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Full Length Research Paper

Ethiopian university science and technology instructors' attitudes toward active learning

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In the present scenario of education system, all people are under pressure to use the innovative strategies in the teaching and learning process, to teach students the knowledge and skills that are required for the 21st century. Active learning is a term used to identify teaching methods that require students to be actively involved in the learning process. Although there is clear evidence for the benefits of active learning, most lecturers in higher education still adhere to traditional teaching methods. This paper seeks to identity the characteristics and attitudes of "active instructors" towards active learning and discerning a distinction between these attitudes and those of the remaining instructors. This study examined the attitudes of 160 lecturers in three higher education institutions in East Ethiopia. The research used attitude questionnaire developed specially for this study on the basis of the experience of 7 ''active instructors" exposing the process of change they had undergone moving from traditional teaching to more active instruction. An analysis of these interviews provided the basis for characterizing the attitudes of "active instructors" and subsequently for the development of the research questionnaire. Based on a literature review and an examination of the attitudes of ''active instructors'' a content analysis was undertaken in which the attitudes were grouped into six key domains that can characterize the tendency of a lecturer to adopt active teaching. The findings reveal that in all these six domains there were differences between the attitudes of "instructors" and their colleagues. This diagnostic tool can supply crucial information to the college and universities directors when planning supportive steps toward advancing active learning in their institutions.

Key words: Active learning, instructors' attitudes, traditional learning versus active learning, scale-up, innovation.

INTRODUCTION

Attitude was defined by Eagly and Chaiken (1993) as "Psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor". Attitudes towards learning science is a very important concept that can be described as the students' views of knowledge, assessment, laboratory activities and the roles of instructors and students, according to Berg (2005).

Over the past decade, researchers and instructors in Ethiopia and around the world have attempted to promote active learning in academic courses. The process of introducing innovation in teaching based on the adoption of active teaching approaches is a long and complex one (Doriet et al., 2003; Pundak et al., 2004; Dori and Herscovitz, 2005; Toledano – Kitay, 2008). In many fields of teaching it is difficult to introduce innovations even when this would clearly be advantageous and beneficial (Rogers, 1995). The Ethiopian Ministry of Education has

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recently begun to promote inquiry learning designed to encourage students and teachers to teach in a more meaningful manner. This approach develops inquisitive and creative thought. It is mirrored by the demand to prepare students for the matriculation examinations, a process which, in many cases, encourages learning by rote and algorithmic learning rather than the development of higher cognitive kill (Dori et al., 2003).

Institutions of higher education also engaged with this dilemma of traditional teaching methods and active learning. These institutions strive to conform to a packed and demanding curriculum that leaves little time for students to develop a profound understanding of the study subjects. Studies examining innovative teaching methods that involve the students in conducting lectures in basic courses in sciences, engineering, and technology suggest that these methods result in enhanced achievements among the students, a better understanding of the studied material, involvement and responsibility for the learning process (Dori and Belcher, 2005; Jose and Pedrosa, 2005; Snellman et al., 2006; Barak et al., 2007).

With the goal of promoting meaningful active learning by students and integrity innovative teaching approaches the Ethiopian Ministry of Education decided to integrate active learning courses at all universities.(Ethiopian Higher Education Proclamation No.650/2009;41;1).

The active learning environments included group activities by students during the lecture, problem solving, laboratory investigations, researching the websites, conceptual tests, peer teaching (Mazur, 1997), active demonstration (Copper and Robinzon, 2000), simulations (Dori et al., 2003), group problem solving (Redish, 2003) and 'just in time' teaching (Beichner et al., 2000; Hovelynck, 2003; Karamustafu, 2009; McCarthy and Anderson, 2000).

A wide range of evidence has been supported in the concept of the active learning students achieve higher conceptual understanding compared to other students who studied the same courses in the traditional learning approach (Dori and Beclcher, 2005). Active learning refers to techniques where students do more activities than listening to a lecture. Students are doing something including discovering, processing, and applying information. Today, the educators feel that traditional methods of teaching are not sufficient. Because the traditional method has positioned the students as passive receptors in which teachers deposit concepts and information and emphasize rote memory for the students. This method of instruction or teaching is not sufficient to develop the required skills.

The research goals included identification of the characteristic attitudes of 'active instructors' to-ward active learning and discerning a distinction between these attitudes and those of the remaining instructors in the university.

The research goals were derived from the following research questions:

A. What are the characteristics of the attitudes of the 'active instructors' toward active learning?
B. Is there any gap, and if so how large, between the attitudes of the 'active instructors' and the attitudes of the other instructors in academic institutions regarding active learning?

LITERATURE REVIEW

Active learning in academic institutions

Lecturing, a time-tested and long-venerated teaching method remains the most frequent method of instruction in higher education throughout the world (Svinicki and McKeachie, 2011; Lambert, 2012). It can prove masterful when offered by inspiring teachers who are also gifted orators. But too often students sit passively, disconnected from the lecture, as they actively engage in "face booking," text messaging, or doing home work for other classes. Lecturing persists, nonetheless, because it provides a convenient and efficient way to deliver content to large numbers of students, particularly in large lecture halls.

Lecturing has advantages, it (1) enables the instructor to supplement the textbook by providing cutting-edge material; (2) gives the instructor presumed "control" in the classroom, although ironically students may not actually be disrupting the flow of material because they are passive or otherwise distracted; (3) lets the instructor offer key information that all students are (presumably) exposed to at the same time; and (4) offers an opportunity for an inspiring teacher to stimulate students.

Despite these perceived advantages, a vast number of studies in recent years-particularly in the area of cognitive science, psychology, and neuroscience-provide evidence that the intuitive conclusions of early educators such as John Dewey and many others were clearly on target: Active learning is a crucial element of the new thrust toward what is now commonly called "learner-centered" or "learning-centered" teaching (Weimer, 2002). If teacher's desire increased student learning, then active learning is an essential component of effective teaching. As Hestenes (2012) in an NPR interview put it: "Students have to be active in developing their knowledge."

Numerous evaluation studies have been undertaken in the united state to examine the advantages of active learning in appropriately adapted classes. This approach emphasizes active learning by students in large classes of fifty or more students. Students in the classes were made to sit in the form of circle, consisting of nine students and every three students from a group .A significant proportion of lesson is distributed to every

group to do activities such as problem solving, simulation, laboratory investigations, researching the websites to practice and acquire skills (Beichner et al., 2000; Beichner et al., 2007).

Active learning and conceptual understanding

A wide range of evidence has been supported in the concept of active learning students active higher conceptual understanding compared to other students who studied the same courses according to the traditional learning approach (Dori and Belcher, 2005). The idea that "active learning only supports the under achiever students and neglects future starts" is in many cases invalid. In a large scale study of 6500 students studied according to active learning methods, Hake (1998) found that stronger students exhibited greater improvement of conceptual understanding of Newtonian physics compared to their less skilled-student. Nevertheless, according to Hake's study, both populations improved their conceptual understanding more than students who studied according to traditional learning methods.

Active learning and higher thinking levels

One of the most significant aims of the active learning approach is to develop high level thinking skills. Students are asked to solve problems according to the scientific method. They collect, analyze, interpret and represent data, and relying on this procedure they design a system, component, or process to meet desired needs (Etkina and Heuvelen, 2001).

One of the first educators to address the issue of different levels of thinking skills was Bloom (1956). According to "Bloom's taxonomy of learning domains (1956), there are three domains of educational activities: (1) The Cognitive Domain, which involves knowledge and the development of intellectual and mental skills; (2) the Affective Domain, which describes the way we face issues emotionally, such as feelings, appreciations, values, enthusiasm, attitudes, and motivations; and (3) The Psychomotor Domain, which involves physical movement, coordination, and use of the motor-skill. Bloom described six sub-categories in the cognitive domain, which are measured by degrees and levels of difficulties so that an individual cannot master one of these levels if he/she has not first mastered the preceding sub-category. The lowest thinking skill category is (1) Knowledge (involving recall data or information); followed by (2) comprehension (interpretation of instructions, translation, understanding the meaning); (3) application (implementation of learned information or an abstraction to understand a novel situation); (4) analysis (separation of material or concepts into component parts, in order to understand the complexity of the organizational structure); (5) synthesis (composition of new structure or pattern from diverse elements); and the final and the highest order component of the cognitive domain, (6) evaluation (making judgments about the value of ideas or materials).

According to the active learning approach, team-work in small groups plays a crucial part in the lesson. Practicing exercises in problem-solving leads students to pay attention to their thinking strategies. The new knowledge that they develop is organized, analyzed, applied, and evaluated through thinking procedures (Zohar, 2003). 'High level thinking' is an action that is hard to define, but it is possible to characterize it by some key qualities, which are recognized when they occur (Resnick, 1987). This type of thinking is not algorithmic, and the thinking and action patterns students have to choose cannot be clearly pre-determined. In many cases the students' products are multiple solutions and each of them has advantages and disadvantages. In many cases uncertainty is an integral part in high level thinking, and it necessitates a high level of independence, judgment and decision-making (Dori and Hersovitz, 1999; Zoller, 1987).

Studies conducted in Michigan and North Carolina universities show that students' learning by team work in small groups during the lessons in much more valuable and fruitful than learning in traditional lectures halls. Abbott et al. (2000), Henderson and Dancy (2008) and Gavalcova, (2008) investigated the teaching of mathematic principles in universities according to the active learning approach. Their findings point out strategies developed by instructors, including open discussion and explanations. These strategies enhance students' thinking skills, for example, asking questions and conceptualizing answers. They found that in active learning the students advanced from questions at a low thinking level such as 'how to calculate?' or 'what is my mistake?' to a higher level of thinking such as 'why does it work this way?', 'what is the reason for this procedure?' or 'where can we find the same patterns?' The students understood the importance of theory as a key to understanding mathematical principles. They also internalized the importance of general concepts and their contribution to effective solutions of various mathematical problems (Zweck, 2006). In a research on Computer Supported Collaborative Learning (CSCL) environments, Ada (2009) found a positive correlation between the quality of the group's engagement in a collaborative process and the quality of cognitive skills fostered. She asserted that *'high levels of social interaction and collaboration contributed to the establishment of a community of learning, nurturing a space for fostering higher order thinking through co-creation of knowledge processes'. That leads active learning to higher order thinking.*

Students' satisfaction regarding active learning

In active learning in the SCALE-UP environment in the US, students are not required to attend class. Despite this, average attendance in the University of North Carolina is as high as ninety percent. Most of the students choose to study in this format in their second year of studies on the basis of recommendations from fellow students. The percentage of dropouts from active courses using this approach was measured at Florida International University and was found to be one-fourth of the dropout rate for similar courses using traditional teaching approaches (Beichner et al., 2007). The level of satisfaction of students and instructors at FIU with the course using the active teaching method was particularly high in comparisons to other courses. Following their exposure to this teaching method, ten to twenty percent of students chose to focus on science studies (Kramer et al., 2008). In conclusion, most researchers who examined active learning identified an improvement in the following indices; conceptual understanding, test achievements, reduced dropout rates, student satisfaction, team work and problem solving.

Instructors' perceptions of active learning

Numerous studies have been undertaken in recent years regarding instructors' perceptions of their function in academic institutions. Some researchers have made a distinction between perceptions focused on the instructor regarding the transmission of knowledge and information, perceptions focused on the instructor-student relations, and perceptions focused on the student's activities and the development of understanding and conceptualization (Gerlese and Akerlind, 2004; Kember, 1997; Samuelowicz and Bain, 2001).

Freire (1970) related critically to the 'banking' approach to education a metaphor used by Freire to suggest that students should be considered as empty bank accounts that should remain open to deposits made by the teacher. Education becomes an act of depositing, in which the teacher is the depositor and the students are depositories patiently receiving, memorizing, and repeating the deposited data transferred by the teacher; there is no chance for active communication. Freire rejects this 'banking' approach, claiming that it results in the dehumanization of both the students and the teachers. In addition, he argues that the banking approach stimulates oppressive attitude and practices in society additionally. Freire claims that knowledge emerges only through invention and re-invention, through restless and impatient, hopeful inquiry, when human beings communicate with each other and interact with the world. The approach of active learning is opposed to the 'banking' model of passive student absorption of information from an authority figure and focuses instead on the student-teacher dialogue and the development of active knowledge construction by the students.

Most academic instructors tend to adhere to traditional teaching approaches, according to which the principal function of the instructor is to convey knowledge. In traditional teaching the students generally remain passive and are not invited to express their opinion, cope with problems, or consider possible solution (Harmin, 2006; Redish, 2003).

In a study that interviewed 332 instructors and teachers (Niemi, 2002), the respondents noted six factor/ variables that they felt prevented them from engaging in teaching that promotes active learning:

A. Lack of time due to the need to complete all the required material in a packed curriculum.
B. Teaching in large groups does not permit active teaching
C. A shortage of study materials suitable for the active teaching approach
D. Opposition among senior peers to changes after they have developed teaching methods suited to their capabilities and experience.
E. A lack of meta-cognitive skills and motivation on the part of the students. The instructors feel that students prefer traditional learning.
F. Among high school teachers, parental opposition to change will be mentioned.

In addition to these factor/variables, instructors argue that difficulties occur in the assimilation of active learning when students lack background knowledge in the studied subject. Active learning also demands more work from both instructors and students than traditional teaching (Scheyvens et al., 2008). It seems that the reluctance to adopt instruction innovations is also related to the professional development of the instructors. Burke (1987) argues that professional development occurs in three cycles: Induction, Renewal and Redirection. The first cycle-induction is characterized by worries and attempts to survive (Huberman, 1993). These feelings are not limited to the first time that the instructors stand in front of the students, but often recur during their instructional career, for example, when an instructor answers the need or demand to change instructing methods and attempts to replace traditional instruction with active instruction.

The tendency to focus on the instructors' reluctance to use teaching innovations, mainly to promote active learning, in order to explain the lack of use of these innovations neglects another important component: the students' expectations from learning. In many cases students prefer an instruction style that allows their passive participation in the lesson and where the instructor presents the learning material in a clear manner and solves all the problems expected to be included in the

Table 1. Participants in the work.

University	Male	Female	Total
Dire Dawa	38	15	53
Haramaya	38	15	53
Jijiga	34	20	54
Total	110	50	160

final exam for them (Slater, 2003). The students, like instructors, who are used to the traditional learning, are not eager to adapt to new learning environments. Consequently, instructors who enthusiastically adopt new methods are often frustrated by their students' responses (Felder and Brent, 1996).

This chapter focused on the general trends in active learning in academic institution and established debates on students' satisfaction on the instructors' ''perception of active learning'' in enhancing science and technology education. The literature also links active learning and higher level thinking. Thus, the locus of power in active learning implementation is a key factor influencing how it is viewed and implemented by academic staff. The notation of power is used as an analytical tool to understand active learning in the three case universities.

METHODS

Sample

The study was carried out with 160 lecturers participating (Table 1). The participants were recruited and selected through a random sampling technique from three public higher education institutions in Eastern Ethiopia; Dire Dawa University, Haramaya University and Jijiga University. The participants had a wide range of teaching experience ranging from 2 to 17 years of practice in their fields. To draw out comparison seven 'active instructors' were selected, from the same three universities, on the basis of their developed experience and practice of active learning methods. These participants were from various disciplines and had spent three years developing active study materials and implementing these materials in classrooms equipped for active learning.

The participants were aged between 26 and 40 and a gender break dawn is given as well.

Development of the research process and tool

The research tool was an attitudes questionnaire developed specially for the purpose of this study on the basis of the experience of the 'active instructors' and interviews with those instructors exposing the process of change they had undergone. Over the five-year period in which active learning was developed and integrated in basic courses at the university, the 'active instructors' were interviewed twice in each semester. An analysis of these interviews provided the basis for characterizing the attitudes of 'active instructors' and subsequently for the development of the research questionnaire.

It is possible to assess the significant change in the attitude of an'active instructor' toward active teaching from her words in an interview we conducted with her two years after she began to teach with active learning methods:

It is an amazing process [and can see] how the students are beginning to construct their knowledge and how it develops along the course. Each student has its own rhythm. It seems as though the student's head is transparent and we can trace how their knowledge is developed and organized.

One of the new challenges for the traditional instructor who begins to use the active learning approach is how to manage students learning in small groups. During an interview with one of the 'active instructors' she described the influence of learning in small groups on her as instructor and on students' involvement.

In the traditional classes it was impossible to provide personal guidance for the student. In contrast, in an active class, when I approach a group of three or even nine students all of them listen to me… group work contributes a lot to the group members. In addition to my impressions I listened to the students' testimonies. The group constitutes a supportive environment. If one of the group members presents an issue to the class and encounters difficulties the rest of the group support him.

On the basis of a review of the literature (Johnson et al., 1998) and an examination of the attitudes of the 'active instructors', a **content analysis** was undertaken in which the attitudes were grouped into six key domains where it is possible to distinguish tendencies that characterize an instructor who is inclined to use teaching methods of active teaching. These domains are:

1. Large Class – Activation of a large class
2. Involvement – Student involvement in the course
3. Independence – Independent learning by students
4. Development of knowledge – by students
5. Quantity versus understanding – A tendency to prefer understanding of the material to full completion of the syllabus
6. Function of instructor – Perception of the role of the instructor.

Table 2 presents the six domains identified as characterizing the attitudes of the 'active instructors', as well as the ways in which these attitudes are manifested in active learning in comparison to the attitudes identified with traditional teaching.

The domains of teaching/learning identified on the basis of the experience of the 'active instructors' are consistent with Constructivist Theory and the approach of participatory learning in small groups. According to these approaches, the learning process, the development of a conceptual world, and the connections between the two are undertaken actively by the learner through the process of coping with different possibilities and examining these against the background of reality in team work (Vygotsky, 1978).

Questionnaire validation

Construction and validation of the questionnaire was carried out in three stages. The first stage was the phrasing of 50 statements regarding instruction in both traditional and active learning, and their categorization within the six domains described in Table 2. Positive and negative statements, regarding active learning points, were phrased for each of these domains. These 50 statements were then presented to 7 experts in learning and teaching at our Diredaw University. According to their responses 6 statements were eliminated so the first version {V1} of the research tool contains 44 statements.

At the second stage questionnaire V1 was administered to 8 'active instructors'. As a result of analysis of the instructors

Table 2. Description of the six domains addressed by the research questionnaire and their manifestation in traditional teaching/learning and active teaching.

No.	Domain of teaching/learning	Manifestation in traditional teaching	Manifestation in active teaching
1	Large classes	There is no requirement to activate the students in a large class and they cannot be guided	Students in a large class should be activated, particularly by means of group work
2	Involvement	Participation in classes is optional; students succeed in the course if they pass the final test	Students' participation in classes is vital in order to ensure that they understand the study material and are successful in the course
3	Independence	Students should not be expected to have knowledge of study topics not presented in class by the instructor	Students can learn by themselves the topics from the syllabus, if they receive proper guidelines
4	Development of knowledge	The students' level of scientific knowledge does not enable them to develop new scientific knowledge	Students can present new scientific arguments and ideas by themselves
5	Quantity versus understanding	It is important to teach the whole syllabus; students should not be expected to gain a profound understanding	It is important for students to understand the basic concepts of the course as a foundation for more complex scientific knowledge
6	Function of instructor	The instructors should focus on their function as transmitters of knowledge	The instructor should identify the students' learning difficulties and develop appropriate teaching methods

responses 7 statements were removed. 37 statements were selected for the second version (V2) or research questionnaire with 75% higher agreement (at least 6 instructors out of 8).

At the third stage questionnaire V2 was administered to 7 experts in teaching and learning from the Department of Education in Technology and Science in the Technion (Dire- Dawa Institute of Technology-IoT). The group from the IoT was a validation group and did not take part in the research group. As a result of their responses, 2 more statements were eliminated and some slight modifications were applied to 4 other statements. The last version of research too (V3) contains 35 statements.

Questionnaire reliability

To improve our categorization of the six domains we adopted a blended approach of two philosophies 'predetermines' and 'row statistics', suggested by Adams et al. (2006). We took advantage of the strengths of both approaches and avoided the weaknesses to obtain statistically robust categories that best characterize instruction thinking in the academic context for which this questionnaire was constructed. Guided by the research results, we then grouped the statements into new categories that were likely to be useful and were evaluated as statistically valid. These cate-gories were not necessarily independent and not all statements needed to be ascribed to a category. This approach was justified because the different aspects of the instructors' beliefs were not necessarily independent; rather, an attempt was made to identify which portions of the data were useful to describe particular general aspects of the instructors' thinking.

The research questionnaire was presented to 160 instructors at three academic institutions. A factor/variable analysis was undertaken in order to improve the division into teaching/learning domains. Questionnaire reliability was examined using Cronbach's Alpha, yielding the value 0.753. Instructors' responses were processed to produce the 35 statements included in the questionnaire using the SPSS program. The analysis of items was undertaken in stages: in each stage, one domain was identified and its reliability level was determined using Cronbach's Alpha. At the end of the process, the statements were divided into the six teaching/learning domains. Table 3 presents the summary of the item analysis.

As a rule of thumb, researchers require a reliability of 0.70 or higher (obtained on a substantial sample) before they will use an instrument. According to this rule the questionnaire is reliable. This is also true for learning domain 1 – Activation of a large class results of analysis for the other three domains (4, 5, 6) came quite close to the threshold of 0.7 results for the last two domains (2, 3) are lower.

RESEARCH FINDINGS AND DISCUSSION

This study is one of many showing that active learning increases student performance in undergraduate science and technology courses (Ebert-May et al, 1997; Crouch and Mazur, 2001; Knight and Wood, 2005; McConnell et al., 2006). The unique aspects of this research are emphasis on instructors' attitudes towards active learning and the ability to apply it in science and technology education.

Table 3. Examination of the reliability of the six teaching/learning domains by means of a factor/variable analysis.

No.	Teaching/learning domain	Number of statement in the domain	Cronbach's Alpha
1	Activation of a large class	7	0.797
2	Students' involvement in course	5	0.478
3	Independent learning by students	6	0.589
4	Development of knowledge by students	6	0.683
5	Quantity versus understanding	6	0.656
6	Function of the instructor	5	0.669

Table 4. Comparison between the ranking of attitudes of faculty members and the ranking of 'active instructors' in six domains of teaching/learning according to a Kruskal-Wallis test.

Domain/Variable	Function of instructor	Quantity/ Understanding	Development of knowledge	Independence	Involvement	Large class
Ranking of faculty members	24.1	23.9	24.2	24.3	24.3	23.5
Ranking of 'active instructors'	46.1	47.6	45.6	44.5	44.6	49.8
Difference in ranking	22.0	23.7	21.4	20.2	20.3	26.3
Chi squared	12.5	14.5	11.8	10.5	10.7	17.7
Significance	<0.001	<0.001	0.001	0.001	0.001	<0.001

Difference between faculty members and 'active instructors'

The study compared the average score of the attitudes of the instructors (N=160) in each of the six domains examined with the average attitudes of the 'active instructors' group (N=7). The comparison of averages was undertaken using Kruskal-Wallis parameter free analysis. Table 4 presents the results of the comparison. The ranking of the attitudes was determined on the basis of the research questionnaire; a high ranking reflects a tendency on the part of the instructors to engage in promoting active learning, while a low ranking reflects a tendency to traditional teaching

The results in Table 4 reflect a significant difference in all six domains addressed by the research questionnaire between the average attitudes of faculty members and those of the 'active instructors'' group. Three most significant differences were evident between these two groups.

The findings of the study show that the largest gap between the ranking of the 'active instructors' and the other instructors (26.3) was in the domain of activation of a big –size class. The 'active instructors' believe that it is possible for students in a large class to be active or take part in active processes and to be divided into small learning groups. A plenum session can be used to guide the students and to develop productive discussion. Most of the faculty members tend to believe that discussion in a large class creates noise and does not lead to any progress in learning the study material. The faculty members' attitude is that it is impossible to achieve personal contact with students in groups or as individuals in a large class. The structure of the lectures by 'traditional instructors' focuses mainly on course content and less on the manner in which the students interpret this content or integrate it within their prior knowledge. A 'traditional instructor' does not usually address the social process involved in group activation and seems to be unaware of this process. Conversely, 'active instructors' who have experienced group work note the importance of involving students in the course and enabling them to achieve its objectives.

A further prominent difference between 'active instructors' and 'traditional instructors' relates to the importance of achieving understanding versus quantity in the curriculum (23.7). 'Active instructors' prefer to move forward with the study material only after ensuring that most of the students in the course have reached an adequate level of understanding of the study material, whereas 'traditional instructors' prioritize the demand to complete the course studies, even if this means that students do not properly understand the study material.

The third domain that exhibited a large gap (22.0) between the groups was the function of instructor. While the tendency of most faculty members was to emphasize

Table 5. Models of active learning tendency of instructors in academic institutions. The three models were developed by linear regression.

Model		Sum of square	Degree of freedom (df)	Mean square	F	Significance
1.	Regression	9.482	1	9.492	119.887	.000[(a)]
	Residual	4.038	152	079		
	Total	13.530	153			
2.	Regression	12.047	2	6.024	203.186	.000[(b)]
	Residual	1.482	151	030		
	Total	13.530	153			
3.	Regression	12.707	3	4.236	252.222	.000[(c)]
	Residual	823	150	.017		
	Total	13.530	153			

Model 1 – only large class; Model 2 – large class + quantity/understanding; Model 3 – large class + quantity/understanding + independence.

the role of instructor as the 'knowledge deliverer', the 'active instructors' related to this point only as one role among many others that the instructor should fulfill. In addition to transmitting knowledge, according to 'active instructors', the instructor should have other roles such as recognizing students' difficulties, guiding students in various assignments during the lessons, directing the groups' work, encouraging students to present their solutions in front of class, raising their level of thinking, and developing methods for the students to provide feedback to one another.

These gaps and the other three point out large differences between faculty members who did not make efforts to create an appropriate atmosphere in class that could help prepare students to face the need of the future employers (Etkina and Van, 2001) and those who are trying to devise and employ new teaching methods.

Despite the evident differences between the attitude of 'active instructors' and the other instructors toward active learning, we assumed that some components of active learning infiltrate into the pedagogy of the latter. In order to evaluate the tendency of these instructors at academic institutions to adopt active learning we built a linear model using an Active Learning Coefficient (ALC). The ALC was calculated as an average of the instructors' attitudes toward active learning. The questionnaire contains positive and negative statements relating to active learning. To calculate the ALC the instructors' attitudes regarding a negative statement (Xn) were converted to positive position (Xp) by Xp = 6 – Xn. Where the value of Xp is in the range 1 ≤ Xp ≤ 5, the value of ALC for each instructor was calculated by the following equation:

$$ALC = \sum_{i=I}^{35} \frac{Xp_i}{35}$$

Where I denote the questionnaire index number and 35 (N) is the number of items in the questionnaire. A linear regression was made on ALC, by ANOVA. The results of the linear regression are presented in Table 5.

From the results presented in Table 5 it seems that Model 1 explains 70.2% of the variance of the faculty member's attitudes toward the use of active learning instruction in a large class (domain 1).

Model 2 is a combination of two domains 1 and 5 (quantity/understanding) and it explains 89.0% of the variance of ALC.

Model 3 includes three domains 1+5+3 (independence) and it explains 93.9% of the variance of ALC.

According to these results pedagogy in large classes is the domain with the largest variance between the faculty members. Some faculty members still teach according to unchanged 'good old' methods they learnt as students in institutions all over the world – 'talk and chalk'. Other divided their lectures into segments and in between these segments conducted discussion. Another group of faculty members used presentations with animations and active demonstrations, and some in structure used an array of different methods for active learning (Cooper and Robinson, 2000).

SUMMARY AND CONCLUSION

One of the major goals of science and technology education today is to promote students' active learning as a way to improve students' conceptual understanding and thinking skills. Although there is clear evidence of the benefits of active learning, most lecturers in higher education adhere to traditional teaching methods. The first step in order to integrate innovation into teachers' instruction is to reveal their attitudes towards such innovations. In this research we identified and characterized six

domains in which it was possible to distinguish different attitudes towards active learning and constructed an attitude questionnaire based on these domains. This questionnaire was developed on the basis of the experience of 'active instructors' and interviews with them, and validated by teaching instructors from several academic institutions.

Our diagnostic tool, the questionnaire, allows schools and institutions to indicate the extent attitudes of their faculty tendency toward active learning. The diagnostic tool supplies crucial information to the college and university directors when planning supportive steps toward advancing active learning in their institutions. In some countries a gap has been found between higher education institutions and high schools in the implementation of active learning (Dori and Herscovitz, 1999, 2005; Zohar and Dori, 2003.). While in high schools the adoption rate of active learning approaches is quite high, in academic institutions only a small fraction of instructors award attention to this approach, and an even smaller fraction consider its adoption for their teaching (Harmin, 2006; Redish, 2003). The present authors believe that active learning could contribute to students' involvement and achievements in academic courses and that their tool (questionnaire) could help instructors to plan the adoption of this approach.

This questionnaire can serve as a practical tool to identify instructors whose attitudes are close to those of 'active instructors and may be open to the use of innovative methods. The specially designed research tool can be used to locate these instructors and suggest that they join the group of instructors using the active teaching approach.

The largest gap found between 'active instructors' attitudes and the other instructors' attitudes was in the domain of activation of a large class. This indicates a large gap between what traditional instructors believe can be done in large classes and what 'active instructors' believe can be done to promote active learning. These issues should be addressed by teacher training developers, by providing greater focus for methods and instructions guiding the activation of students in large classes and by conducting training courses and seminars to promote active learning.

Based on our six domains of active learning perceptions, we suggest the following six aspects that should be addressed by teacher training developers:

1. Make ways for activate students in a large classes, particularly by means of group work;
2. Encourage student participation in classes in order to ensure that they understand the study material and are successful in the course;
3. Give students the opportunity to learn by themselves topics from the syllabus, following proper guidelines; involve students in assignments that force them to present new scientific arguments and ideas by themselves;
4. Involve students in assignments that force them to present new scientific arguments and ideas by themselves;
5. Give more importance to students' understanding of the basic concepts of the course as a foundation for more complex scientific knowledge;
6. Identify students' learning difficulties and develop appropriate teaching methods in order to assist students.

The present authors believe that if teacher's desire increased students' learning, then active learning is an essential component of effective teaching (Doyle, 2011; Haak et al., 2011; Zull, 2011 Cullin et al., 2012 Hestenes, 2012).

The increasingly large classes prevalent in academic institutions, the strong need to reduce expenses, and institutional pressure on staff to spend more time on research rather than instruction, directs faculty staff toward the traditional approach. On the other hand, the results from science education research and success in implementation of active learning methods in many institutions encourage faculty members to adopt this innovative approach. Online resources play an important role by supplying information and methods to advance the students' involvement in academic learning. The deliberation between traditional and active instruction is still ongoing and so far traditional instruction is still the favorite. As John et al. (2011) have suggested, active learning-because it is grounded solidly in the biological basis of learning and because it has been increasingly researched and reviewed-is not just the latest academic fad. On the contrary, active learning is a well-tested approach that teachers committed to student learning should consider adopting. Intentionality provides the key to using active learning effectively, just as purposeful teaching helps faculty members use cooperative learning and other approaches that lead to deep learning. Carnes (2011) also notes that teamwork and problem solving result in strong pedagogical gains and concludes that students "need to attend classes that set their minds on fire". We hope that our facilitating tool will contribute modest support to change what we believe to be an unjustified and unbalanced situation.

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