%)	86 (55.8%)	49 (31.8%)	3.16 (.718)
3	Makes schools a better teaching place	2 (1.3%)	5 (3.2%)	101 (65.6%)	46 (29.9%)	3.24 (.572)
8	Improves teaching	2 (1.3%)	5 (3.2%)	97 (63.0%)	50 (32.5%)	3.27 (.583)
9	Provides a good instruction	10 (6.5%)	0 (0%)	105 (68.2%)	39 (25.3%)	3.19 (.533)
10	Make the chemistry more interesting	4 (2.6%)	7 (4.5%)	90 (58.4%)	53 (34.4%)	3.25 (.660)
17	Make the teaching task easier	4 (2.6%)	9 (5.8%)	88 (57.1%)	53 (34.4%)	3.23 (.674)
18	Decrease the difficulty of chemistry concepts	6 (3.9%)	11 (7.1%)	82 (53.2%)	55 (35.7%)	3.21 (.738)
2	Make the schools a better place for learning	3 (1.9%)	6 (3.9%)	102 (66.2%)	43 (27.9%)	3.20 (.598)
5	Motivate chemistry students	1 (0.6%)	9 (5.8%)	86 (55.8%)	58 (37.7%)	3.31 (.609)
7	Enhance students' learning	1 (0.6%)	7 (4.5%)	100 (64.9%)	46 (29.9%)	3.24 (.561)
11	Usefulness	3 (1.9%)	5 (3.2%)	94 (61.0%)	52 (33.8%)	3.27 (.616)
13	Appropriate learning activities	5 (3.2%)	10 (6.5%)	96 (62.3%)	43 (27.9%)	3.15 (.674)
14	Provides independent learning opportunities	4 (2.6%)	14 (9.1%)	98 (63.6%)	38 (24.7%)	3.10 (.658)
15	Provides individualized learning opportunities	4 (2.6%)	17 (11.0%)	105 (68.2%)	28 (18.2%)	3.02 (.631)
21	Provide collaborative learning	6 (3.9%)	12 (7.8%)	100 (64.9%)	36 (23.4%)	3.08 (.682)
6	Obtaining Information	4 (2.6%)	8 (5.2%)	101 (65.6%)	41 (26.6%)	3.16 (.631)
12	Increase creativity	2 (1.3%)	11 (7.1%)	92 (59.7%)	49 (31.8%)	3.22 (.629)
16	Can get information faster	3 (1.9%)	6 (3.9%)	103 (66.9%)	42 (27.3%)	3.19 (.595)
19	Increase productivity	2 (1.3%)	7 (4.5%)	99 (64.3%)	46 (29.9%)	3.23 (.589)
20	Increase students' skill and knowledge	3 (1.9%)	7 (4.5%)	92 (59.7%)	52 (33.9%)	3.23 (.589)
4	Increase teaching work load	7 (4.5%)	36 (23.4%)	71 (46.1%)	40 (26.0%)	2.94 (.822)

The third part of the questionnaires is the behavior of the lecturers. There are six elements that have involved four positives and two negative statements. In accordance with Table 5, the conduct of respondents in the field of teaching chemistry with educational technology is positive. The cumulative results of four positive items indicate that 64.0% of respondents agreed, 27.7% pocked up the option "strongly agree", 6.3% disagreed, and a minority of them,1.9%, selected "strongly disagree". The total mean value was 3.21, with a standard deviation of 0.64, emphasizing respondents' high agreements with four items.

As a conclusion, result indicates that the attitudes of Afghanistan chemistry lecturers toward using educational technology are positive and high. This result is aligning with the finding of other studies that performed in a different context in the past [29]–[31]. A research study performs in Iran to examine teachers' attitudes in using technology in the class also found a similar result. The study found out that teachers were enthusiastic about the use of educational tools in teaching [28].

Table 5. Lecturers' belief toward using educational technology in the class

No	Item	SDA f (%)	DA f (%)	A f (%)	SA f (%)	Mean (SD)
1	Buy tools that support educational technology.	4 (2.6%)	10 (6.5%)	94 (61.0%)	46 (29.9%)	3.18 (.661)
2	Learn more about educational technology.	2 (1.3%)	5 (3.2%)	78 (50.6%)	69 (44.8%)	3.39 (.619)
4	I prefer using technology	4 (2.6%)	9 (5.8%)	93 (60.4%)	48 (31.2%)	3.20 (.661)
6	Use educational technology in the future	2 (1.3%)	15 (9.7%)	90 (58.4%)	47 (30.5%)	3.18 (.651)
3	I hesitate using educational technology	30 (19.5%)	59 (38.3%)	45 (29.2%)	20 (13.0%)	2.36 (.941)
5	I would avoid using educational technology	39 (25.3%)	35 (22.7%)	61 (39.6%)	19 (12.3%)	2.39 (.999)

3.2. The differences between lecturers' attitudes based on gender

The second objective of the study was to determine the differences between male and female lecturers' attitudes' toward using educational technology in the class. It is necessary to ensure that the data is the normal distribution to use the parametric tests in data analysis. The standard score distribution was then evaluated by the Shapiro-Wilk model measure, which was more suitable for the small sample size. The Shapiro-Wilk check p-value is less than 0.005, which shows that the data was not normally distributed. Since the data has not been standard, non-parametric sampling (e.g., Mann Whitney u test) was used. Of 154 participants, 100 (64%) teachers were female, and 54 (35%) were female.

Question:
Is there any significant difference between male and female chemistry lecturers' attitude toward using educational technology in the class?
Hypothesis:
H_0: $\mu 1=\mu 2$ (there is no significant any difference between male and female chemistry lecturers' attitude toward using educational technology in the class).
H_1: $\mu_1 \neq \mu_2$ (there is a significant difference between male and female chemistry lecturers' attitude toward using educational technology in the class).

Table 6 shows the results of the non-parametric single test (Mann Whitney u test). However, we see that the mean male rank is 82.28, with a rank total of 8227.50, and the mean of female rank is 68.66, totaling 3707.50. This result shows that the mean ranking of males is higher than females, but the mean value is 0, 0.071 (i.e., p=0.071), which means that there is no statistically significant difference between 2 mean groups (U=22.500; P>0.005). On account of this, we do not reject the null hypothesis and can conclude that there are no significant differences between male and female lecturers' attitudes toward using educational technology in the chemistry class of Afghanistan universities.

Table 6. Lecturers' attitudes differences based on gender

Gender	N	Rank Mean	Rank Total	U	P
Male	100	82.28	8227.50	2222.50	0.071
Female	54	68.66	3707.50		

The result indicated that there is no significant difference between male and female lecturers' attitudes toward using educational technology in the classroom. The findings of this study support previous studies, which showed no difference in gender among computer- and ICT teacher attitudes [32]–[34]. Many studies are now reporting that women are similar to men's attitudes in using technology. They seem to be more comfortable than before when using technology and could have reduced their perceived barriers. The difference in attitude can be presumed to be essential because males were more exposed to technology in both formal and informal settings. However, technology has quickly developed and invaded every aspect of society to the degree that technology has been turned into an integral part of our daily life. In Afghanistan, the government is trying to develop the education situation for women and prepared facilities and better opportunities for them to achieve the goal. This can be the reason for the similarity of male and female lecturers' attitudes toward using educational technology in the chemistry classes of Afghanistan universities.

3.3. The differences between lecturers' attitudes based on years of teaching experiences

The third objective of this investigation was finding the differences between lecturers' attitude toward using educational technology based on their years of teaching experiences. The respondents divided in three main parts. The first group includes those lecturers who had 1-5 years of teaching experience (72 respondents,46.75%), the second group consists of lecturers those who had 6-10 years of teaching experiences (42 respondents,46.75%), and the third group involve more than 10 years experienced lecturers (40 respondents, 25.97%). Non parametric test performed to answer the question because the assumption for parametric test was not completed. However, the sample is independent observed and the data is homogenized, the normality test was not acceptable. The normality test of the Shapiro-Wilk was used to analyze the standard score distribution because it was more appropriate for the limited sample size. The p-value for the Shapiro-Wilk check is 0.005, which indicates that the data has not been distributed normally. So, nonparametric sample test (Kruskal Wallis test) was used to test the hypothesis.

Question:
Is there any significant difference between chemistry lecturers' attitude toward using educational technology based on their teaching experiences?
Hypothesis:
H0: $\mu 1 = \mu 2$ (There is no significant differences between chemistry lecturers' attitude toward using educational technology based on their teaching experiences).
H1: $\mu 1 \neq \mu 2$ (There is significant differences between chemistry lecturers' attitude toward using educational technology based on their teaching experiences).

Table 7 provides some very useful descriptive statistics for every group of Afghanistan chemistry lecturers. The results show the output of the non-parametric Kruskal Wallis test analysis indicates that there is a statistically significant difference between three group means. We can see that the significance value is 0. 0.001 (i.e., p=0.001), which is below than 0.05 ($\chi 2$ (2)=17.61, p=0.001). Based on this result, mean rank value of 1-5 years experienced lecturers is (M=91.22) more than the second group of lecturers who were 1-6 years teaching experienced with the rank mean of (M=76.01). Furthermore, the rank value of 6-10 years experienced lecturers (M=91.22) is more than the third group of lecturers who had more 10 years of teaching experience with the rank mean value of (M=54.38). However, the mean rank valued is different between three groups of lecturers, there is just statistically significant differences between less experienced and more experienced lecturers' attitude ($\chi 2$=36.840, p=0.001). The mean rank differences between more experienced and moderate lecturers are ($\chi 2$=21.637, p=0.84) and the mean differences between more experienced lecturers and moderate lecturers is ($\chi 2$=15.203, p=0.237). To conclude, we reject the null hypothesis because there is statistically significant difference between less experienced and more experienced chemistry lecturers' attitude toward using educational technology. It means that the Afghanistan young chemistry lecturers' attitudes are more positive than more experienced lecturers toward using educational technology in the class. In fact, young lecturers are more success in using new technology during teaching process.

Table 7. The differences between lecturers' attitude based on their teaching experiences

Differences between	Teaching experiences		N	Rank mean	df	X2	P	Significant difference
lecturers' attitude based on teaching experience	A	1-5 years	72	91.22	2	17.610	0.001	A>C
	B	6-10 years	42	76.01				
	C	>10 years	40	54.38				
1-5 years .... 6-10 years						15.203	0.237	No
6-10 years .... More than 10						21.637	0.84	No
1-5 years .... More than 10						36.840	0.001	Yes

The result of this research indicated that young lecturers' attitude is more positive than experienced lecturers toward using educational technology in the class. This result is in line with many research previously performed. For instance, a study found that 59% of under 35 years old teachers who had fewer years of experience believed in the importance of technology integration in the class [35]. At the same time, only 29% of the upper 55 years old of teachers believe that using technology in the class is necessary. Similarly, Van and Young [20] conducted research in community college toward using technology in the class. Their finding indicated that overall, the young respondents' attitude is higher than those lectures who had more years of teaching experiences and the level of using technology in education system was by less experienced teachers was more than elder teachers.

4. CONCLUSION

As a conclusion, we can discover one sight about the Afghanistan university chemistry lecturers' attitude toward using educational technology. We also can determine the differences between male and female lecturers' attitudes toward using educational technology in the classroom. The studies were highlighted interesting results that indicated a high level and positive attitude of Afghanistan lecturers toward using educational technology in the classroom. The result also showed the similarity between male and female lecturers in educational technology used in teaching chemistry. Moreover, the result shows that young chemistry lectures' attitude is higher and more positive than those lecturers who had more years of teaching experience.

Hence, the results of this study indicate that Afghanistan chemistry lecturers' attitude towards the use of education technology is positive. They believe in positively the role of educational technology in developing the education process and can enhance learning outcomes as well. In addition, they use technology very well and usually feel relaxed. They enjoy in teaching chemistry using educational technology in the class. Furthermore, it is difficult and often impossible to incorporate innovations into the educational system without concern to the teachers' approach. Therefore, if the teachers are not interested or have negative attitudes towards educational technology used, we cannot integrate it effectively in education system.

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