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Bangladeshi Science Lecturers' Beliefs and Self-reported Actions on Universal Design for Learning*

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방글라데시 이공계열 강사의 보편적 학습설계에 대한 신념과 실행에 대한 인식*

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ABSTRACT

[Purpose] In this research, the authors surveyed Bangladeshi university science lecturers' beliefs and self-reported actions on diversified students' disability-related topics and on inclusive teaching practices and their implementation. [Method] For this purpose, we use the Inclusive Teaching Strategies Inventory (ITSI), which is comprised of the following six subscales: a) Accommodation, b) Accessible Course Materials, c) Course Modification, d) Inclusive Lecture Strategies, e) Inclusive Class, and f) Inclusive Assessment. The ITSI contains two feedback categories that evaluate both lectures' beliefs and self-reported actions on UDL in the six areas. We conducted SPSS-24 for a series of analyses to determine the Bangladeshi science lecturers' beliefs and self-reported actions on UDL by lecturers' gender and teaching experience, as well as the differences with equivalent data from the U.S., Spain and Canada. [Results] The results revealed that Bangladeshi science lecturers' belief levels were higher than their self-reported actions. There were some significant differences among lecturers' gender and teaching experience in both belief and action of UDL. Bangladeshi lecturers' self-reported actions were significantly lower than that of the three other countries, although their beliefs were higher. [Conclusion] Professional development for Bangladeshi lecturers are needed in future to help them utilize UDL guidelines in their classes.

Key Words : Universal Design for Learning, Bangladesh, Inclusive education, Higher education, Science Education

요 약

[목적] 이 연구에서는 방글라데시 대학교 이공계열 강사의 학생들의 장애관련 주제와 통합교육환경의 수업에 대한 신념 및 실제 실천에 대한 인식을 통합교육 수업전략 검사지(ITSI)를 이용하여 조사하였다. **[방법]** 이 검사지는 a) 교수적 수정, b) 수업자료에의 접근성, c) 강의내용 수정, d) 통합적 강의전략, e) 통합적 교실 운영, f) 통합적 평가의 여섯 개 하위영역으로 구성되어 있다. ITSI 검사지는 199명의 이공계열 강사를 대상으로 실시되었고, 보편적 학습설계에 대한 신념과 실천을 여섯 개의 측면에서 평가하도록 구성되었다. 통계분석에는 SPSS 24가 사용되었고, 방글라데시 이공계열 강사와 학생들의 보편적 학습설계에 대한 신념과 실천에 대한 인식을 응답자의 성별과 강의 경력에 따라 분석하였고, 선행연구에 제시된 미국, 스페인, 캐나다의 결과와 비교하였다. **[결과]** 연구 결과, 방글라데시의 이공계열 강사의 UDL에 대한 신념은 실제 실천 수준에 비해 통계적으로 유의미하게 높았다. 또한 UDL에 대한 신념 수준은 선행연구의 세 나라에 비해 통계적으로 유의미하게 높았던 것에 비해 실천 수준에 대한 인식은 유의미하게 낮았다. 성별과 교직 경력에 따라 부분적으로 UDL에 대한 신념과 실행 수준에 통계적으로 유의미한 차이가 있었다. 선행연구의 세 나라와의 비교한 결과 방글라데시 이공계열 강사들의 UDL에 대한 신념 수준은 높은 반면 실행 수준은 낮은 것으로 나타났다. **[결론]** 향후 방글라데시 강사들을 대상으로 UDL에 대한 연수를 강화하여 신념 수준에 맞게 실행 수준을 높일 수 있도록 지원이 필요하다.

주제어 : 보편적 학습설계, 방글라데시, 통합교육, 고등 교육, 과학 교육

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Introduction

Rationale

Providing an adequate learning environment according to students' diverse education backgrounds is the most important consideration for teachers. Students' diversity encompasses ethnicity, age, gender, socioeconomic status, level of preparedness, learning English, employment and caregiver responsibilities and characteristics [1, 2, 3]. It affects students' vision, understanding capacity, language efficiency, cognitive process, and emotions. Especially for students with special needs, no single teaching method can fulfill the needs of all learners and flexible methods of instruction are needed.

Traditionally, teachers consider the average standard of the students so that some slow learners and students with disabilities cannot follow the lectures well and their academic achievements are degraded. The "average learner" does not exist because all students' perceptions differ [4, 5]. Therefore, university lecturers must have a broad awareness of students' diversity including disability.

Universal Design for Learning (UDL) has been suggested as a way to create a more accessible learning environment for equalizing the opportunities for all kinds of learners, regardless of age, gender, ethnicity and other disabilities with the help of technology [6]. Although UDL was initially formulated to support instructional designers in creating curricula, recently it was identified as a scientifically valid framework for guiding educational practice and reduced barriers in instruction by providing lecturers with a blueprint for creating curricula, materials and a classroom environment that has greater accessibility and usability for all students from different backgrounds and with different learning needs [6, 7, 8].

However, research on the design and implementation of UDL principles remains insufficient for application to specific teaching and learning contexts. Some researchers have surveyed lecturers' and students' perceptions of UDL. Two surveys on faculty members of college and university-based teacher preparation programs have shown a gap between faculty members' awareness and actual practices of UDL principles in terms of inclusion (i.e., theory) and a willingness to embrace it (i.e., practice) [9, 10]. Here, attitudes refer to general support for the policy of inclusion, while willingness refers to a specific commitment to the practice of inclusion [11]. These findings indicated that instruction of UDL is increasingly occurring in teacher preparation programs; however, the depth of program integration remains "modest" [12]. Therefore, more research should be conducted in various cultures and contexts.

The university educational system in Bangladesh has developed through many

changes over the last two decades that were applied to ensure educational continuity. The government's 20 year (2006-2025) strategic plan has focused on science and technology in higher education [13]. As a signatory country of the Salamanca Declaration-1994, Dakar Framework for Action-2000, and United Nations Convention on the Rights of Persons with Disabilities-2006, Bangladesh is also trying to foster educational facilities for special students alongside general students in one teaching learning context. The Government of Bangladesh is committed to ensuring education for all by 2018 [14]. In spite of such policy initiatives of the Government of Bangladesh, little progress in inclusive education has been made [15].

To create a positive classroom environment for all types of learners, teachers need to create many creative teaching strategies, for which UDL can efficiently help science lectures. Bangladeshi university lecturers are usually hired based on an examination and/or their previous records of content knowledge of the subject and published research in their field of study. Not considered in this process is their ability to deliver lectures, to make the subject matter interesting for students, or use diverse teaching methods. After hiring, most lecturers become more committed to their profession than to their teaching and learning; consequently, they consistently focus on lecturers' development towards their individual professions rather than on their conceptions or beliefs of the teaching-learning process [16, 17].

Therefore, lecturers who are giving lectures in inclusive schools may face challenges in providing education at the same level for both normal and special need students. However, UDL is a new research area and little research has been done on this issue in Bangladesh. Very few studies have focused on science lecturers' beliefs and their self-reported actions based on UDL in the Bangladeshi university teaching-learning environment to provide information about inclusive education and guide novice and new lecturers to step forward in the inclusion system. UDL is a platform that can encourage and ensure equal learning opportunities for all. Therefore, the purpose of this research was to investigate the real scenario of science lecturers' beliefs and actions who are teaching science courses like physics, chemistry, engineering and agriculture on UDL at Bangladeshi universities.

There is some incongruence between a teacher's beliefs and his/her intentions due to the influences of the social and academic context [18]. Lecturers' self-report of intention actually matched their observed practice reflecting the similarity between self-report and practice [19]. However, no research has examined Bangladeshi science lecturers' beliefs and actions in the classroom environment. Therefore, it is important to determine science lecturers' beliefs and actions and to compare beliefs and actions based on UDL for ensuring equal opportunity for learning science.

Research Question

The study is guided by four primary research questions concerning Bangladeshi university science lecturers' beliefs and their self-reported actions on UDL.

1. What is the present level of science lecturers' beliefs and self-reported actions based on UDL in science classrooms in Bangladeshi universities?
2. What are the differences between science lecturers' beliefs and self-reported actions associated with UDL principles and practices in their science classrooms?
3. What are the differences between science lecturers' beliefs and self-reported actions associated with UDL principles and practices based on gender and teaching experiences?
4. What are the differences between Bangladeshi lecturers' beliefs and self-reported actions with those of three other countries?

Methodology

Subject

The survey data came from 199 science lecturers at different positions at 6 different universities in Bangladesh. All of them were teaching science classes at the time of responding to the questionnaire. Almost 80% of the respondents were male and one fifth were female (20.1%); two lecturers did not mention their gender. The respondents were mainly in their 30s (36.3%) and 40s (29.9%) and half had taught for less than 10 years. All of the surveyed universities offer four-year bachelor courses in science, 1-2-year master's courses in science and also 3-5-year doctoral courses. The universities also offer extensive technical training programs in career fields and also provide certificates after course completion.

Survey Instrument

The survey questionnaire was the "Inclusive Teaching Strategies Inventory" (ITSI) [20]. This instrument has two forms (belief form and action form) and each form consisted of 33 items. Belief form has a 7-point Likert scale: 1= strongly disagree; 2= disagree; 3= somewhat disagree; 4= I have not thought about this; 5= somewhat agree; 6= agree; 7= strongly agree. Action form has a 5-point scale: 1 = No opportunity;

2= Never; 3= Sometimes; 4= Most of the time; 5= Always. Both belief and action forms have six subscales: Accommodation (ACC), Accessible Course Materials (ACM), Course Modification (CM), Inclusive Lecture strategies (ILS), Inclusive Classes (IC) and Inclusive Assessment (IA).

The ITSI is a self-report survey that measures university lecturers' attitudes and actions with regard to inclusive teaching strategies based on UDL principles [21]. The first subscale, ACC, contains eight items specific to accommodation requests from the science lecturers (e.g., "provide copies of my lecture notes or outlines to students with disabilities" and "arrange extended time on exams for students who have documented disabilities"). The second subscale, ACM, contains four items relevant to the use of a course website (e.g., "post electronic versions of course handouts: and "put lecture notes online for all students"). The third subscale, CM, contains four items related to major changes in course assignments or requirements (e.g., "allow a student with a documented disability to complete extra credit assignments" and "allow any student to complete extra credit assignments"). The fourth subscale, ILS, contains four items that measure teaching strategies specific to a typical postsecondary lecture-style class (e.g., "summarize key points throughout each class session" and "begin each class session with an outline/agenda of the topics that will be covered"). The fifth subscale, IC, contains nine items related to the presentation of course content with a particular emphasis on flexibility, use of technology, and various instructional formats (e.g., "use interactive technology to facilitate class communication and participation" and "present course information in multiple formats"). The sixth subscale, IA, contains four items pertaining to flexible response options on exams (e.g., "allow students to express comprehension in multiple ways" and "all flexible response options on exams").

<Table 1> provided descriptive statistics and internal consistency according to the subscales and response categories (beliefs and actions). The values ranged from .739 to .908. All values met the acceptable range of .70 or higher and indicate that all the items have good internal consistency reliability [22].

<Table 1> Reliabilities of subscales of ISTI

Subscale	Number of items	Cronbach's α	
		Belief	Action
Accommodations (ACC)	8	.804	.823
Accessible Course Materials (ACM)	4	.786	.758
Course Modifications (CM)	4	.851	.822
Inclusive Lecture Strategies (ILS)	4	.764	.886
Inclusive Classroom (IC)	9	.903	.908
Inclusive Assessment (IA)	4	.735	.739

Procedure

Permission to use and modify the ITSI was obtained from the original author. Approval from the Institutional Review Board (IRB) of the University was also received before conducting the research. A small pilot test was conducted among 20 science lecturers from three universities to help establish content validity and to improve the questions for lecturers of the final ITSI instrument. After that, the questionnaire was sent to 980 Bangladeshi university science lecturers by using Google Drive. Five reminders were sent to the respondents in order to increase the response rate for this online survey [23]. Through the online survey questionnaire data collection and analysis are easier, faster, and more accurate when captured electronically [24]. The 232 received responses gave a low response rate of 23.7% because online surveys typically have lower response rates than face-to-face surveys [25]. After 33 responses were deleted due to not answering more than 20% of all items or incomplete answers, the remaining 199 responses were analyzed through SPSS statistics 24. After calculating mean scores of each subcategory, *t*-test for comparing means by gender and *F*-test for comparing means by teaching experience were conducted. Comparison between science lecturers' belief and actions was also done by chi-square analysis.

Result and Discussion

Present Level of Science Lecturers' Beliefs and Self-reported Actions of the UDL

<Table 2> provides means and standard deviations of the six subscales on lecturers' beliefs and self-reported actions. For belief form, mean scores of subscales ranged from 4.30 (CM) to 5.38 (ILS), with all means falling between somewhat agree and agree, except for CM and IA, which fell between I have not thought about this and somewhat agree. The highest scores of this form were found in subscale ILS which scored 5.38 (in between somewhat agree-agree). Followed by ILS the lecturers' higher beliefs were noted in IC and ACC with scores of 5.25 and 5.19 (both are in between somewhat agree-agree), respectively. The lowest score of 4.30 was recorded in the subscale CM (in between I have not thought about this-somewhat agree).

The mean scores of action form ranged from 2.83 (CM) to 3.85 (ILS), most of which ranged between sometimes and most of the times, except CM, which fell in between never to sometimes. The highest scores of action form were found in the subscale ILS scored 3.85 (within sometimes to most of the times). Followed by ILS, the lecturers'

higher self-reported actions were noted in ACC, ACM and IC where score points were 3.28. 3.27 and 3.26, respectively, although self-reported action levels were within sometimes to most of the time. But the lowest score was placed in the subscale CM with 2.83 where action levels were in between never to sometimes.

The terminology UDL in science classrooms has only recently been introduced in Bangladeshi universities and only 9% of lecturers had heard of it. A big percentage of university lecturers (nearly 97%) agreed that "it is a very good concept we should implement in our classes". It indicates that Bangladeshi science lecturers agreed that all the strategies mentioned in the ITSI must be used for inclusive teaching but, they did not practice inclusive strategies perfectly in reality. Some have other jobs, where consultancy has become more important as faculty pay is generally very low in relation to that offered by alternative professional occupations [26]. The growth of quality education at all levels is based on teaching method to a greater extent which needs to be supported with required infrastructure and facilities and such educational environment is very much lacking in Bangladeshi universities. The libraries are also poor as they lack adequate resources to buy recent publications and order basic journals. Likewise, the laboratories suffer from inadequate equipment [26].

<Table 2 Means and standard deviations of belief and action forms of ITSI

Subscale	Beliefs[a]		Actiolns[b]	
	M	SD	M	SD
Accommodation (ACC)	5.19	1.00	3.28	0.73
Accessible Course Materials (ACM)	5.03	1.33	3.27	0.83
Course Modification (CM)	4.30	1.58	2.83	0.92
Inclusive Lecture Strategies (ILS)	5.38	1.07	3.85	0.95
Inclusive classes (IC)	5.25	1.17	3.26	0.85
Inclusive Assessment (IA)	4.80	1.23	3.14	0.73

[a]7 point scale, [b]5 point scale

Comparison between Bangladeshi Science Lecturers' Beliefs and self-reported Actions Based on Gender and Teaching Experiences

To evaluate potential discrepancies in lecturers' beliefs and self-reported actions based on gender and teaching experience, we conducted a series of ANOVA test in each form by subscale. <Table 3> and <Table 4> indicates the comparison between science lecturers' belief and action based on gender and teaching experience respectively.

From the <Table 3>, it was revealed that there were no significant differences between male and female in most of the subscales of belief category. While subscale CM and IA female science lecturers mentioned significantly higher level of beliefs than their male counterpart ($p<.05$). But in practically, their self-reported action showed lower level of UDL strategies in their science class than the male lecturers. Male lecturers noticed significantly higher level of action regarding inclusive practice in subscales ACC, ILS and IC ($p<.05$), while other subscales showed insignificant differences. If we summarize then it was found that though female science lecturers had shown higher belief in some practices for using UDL guidelines in their class but in practically male performed more.

<Table 3> Science lecturers' belief and reported action on UDL by gender

Subscale	Gender	Belief					Action				
		n	M	SD	*t*	p	n	M	SD	*t*	p
ACC	Male	156	5.21	0.97	.621	.535	155	3.35	.730	2.159	.032*
	Female	40	5.10	1.12			40	3.07	.662		
ACM	Male	156	5.05	1.27	.246	.807	154	3.32	.823	1.343	.181
	Female	40	4.98	1.55			40	3.12	.828		
CM	Male	156	4.14	1.58	-2.875	.004**	154	2.82	.968	-.233	.816
	Female	40	4.93	1.40			39	2.85	.678		
ILS	Male	155	5.38	1.11	.008	.930	153	3.98	.836	3.016	.004**
	Female	38	5.36	0.89			40	3.37	1.21		
IC	Male	150	5.21	1.18	-1.359	.176	138	3.37	.742	2.550	.014*
	Female	37	5.50	1.08			38	2.89	1.08		
IA	Male	149	4.71	1.26	-2.041	.043*	155	3.19	.696	1.761	.080
	Female	40	5.16	1.03			40	2.96	.827		

*$p<.05$, **$p<.01$

In <Table 4>, it was found that the science lecturers having the teaching experiences over 15 years showed significantly higher level of belief ($p<.01$) over the young lecturers in the subscale ACC and ILS. The similar results were found in Action form due to their rich pedagogical knowledge. Only in belief form, the subscale CM subscale revealed the different result, where the science lecturers having the teaching experience below 5 years showed significantly highest level of belief among all other lecturers ($p<.01$). But while comparing with lecturers self-reported action on the same subscale, their expected responses were insignificant. Beside these here were no significant difference in both belief and action forms to all other subscales.

<Table 4> A Comparison Between Science Lecturers' Belief and Action Based on Teaching Experience

Subscale	Teaching Experience	Belief					Action				
		n	M	SD	*F*	p	n	M	SD	*F*	p
ACC	Below 5	61	5.00	.93	4.762	.003**	62	3.14	.74	6.189	.000**
	5-9	48	5.09	1.12			48	3.12	.74		
	10-14	40	5.03	1.09			38	3.23	.74		
	Over 15	48	5.65	.77			48	3.66	.59		
ACM	Below 5	61	5.07	1.35	1.095	.352	62	3.22	.82	1.857	.138
	5-9	48	4.90	1.49			48	3.27	.88		
	10-14	40	4.80	1.26			38	3.08	.88		
	Over 15	48	5.27	1.19			47	3.49	.72		
CM	Below 5	62	4.84	1.55	5.755	.001**	58	3.07	.95	2.566	.056
	5-9	47	4.45	1.61			48	2.85	.87		
	10-14	40	3.85	1.65			40	2.64	1.02		
	Over 15	48	3.79	1.26			48	2.65	.78		
ILS	Below 5	60	5.09	1.12	4.918	.003**	62	3.48	.85	13.114	.000**
	5-9	48	5.22	1.14			47	3.56	1.00		
	10-14	49	5.48	.83			40	4.13	.94		
	Over 15	47	5.82	.98			45	4.42	.69		
IC	Below 5	55	5.24	1.16	.206	.892	56	3.22	.83	.547	.651
	5-9	48	5.14	1.38			44	3.18	.97		
	10-14	40	5.25	1.06			37	3.25	.77		
	Over 15	48	5.34	1.07			40	3.40	.83		
IA	Below 5	62	5.09	1.09	2.343	.075	62	3.14	.66	1.757	.157
	5-9	47	4.71	1.41			47	3.07	.77		
	10-14	37	4.44	1.48			38	2.99	.83		
	Over 15	44	4.77	.87			48	3.32	.64		

*$p<.05$, **$p<.01$

We further had conducted *post-hoc* test to find out the differences among the different groups of these subscales in both belief and action form. As the values of N were different among the groups, we had used Scheffé's test. Result showed that there were no significant differences among the lecturer's belief, except in the subscale ACC and ILS where results mentioned significant differences. In both ACC and ILS, over 15 years experienced lecturers showed significantly higher level of belief than the other groups ($p<.05$). But for the subscale CM, below 5 years experienced lecturers showed significantly higher belief than 10-14 years experienced lecturers ($p<.05$) and over 15 years experienced lecturers ($p<.01$) though in action form there were no significant difference among the science lecturers in this subscale.

The lecturers whose teaching experience over 15 years also had shown significantly higher level of self-reported action than below 5 years experienced lecturers ($p<.01$) and 5-9 years experienced lecturers ($p<.01$) in ACC. They also had significantly higher level of self-reported action than below 5 years experienced lecturers ($p<.001$) and 5-9 years experienced lecturers ($p<.001$) in ILS which was followed by over 15 years experienced lecturers, the 10-15 years experienced science lecturers had significantly higher level of self-reported action than below 5 years experienced lecturers ($p<.01$) and 5-9 years experienced lecturers ($p<.05$) in ILS. These findings are inconsistent with

previous studies [20, 27, 28] where amount of teaching experience was not a significant factor.

Comparison Between Science Lecturers' Beliefs and Self-reported Actions of UDL

The two forms (beliefs and actions) were scaled differently (7- and 5-point Likert scales), we further recorded the lectures' belief and self-reported action responses to resemble No / Maybe / Yes categories for finding whether lectures beliefs towards inclusive instruction differed from their self-reported actions [29]. For the belief form, we coded 1 (strongly disagree) and 2 (disagree) as "No" responses. Responses 3 (somewhat disagree), 4 (I have not thought about this) and 5 (somewhat agree) were coded as "Maybe", and responses 6 (agree) and 7 (strongly agree) were coded as "Yes". For the action form, we coded 1 (I don't know) to 2 (Never) as "No" because these responses indicated that the science lecturers did not conduct the specific actions represented by the item. Response 3 (Sometimes) was coded as "Maybe", and responses 4 (Most of the time) and 5 (Always) were coded as "Yes". To evaluate potential discrepancies in lecturers' beliefs and self-reported actions, we also conducted a series of chi-square analyses on the proportion of lecturers in each form by subscale. Table 3 indicates the frequencies of No / Maybe / Yes data by response category and chi-square values.

<Table 5> Comparison Between Science Lecturers' Beliefs and Self-reported Actions of UDL

Subscale	Beliefs			Actions			χ^2
	No	Maybe	Yes	No	Maybe	Yes	
ACC	105 (7%)	448 (28%)	1039 (65%)	391 (25%)	325 (20%)	876 (55%)	198.36**
ACM	83 (10%)	221 (28%)	492 (62%)	197 (25%)	209 (26%)	390 (49%)	58.55**
CM	163 (20%)	301 (38%)	332 (42%)	287 (36%)	270 (34%)	239 (30%)	51.00**
ILS	32 (4%)	151 (19%)	613 (77%)	96 (12%)	81 (10%)	619 (78%)	53.15**
IC	85 (5%)	405 (23%)	1301 (73%)	371 (21%)	328 (18%)	1092 (61%)	205.72**
IA	88 (11%)	248 (31%)	460 (58%)	188 (24%)	209 (26%)	399 (50%)	43.89**

Note. df=2 for all chi-square tests; $^{**}p<.01$,
ACC (Accommodation), ACM (Accessible Course Materials), CM (Course Modification), ILS (Inclusive Lecture Strategies), IC (Inclusive classes) and IA (Inclusive Assessment).

In <Table 5>, lecturers' belief responses (columns 1-3) show that a very small proportion (range from 4% to 20%) of lecturers endorsed negative beliefs as indicated by the proportion of respondents in the first column under the "No" category. The majority of lecturers reported positive endorsements on four of the six subscales, as indicated by the high proportion of respondents in the "Yes" column for ILS (77%), IC

(73%), ACC (65%) and ACM (62%). When considering lecturers' actions (column 4-6), a greater proportion of lecturers' actions indicated low endorsement (range 12%-36%). Notably, approximately one third (36%) of lecturers reported that they did not use CM and around one fourth of science lecturers indicated that they did not use ACC (25%), ACM (25%) or IA practices (24%) in their classes. A high proportion (more than 60%) of lecturers reported they currently implement ILS (78%) and IC (61%). The results of chi-square analyses showed statistically significant differences in all subscales ($p<.01$).

The analysis results were mixed, with a greater proportion of science lecturers endorsing beliefs than their self-reported actions on most of the subscales, and the reverse on other subscales. For example, a greater proportion of lecturers' beliefs related to providing ACC, ACM, CM, IC and IA than the proportion that intended actions about these same factors. But in contrast, only for the ILS subscales, a greater proportion of lecturers showed higher actions than the proportion of beliefs pertaining to the same scale. This is attributed to fact that UDL is a recent concept [30] and most Bangladeshi university science lecturers don't have adequate training in its implementation. Training for lecturers in disability awareness and in inclusive instruction may meaningfully contribute to their beliefs [21, 31] though in some cases these same predictors do not contribute to lecturers' actions on most of the ITSI constructs [20]. This finding demonstrates the importance of conducting further research on specific barriers of university science lecturers that might be encountered if and when they attempt to carry out actions related to inclusive instruction.

The subscales CM and IA comprise the items describing the greatest amount of modification to current practices in science classrooms in Bangladeshi universities. As such, lecturers may comprehend these particular actions as compromising the integrity of their science courses. For example, the CM items asked lecturers to complete extra credit assignments and to reduce overall course reading load. Thus, lecturers may think that these accommodations conflict with their desired measures for all students and they may not implement it in their classrooms. In the same way, the IA subscale indicated a lower amount of lecturers' beliefs and self-reported actions, indicating this area is also more challenging for lecturers to accomplish in their own teaching practices. IA items asked about alternative evaluation systems, where in other areas the lecturers may feel the standards of their course would be compromised. Some researchers have shown that lecturers expressed minimal willingness to modify their courses (i.e., reading load reduction, course substitution) [29, 32] and adjust their course assignments and requirements [21]. Because the CM and IA items are more challenging to lecturers for practical implementation [21, 29, 32]. Our findings are notable because the previously mentioned studies used measures based on the UDI framework and our measure, the ITSI, contained six constructs representing common themes across three major UDL frameworks [21, 33].

Comparison of Bangladeshi Lecturers' Beliefs and Actions with Those of Three Other Countries

<Table 6> indicate compare the mean scores across all belief and action subscales, respectively, between the Bangladeshi science lecturers with inclusive instruction among college and university teachers in the U.S., Spain and Canada. The 7- and 5-point scales used in our survey were converted to 6- and 4-point scales for the comparison with the U.S., Spain and Canadian teachers.

The six ITSI subscales of beliefs and actions differed significantly among the four countries. The highest beliefs were noted in the subscale ILS (=4.61) from Bangladeshi science lecturers and the lowest beliefs were recorded in the subscale CM (=1.86) from Canada. In the subscale ILS, the faculty members of all four countries had the highest beliefs among all six subcategories (Bangladesh, the U.S., Spain and Canada had scores of 4.61, 3.79, 2.78 and 3.64, respectively). Similar results were found in lecturers' self-reported actions in the same ILS subscale (scores of 3.09, 3.16, 3.31 and 3.21 in Bangladesh, the U.S, Spain and Canada, respectively). Followed by ILS, Bangladeshi lecturers' beliefs were higher in the subscale IC (score 4.50). But in the case of the U.S. Spain and Canadian, lecturers' beliefs in the subscales CM (score 3.6), ACM (score 2.58) and in ACC (score 3.47) were higher, followed by ILS. Whereas lecturers' self-reported actions in all four countries were higher (scores of 2.62, 3.09, 3.21 and 3.14 for Bangladesh, the U.S., Spain and Canada, respectively) after the subscale ILS. All subscales in beliefs of Bangladeshi science lecturers were higher than the three other developed countries but their actions were comparatively lower. In other subscales, lecturers' responses were almost the same in both beliefs and actions, despite some variation.

<Table 6> Comparison of lecturers' beliefs and self-reported actions on ITSI with one previous study

Subscale	Forms	Bangladesh[a]	U.S.[b]	Spain[b]	Canada[b]
ACC	Belief	4.45	3.02	2.08	3.47
	Action	2.59	2.21	1.15	2.82
ACM	Belief	4.31	3.49	2.58	3.37
	Action	2.62	3.09	3.21	3.14
CM	Belief	3.69	3.60	2.29	1.86
	Action	2.26	3.03	1.47	1.15
ILS	Belief	4.61	3.79	2.78	3.64
	Action	3.09	3.16	3.31	3.21
IC	Belief	4.50	3.47	2.52	3.36
	Action	2.61	2.72	2.67	2.72
IA	Belief	4.11	3.01	2.37	2.66
	Action	2.39	2.34	2.19	2.07

[a]Converted into 6-point scale for comparison with other countries
[b]Taken from Lombardi, Vukovic & Sala-Bars (2015)[11]

However, the findings represent the utility of the ITSI across different university contexts within and outside of Bangladesh to measure lecturers' disability-related knowledge and inclusive instructional practices. Although one existing instrument aims to measure the classroom environment, lecturers' beliefs and disability-related knowledge [28, 32, 34] other measures of inclusive instruction based on UDL principles are not established in the current literature. In addition, many researchers agree that there is a gap in the literature between the theoretical basis of UDL and empirical support for the benefits on student learning and outcomes [8, 35, 36]. With regard to course modifications, Canadian lecturers responded with the lowest overall endorsement of these practices. Interestingly, the Canadian responses were coherent to lower endorsement (beliefs) and implementation (actions), indicating that Canadian lecturers did not endorse or implement these practices; whereas, the Bangladesh, U.S. and Spanish lecturers revealed greater incoherency between a somewhat positive endorsement but a lack of implementation. The result is consistent with previous research indicating that Canadian lecturers' beliefs and actions were the lowest; whereas, the U.S. and Spanish lecturers showed higher consistency between somewhat positive beliefs but a lack of practice in the classrooms [11].

Bangladeshi lecturers scored the highest in their beliefs compared to other facets of inclusive instruction that are important, yet they scored a lower implementation in regard to these practices. In other words, Bangladeshi lecturers indicated that they believed accommodation, accessible course materials, inclusive lecture strategies, inclusive classroom, and inclusive assessment were important, yet they may not necessarily use these strategies. Although Bangladeshi lecturers' believe that UDL is a good technique for ensuring equity in the classrooms, they also worry that its application will be difficult and will take time as it needs some support to implement such as good infrastructure, high speed internet connection, and training on classroom management practice to follow the UDL concepts and guidelines. This this study was limited to only science lecturers from only six Bangladeshi universities. These findings are similar to previous studies that noted college or university lecturers positively endorse inclusive instruction based on the tenets of UD, yet do not implement such practices [20, 33, 37]. While it is not clear in all respects why lecturers do not implement inclusive instruction, some evidence focuses on a lack of institutional resources, supports and time [37, 38].

Conclusion

The purpose of this study was to survey Bangladeshi university science lecturers' beliefs toward and actions associated with UDL principles and practices. The current research has indicated that lecturers' beliefs are comparatively higher than their actions in all items. In comparison with the U.S., Spain and Canada, Bangladeshi lecturers' beliefs are higher but their actions are drastically lower due to various barriers like lack of good infrastructure, unavailability and slow internet connection, lack or minimal utilization of ICT equipment, inadequate training on classroom management practice, and ignorance or inadequate experience on UDL principles and guidelines.

The reality is that the students' diversity in university science classrooms reflects the increasing diversity of students' learning styles, preferences, and abilities. It is essential that instructional strategies and techniques that meet the learning needs of diversified students are integrated into the science classroom environment. Programs need to provide innovative and effective ways of providing training in these methods to university science lecturers and their associates.

This is the first study on science lecturers' beliefs and their self-reported actions of inclusive instruction in the context of UDL in Bangladeshi universities. This study contributes to the growing knowledge base of the existing literature and begins to shed some light on the overall environment of the perceptions and experiences of science lecturers. The present research findings promise to support the application of UDL as a paradigm for meeting instructional delivery for all students, especially those with diverse learning styles and from historically underrepresented populations. Additional studies are needed to validate the impact of the UDL approach and strategies on student learning outcomes and to determine the most efficient and effective means of providing this information to science lecturers.

The ITSI is a self-report measure that therefore suffers from the limitation of respondent bias despite efforts to eliminate it with two response categories; hence, the generalizability of the findings is limited. Future research with more universities and strategies for increasing the response rates of science lecturers is needed. Although we assessed university science lecturers' beliefs and actions towards inclusive education, we did not make connections to students learning outcomes. UDL scholars have emphasized the potential for inclusive teaching practices to have a positive effect on students learning [39, 40, 41] An important next step is to create a parallel student version of the ITSI so that students' perceptions of inclusive instruction can be measured and compared with those of lecturers.

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