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Active learning approaches in mathematics education at universities in Ethiopia: the discrepancies between policy and practice

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This article aims to examine the extent to which active learning approaches are implemented in mathematics classrooms in selected Ethiopian universities. Constructivist learning theories are used as conceptual framework. In a mixed-methods sequential explanatory design, four universities in one state are purposefully selected. In the quantitative phase, 84 lecturers completed questionnaires. The qualitative approach included observation of 16 lessons, and interviews with eight lecturers and four department heads. The study found that, although the application of active learning is emphasised in Ethiopian policies, traditional lecture methods dominate most classrooms. Obstacles that practitioners experienced are identified and recommendations made. The significance of the study lies in the fact that it highlights discrepancies between policy and practice.

Aktiewe leerbenaderings tot wiskunde-onderwys aan Ethiopiese universiteite: die diskrepansies tussen beleid en praktyk

Hierdie artikel beoog om die mate waartoe aktiewe leer in wiskunde-lokale in geselekteerde Etiopiese universiteite geïmplementeer word, na te vors. Konstruktiwistiese leerteorieëwordaskonseptueleraamwerkgebruik.In'ngemengdemetodeopeenvolgende verklarende ontwerp is vier universiteite in een streek doelgerig geselekteer. In die kwantitatiewe fase het 84 dosente vraelyste voltooi. Die kwalitatiewe fase het observasie van 16 lesse en onderhoude met agt dosente en vier departementshoofde ingesluit. Die studie het gevind dat alhoewel Etiopiese beleid aktiewe leer vereis, tradisionele lesings die meeste klaskamers oorheers. Probleme wat dosente beleef, word geïdentifiseer en aanbevelings word gemaak. Die waarde van die studie lê in die feit dat dit diskrepansies tussen beleidsmakers en die toepassers van die beleid blootlê.

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The needs of society should be reflected in the educational objectives of a country. Until the final decade of the twentieth century, little attention was paid to university education in Ethiopia with the result that its curriculum was not always relevant to the country's requirements (MoE 2002: 18). However, the Ethiopian government has since been striving to transform its university system to contribute more directly to economic growth (Saint 2004: 34). Policies that included general objectives such as the development of the cognitive and problem-solving capacity of individuals were formulated (MoE 2002: 35-7). This requires active learning.

Nardos (2000: 24) explains that active learning is enjoyable and develops positive student attitudes. Key advantages include that active learning encourages effective participation; involves collaborative activities and the development of communicative skills; builds on prior knowledge; encourages critical reflection; challenges previous assumptions; adopts new perspectives; is open to diverse learning outcomes, and supports individual responsibility for learning (Duffy & Kirkley 2004: 21-42, Kane 2004: 275-86, Kim 2005: 10-8). Active learning leads to improvement in the quality of education and its success. Students are required to move from a competitive to a cooperative stance. Active learning also encourages students to generate their own ideas and provides opportunity to extend their horizons of thinking. This type of learning generates new knowledge.[1]

With particular reference to mathematics education, Daley (2003: 23-30) as well as Tanner and Jones (2000: 43) point out that failure to learn and a loss of interest in mathematics may be related to poor teaching methods. Learners enjoy active learning approaches (Eggen & Kauchak 2001: 23-4). Such approaches emphasise the role of the lecturer as facilitator. It includes a view of the learner as an active problem-solver working individually and in small groups to make connections between multiple forms of representations of mathematical concepts, for instance spoken symbols, written symbols, concrete models, graphics and real-world situations in order

1 *Cf* Balch 2005: 29-34, Petrosino *et al* 2007: 110-26, Robertson 2005: 186-8, Santrock 2001: 50-8, Shen *et al* 2007: 267-78, Steckol 2007: 24-5, Vaughan 2002: 362-4, Zweck 2006: 112-4.

to construct meaning (Biggs 2003: 46-51, Schnotz & Lowe 2003: 117-9, Zweck 2006: 112-4).

In light of the above, Ethiopian education policies stipulate that active learning be implemented in mathematics classrooms at all levels (MoE 2002: 39). An electronic search revealed that research on issues of active learning in Ethiopia generally focus on school level (*cf* Barrow & Leu 2006, Desta *et al* 2009, Serbessa [*s a*]). This research therefore aims to examine to what extent active learning approaches were applied in mathematics education at university level in one district in Ethiopia. The authors will argue that there is a discrepancy between policy and practice, and identify factors related to the non-implementation of active learning in university classrooms.

The remainder of the article explains the conceptual framework, data-collection methods, results and conclusions. Some recommendations are also made.

1. Conceptual framework: constructivist learning

The field of education has undergone a significant paradigm shift concerning the nature of human learning from behaviourism to constructivism (Bolt & Brassard 2004: 161-2). According to constructivism, "individuals create or construct their own new understandings or knowledge through the interaction of what they already know and believe and the ideas, events, and activities with which they come in contact" (Boudourides 2003: 6). Students are required to be "active learners", meaning that they engage in self-directed, experiential learning; reflect on their individual learning processes, and have learner autonomy (Christensen 2003: 235-43).

A constructivist model of teaching has five characteristics: active engagement; use and application of current knowledge; multiple representations; use of learning communities, and employment of authentic tasks (Siemens 2006: 16-8). A mathematics lecturer with a constructivist approach provides new information that will meaningfully connect with prior knowledge (Huang 2002: 30). Construction occurs while the student interacts with the environment (Hendry *et al* 1999: 63-4). The nature of the interaction causes a reaction in the schema of the brain which, according to Piaget's theory, causes either equilibrium or disequilibrium. If there is disequilibrium the

schema is rearranged in order to accommodate new information (Bransford *et al* 2000: 327). The mathematics lecturer encourages student dialogue to enable students to reorganise their existing knowledge and accommodate newly constructed information (Felder & Brent 2001: 72-3, McConnell 2005: 34-6). A lecturer's role is that of facilitator and co-learner (Santrock 2001:116). The lecturer de-emphasises single interpretations and motivates students to constantly check new information against old mathematical rules to revise the rules (Healey & Roberts 2004: 44-52, Taylor 2000: 109). The following teaching modes enhance such learning: cooperative learning, problem-based learning, inquiry-based learning, discovery learning, and the discussion method.

Moving towards constructivist instruction requires changes in traditional assessment procedures (Biggs 1999: 183, Slavin 2005: 129). Traditional examinations often lead students to adopt a surface approach to learning (Boudourides 2003: 158). By contrast, assessment methods that emphasise the learning process itself encourage students to engage in metacognitive and reflective activities. Opportunities for self-assessment are embedded in learning activities to encourage knowledge construction. Assessment in mathematics focuses on problem-solving, exploration of possible solutions and developing projects in groups. Assessment methods comprise open-ended questions, portfolios and narratives (Roblyer 2006: 53-4).

In light of the above, the remainder of this article explains the research design, results and discussion thereof, as well as the conclusions. As indicated earlier, the main aim of this article is to determine to what extent active learning approaches were used in mathematics education at selected universities in Ethiopia and to point out the implications for mathematics education in general.

2. Research design and data collection

In this study a mixed methods sequential explanatory design was used as the use of both quantitative and qualitative data-collection methods leads to a better understanding of issues under investigation (Cohen *et al* 2003: 31-4, McMillan & Schumacher 2010: 401). According to Cohen *et al* (2003: 24-8), "use of both forms of data allows researchers to simultaneously make generalizations about a population

from the results of a sample and to gain a deeper understanding of the phenomena of interest". It triangulates data. This allows for crosschecking of information and thus enhances validity of findings (Gay & Airasian 2000: 201).

Six of the 21 universities in Ethiopia are situated in the state of Oromia where this study took place. Of the six universities, four were purposefully selected as sample: two from the newly established universities (younger than five years) and two from the old universities (older than 10 years). This was reputational-case selection based on the authors' judgement of their potential for providing rich data (Gay & Airasian 2000: 120-40). In addition, convenience sampling also played a role (McMillan & Schumacher 2010: 486) in that the four universities were selected because of their accessibility and availability. All the mathematics lecturers (84 in total, 79 males and five females) of the four sample universities were involved in the quantitative section of the study.

In the quantitative phase, a descriptive survey design was used. The 84 lecturers completed a structured questionnaire. The 110 items were divided into five sections that included biographic characteristics of the respondents; the extent to which the lecturers implemented active learning approaches; factors affecting the implementation of active learning approaches – including for assessment; lecturers' attitudes towards active learning; the training of lecturers, and the support provided. The questionnaire used a four-point Likert Scale which ranged from 1 (strongly disagree) to 4 (strongly agree).[2] A final section consisted of three open-ended items that asked what worked or did not work well regarding active learning, and what the lecturers recommended regarding active learning/teaching of mathematics.

The researcher pilot-tested the questionnaire with 10 experienced lecturers who taught either teaching methods or mathematics, from a university which did not form part of the sample of the study. A number of problems with the wording of questions came to light and changes were made accordingly. For example, 'homework' was replaced by 'worksheet'; 'too much' work was replaced by 'enough' work; and 'I believe students learn mathematics by doing things' was

2 For the purpose of this article, the two positive responses were grouped together, and the two negative responses were also grouped together, as the tables show.

modified to 'I believe students learn mathematics through repeated practice approaches'.

The data obtained from the questionnaires were analysed by using frequencies, percentages and mean values. No hypotheses were tested as this was not the aim of the study.

The phenomenology design used in the follow-up qualitative phase was to gain insight into the phenomenon from participants' own views about their contexts, namely mathematics teaching at universities in Oromia. Data collection by means of classroom observation consisted of 16 observations: two lecturers were purposefully selected (for being experienced and willing to participate) from each of the four sample universities. They were twice observed and the observations were recorded on an observation sheet. Semi-structured interviews were also conducted with the eight observed lecturers and four mathematics department heads (12 interviews in total). An interview guide focused on the results of the questionnaire and the lessons that were observed. The data were analysed and coded by identifying segments, coding the segments, comparing codes and naming categories (McMillan & Schumacher 2010: 371-81).

Visits were paid prior to the commencement of individual weekly data-collection blocks. Following the selection and initial contact with staff, two weeks were spent in separate weekly intervals at each of the four sample universities. A further six weeks were spent completing follow-up visits, classroom observation, dispatching and collecting of questionnaires, and conducting interviews.

All ethical measures were adhered to. The researcher obtained informed consent for participation from the institutions and the respondents, and assured them of confidentiality and anonymity. The financial support provided by the Ethiopian Ministry of Education did not influence the research report.

Validity and reliability for quantitative data were addressed. The researchers ensured the content and face validity of the questionnaire by having it assessed by an experienced researcher. Regarding reliability, a reliability coefficient of 0.7 or above is generally acceptable (Cohen *et al* 2003: 104-32, Gay & Airasian 2000: 173-5). The Cronbach alpha correlation coefficients for the different sections of the questionnaire were between 0.76 and 0.82. Thus, the questionnaire

was reliable. Regarding the qualitative data, trustworthiness was assured by triangulation of data, lengthy data collection in the natural environment of the issue under investigation, and interviews in the participants' own language.

3. Results

3.1 Lecturers' use of active learning in the teaching-learning process and while assessing students

The study determined to what extent lecturers used active learning approaches in mathematics teaching and assessment. The quantitative results are presented in Tables 1 and 2.

As far as the teaching method is concerned, Table 1 shows that more than 75% of the lecturers agreed (means 3.5 and higher) that they encouraged students to ask questions. They thought that cooperative group work was worthwhile, that cooperative learning was needed to help students understand new concepts, and that discussion between students on new course materials was vital for deep understanding. They indicated that they supported students to discover the desired conceptual knowledge in the learning process for themselves and facilitated problem-solving in the mathematics class. They disagreed that they discouraged students to mathematically or statistically explore their current beliefs (often culture-based) about issues (N>90%; mean=1.4). Thus, lecturers expressed their beliefs in active learning. However, observation of mathematics teaching in the classroom showed that the majority of the lecturers did not use a wide variety of teaching methods to engage students in learning (for example, linking previous knowledge and experience; using appropriate pacing and questioning strategies; encouraging higher level thinking skills; implementing flexible grouping; differentiating instruction, and accommodating print, non-print and electronic resources); to encourage students to investigate problems by asking questions that begin with "what, when, where and how", or to use cooperative groups for problem-solving.

Table 1: The extent to which lecturers provide students with opportunities to actively participate in the teaching-learning process or lecturers' use of active learning methods

Item	Disagree f (%)	Agree f (%)	Mean
I rarely arrange the students into groups for mathematics teamwork.	20 (23.8)	64 (76.2)	2.9
I think that lectures are the best way to teach students to solve mathematics problems.	30 (35.7)	54 (64.3)	2.7
I encourage students to ask questions.	5 (6)	79 (94)	3.6
I think that inquiry-learning is effective to actively involve students in the mathematics learning process.	5 (6)	79 (94)	3.2
I often confront the students with problems to solve.	15 (17.9)	69 (82.1)	3.1
I encourage students to deduce general principles from practical experiences.	8 (9.5)	76 (90.5)	3.3
I consciously create conditions to stimulate students' need to know.	5 (6)	79 (94)	3.3
I discuss worksheet results with students.	8 (9.5)	76 (90.5)	3.4
I think a well-prepared lecture can stimulate students to solve mathematics problems.	4 (4.8)	80 (95.2)	3.4
I think cooperative work in groups is good for efficient learning.	2 (2.4)	82 (97.6)	3.7
I consciously facilitate problem-solving in the mathematics class.	2 (2.4)	82 (97.6)	3.5
I discourage students to discuss their feelings.	78 (92.9)	6 (7.1)	1.4
I discourage students to explore their current beliefs.	76 (90.5)	8 (9.5)	1.4
I support students to discover the desired conceptual knowledge in the learning process for themselves.	3 (3.6)	81 (96.4)	3.7
I believe that cooperative learning is needed to help students understand new concepts.	6 (7.1)	78 (92.9)	3.5
I think that discussions between students on new course materials are vital for deep understanding.	8 (9.5)	76 (90.5)	3.5

When interviewed on the above-mentioned discrepancy, some of the lecturers did not appear to be convinced of the merits of active

learning despite giving the 'correct' answers in the questionnaires. One stated:

I am concerned that problem solving and the cooperative learning method are becoming overused and that without a broad range of knowledge for reference the 'problem' is more guesswork. In such cases, it may be that students are active, enjoy the activity and remember the desired outcomes without truly challenging their own existing concepts. I do not believe in 'active listening' but I [believe in] using simple pauses to allow students to review what has been discussed [Lecturer C].

Table 2 presents the quantitative data on assessment practices.

Table 2: The extent to which lecturers implement active learning approaches while assessing

Item	Disagree f (%)	Agree f (%)	Mean
I have too much work to evaluate students continuously.	15 (17.9)	69 (82.1)	3.1
I frequently ask close-ended questions for which there is only one correct answer.	42 (50)	42 (50)	2.5
Students become too noisy if I ask many questions.	70 (83,3)	14 (16.7)	1.9
I praise students' work as often as possible.	12 (14.3)	72 (85.7)	3.1
I frequently ask open-ended questions.	52 (61.9)	32 (38.1)	2.4
Students need to be able to respond very quickly to questions.	45 (53.6)	39 (46.4)	2.4
I often assess students' understanding during group work.	41 (48.8)	43 (51.2)	2.5
I often assess students' understanding through questioning.	6 (7.1)	78 (92.9)	3.3
I provide exercises on some of the lessons.	2 (2.4)	82 (97.6)	3.5
It is impossible to follow students' participation in learning.	64 (76.2)	20 (23.8)	1.8
I help students to take responsibility for their own learning.	1 (1.2)	83 (98.8)	3.4
Providing ongoing meaningful feedback to students is too time-consuming.	31 (36.9)	53 (63.1)	2.6
I often assess students when they solve problems in a group.	32 (38.1)	52 (61.9)	2.6

Table 2 reveals that more than 80% (mean 3.1 and greater) of the lecturers agreed that they had too much work to evaluate students continuously. However, they indicated that they praised students often; frequently assessed students' understanding by asking questions; provided exercises on lessons, and helped students to take responsibility for their own learning. Of the group, 83% disagreed that students became too noisy when questioned (mean=1.9).

Although it appears that the above views (with one exception) support active learning assessment, observation showed that lecturers seldom requested students to demonstrate solution processes on the chalkboard (to help the lecturer assess the students and thus develop a sense of students' misunderstandings in the solution process), or do ongoing formative assessment. In general, students were expected to memorise, rephrase, and infer meaning in the teaching-learning process. The lecturers frequently asked low-level order questions despite the fact that only a third of them agreed with the item "I frequently ask close-ended questions for which there is only one correct answer".

When interviewed on their assessment practices, lecturers indicated that they were uncertain as to how to assess in an active learning approach. This uncertainty seems to have arisen from a lack of knowledge on how to handle the amount of work that assessment caused, how to educate the students in what was expected of them, and how to deal with noise during group discussions. Observations confirmed that the students tended to be very noisy during discussions. This problem occurred in nearly all sample universities. Even a lecturer who taught next to the observed class complained about the din. Lecturers were also uncertain about how to assess group work. For example:

Many of the cooperative teams in my class are not working well. Their assignments are superficial and incomplete and some team members keep complaining to me about others not participating. Because of this and large class sizes, I use short answer, true-false, matching and multiple-choice questions [Lecturer E].

3.2 The major challenges in implementing active learning approaches in mathematics classes

The study identified the challenges that mathematics lecturers faced in implementing active learning approaches. Table 3 presents the quantitative data.

Table 3 shows that the most important factors that prevented the implementation of active learning approaches were a lack of resources, and a lack of time to actively involve students in classroom teaching (more than 78% of the lecturers agreed with this; means 3.0 and greater). Lecturers pointed out other factors, namely large classes, a rigid timetable, lack of administrative support, too much effort needed by lecturers, and a lack of instructional material (at least two-thirds of the respondents agreed with this; mean=2.8 and higher).

Lecturers also indicated that there was not enough space for group work. Classroom observations indicated that lack of room was not the main problem but rather the heavy furniture which was difficult to move to accommodate group work. Thus, none of the lecturers arranged their students into groups for activities. One lecturer stated:

> For groups, adaptive classroom environments with movable chairs and tables work better than fixed seats and tables. In my university, one of the problems that affect the use of active learning approaches is the classroom furnishing and layout, because it was arranged in fixed seats and tables [Lecturer F].

Other obstacles to the adoption of active learning approaches mentioned by the interviewees related to negative attitudes of lecturers, students' expectations that lecturers were the 'experts' who needed to transmit their knowledge to the students, a lack of resources, and a shortage of time to cover a considerable amount of content.

Table 3: Factors that hindered the implementation of active learning/ student-centred approaches in the sample universities

Item	Disagree f (%)	Agree f (%)	Mean
I feel that lecturers in general have negative attitudes towards group work.	41 (48.8)	43 (51.2)	2.5
There is a lack of time to actively involve students in my classroom teaching.	18 (21.4)	66 (78.6)	3.0
To involve students in active learning will add too much to my work load.	37 (44.1)	47 (55.9)	2.5
It is difficult to cover the prescribed work if students ask many questions.	40 (47.6)	44 (52.4)	2.5
Active student learning will create problems in my classroom management.	71 (84.5)	13 (15.5)	1.8
It is impractical to implement active learning in large classes.	21 (25)	63 (75)	2.9
The amount of content that needs to be covered prevents the use of active learning in the classroom.	31 (36.9)	53 (63.1)	2.7
The rigidity of the time table prevents the implementation of an active learning technique.	25 (29.8)	59 (70.2)	2.8
I think students have negative attitudes towards active learning.	57 (67.9)	27 (32.1)	2.2
I think that lack of administrative support (for instance, financial, facilitating) inhibits the implementation of active learning in class.	19 (22.6)	65 (77.4)	2.8
Lack of classroom space inhibits group work.	15 (17.9)	69 (82.1)	3.1
Lack of resources affects the implementation of problem-based learning.	14 (16.7)	70 (83.3)	3.0
Active learning demands too much effort from lecturers.	31 (36.9)	53 (63.1)	2.8
I think educational administration is unsupportive towards active learning.	36 (42.9)	48 (57.1)	2.6
I think that lack of instructional materials inhibits the implementation of active learning.	23 (27.4)	61 (72.6)	2.8

3.3 The attitudes of university lecturers towards active learning/student-centred approaches

To determine lecturers' attitudes towards active learning, 29 questionnaire items were listed. The results are presented in Table 4.

Table 4: Lecturers' attitudes towards active learning

Item	Disagree f (%)	Agree f (%)	Mean
I encourage students to reflect during the process of knowledge construction.	4(4.8)	80(95.2)	3.3
I try to create a classroom environment that supports inactive learning.	56(66.7)	28(33.3)	2.3
I use lectures to help students to develop critical thinking skills.	28(33.3)	56(66.7)	2.7
I prefer classes in which students are quiet.	32(38.1)	52(61.9)	3.0
I believe lecture method is the most valuable teaching approach.	52(61.9)	32(38.1)	2.4
I believe group work discourages students' mathematical insight.	75(89.3)	9(10.7)	1.7
I believe students learn mathematics through repeated practice.	7(8.3)	77(91.7)	3.2
I motivate students to actively participate in the teaching-learning process.	1(1.2)	83(98.8)	3.6
I believe problem-solving enhances students' mathematics learning.		84(100)	3.7
I generally link new knowledge to students' prior experiences.	29(34.5)	55(65.5)	2.7
I believe students dislike active participation in class.	56(66.7)	28(33.3)	2.2
In active learning my responsibility is to facilitate students' learning.	5(6.0)	79(94)	3.2
I feel that good lectures enhance students' sense of commitment.	12(14.3)	72(85.7)	3.1
Active problem-solving offers students opportunities for quick progress.	1(1.2)	83(98.8)	3.3
Through lectures I stimulate students' responsibility for their own learning.	25(30)	59(70)	2.7
Guided feedback is impractical in large classes.	50(60)	34(40)	2.4
I lack time to provide students with constructive feedback on their work.	25(29.8)	59(70.2)	2.8
I believe students learn more effectively if they work individually than in groups.	67(80)	17(20)	2.2

Item	Disagree f (%)	Agree f (%)	Mean
I engage students mostly as fine listeners during learning.	29(35)	55(65)	2.6
There is no time for reflection in my classes.	33(39.3)	51(60.7)	3.0
I react on feedback from students about how they learn effectively.	37(44.1)	47(55.9)	2.6
I actively engage students in my mathematics classes.	27(32.1)	57(67.9)	2.8
I encourage students to make decisions about the what, how, and when of learning.	26(31)	58(69)	2.8
Students participate in activities in my mathematics class.	22(26.2)	62(73.8)	2.9
Students should be lectured on how to formulate conclusions.	27(32.1)	57(67.9)	2.8
It is impossible to learn actively in large classes.	36(42.9)	48(57.1)	2.6
I think well-prepared lectures are most important for student achievement.	19(22.8)	65(77.4)	3.0
I believe that teaching at university level is generally lecturer-centred.	22(26.2)	62(73.8)	2.8
Learning is an active process of creating hypotheses through activities.	6(7.1)	78(92.9)	3.3

Table 4 indicates (at least 85.7% of the respondents agreed with this; means of 3.1 and higher) the following attitudes of lecturers as most influential: they agreed that problem-solving enhanced students' learning of mathematics; they motivated students to actively participate in the teaching and learning process; learning was an active process of creating hypotheses through activities, and their responsibility in active learning was to facilitate students' learning (means 3 to 3.7.) However, while 95.2% of the lecturers indicated that they encouraged students to reflect during the process of constructing knowledge, 60.7% indicated that there was no time for reflection in their classes. This indicates a discrepancy in their responses, which could perhaps be attributed to an incongruity between knowing what should be done, and actual classroom practices. In addition, 61.9% of the respondents indicated a preference for traditional practices by their predilection for classes in which students were quiet and for the lecture method. In this respect, 66.7% mentioned that they used

lectures to develop critical thinking skills; 70% that they stimulated student responsibility through lectures; 67.9% that students should be lectured on how to formulate conclusions; 77.4% that well-prepared lectures were crucial for student achievement, and 73.8% that university teaching was mainly lecture-centred.

Classroom observations confirmed that instruction was lecture-centred. The class was lectured as one group, and all students were expected to cover the same amount of material, in the same way, at more or less the same pace. The approach in general was business-like and highly structured. Strict discipline was maintained.

When lecturers were asked about the discrepancy in their responses, they identified a lack of training as one reason:

> The use of innovative teaching techniques presumes specialised knowledge on the part of lecturers that only constant training and substantial experience can provide. But enough training was not provided in my university [Lecturer H].

Related to lack of training was lecturers' own self-doubt or uncertainty of when active learning was appropriate. They perceived difficulties with the approach, for example related to large class size, shortage of time, and work overload. They pointed out that the approach needed thorough preparation for problem-based, project-based, discovery and inquiry-based learning.

3.4 Training provided for the implementation of active learning approaches

The study determined the nature of the training provided to lecturers, as shown in Table 5.

The results in Table 5 indicate poor pre-service and in-service training to implement active learning approaches. While 96.4% of the lecturers agreed that "training in active learning is helpful", 83.3% indicated that they were trained in general teaching methodology rather than in active learning techniques. However, 76.2% mentioned that they knew how to structure courses to enable students to be active participants.

Table 5: The training of lecturers

Item	Disagree f (%)	Agree f (%)	Mean
I had adequate pre-service training on the implementation of active learning techniques.	54 (64.3)	30 (35.7)	2.3
I have received training on the implementation of active learning techniques.	47 (55.9)	37 (44.1)	2.6
I have adequate in-service training on the implementation of active learning techniques.	48 (57.1)	36 (42.9)	2.5
I have received training on how to prepare teaching material through active learning.	37 (44.1)	47 (55.9)	2.6
I know how to structure courses so that students can be active participants.	20 (23.8)	64 (76.2)	3.2
I lack training on the implementation of active learning techniques in mathematics teaching.	55 (65.5)	29 (34.5)	2.3
Special training motivated me to implement active learning approaches.	36 (42.9)	4 (57.1)8	2.6
Special funds have allowed me to be trained in active learning.	76 (90.5)	8 (9.5)	2.1
Training in active learning is helpful.	3 (3.6)	81 (96.4)	3.4
I have participated in off-campus training on active learning techniques.	35 (41.7)	49 (58.3)	2.4
I was trained in general teaching methodology rather than in active learning techniques.	14 (16.7)	70 (83.3)	2.8
I lack training on how to implement group work.	56 (66.7)	28 (33.3)	2.2
I am qualified for the implementation of active learning techniques.	54 (64.3)	30 (35.7)	2.3
The university has organised workshops or seminars to mathematics teaching staff on active learning techniques.	33 (39.3)	51 (60.7)	2.5

The above indicates that the lecturers had had some training in active learning methods but that the training was ineffective (once-off, short-term with no follow-up support) and did not motivate the lecturers to implement their knowledge. When the lecturers were queried on this issue during interviews, it surfaced that some learnt about active learning through formal study while others had trained themselves informally by reading and observing other lecturers whom they thought were skilled.

3.5 The support and resources lecturers received

Table 6 presents the data on the support lecturers received for using active approaches in class.

Table 6: The provision of support or the implementation of active learning approaches

Item	Disagree f (%)	Agree f (%)	Mean
The dean of my faculty/school is committed to the implementation of active learning.	49(58.3)	35(41.7)	2.4
My department head is committed to stimulate the development of well-prepared lectures.	30(35.7)	54(64.3)	2.7
My university allocates funds for instructional materials to facilitate group work.	68(81)	16(19)	2.0
I get relevant feedback from my department head on how to implement active learning in class.	64(76.2)	20(23.8)	2.1
My university provides continuous professional support to lecturers who implement active learning in class.	64(76.2)	20(23.8)	2.1
My department head supports training to develop good lectures.	45(53.6)	39(46.4)	2.4
The university provides funding for resources to promote activity in the class.	57(67.9)	32(32.1)	2.4
The university provides resources to lecturers for group work.	68(81)	16(19)	2.1
The university encourages mathematics departments to promote activity in their classes.	68(81)	16(19)	2.1
My university discourages activity in class.	60(71.4)	24(28.6)	2.2
My university administrators prepared short-term training on the implementation of active learning techniques.	32(38.1)	52(61.9)	2.6
My university administrators prepared long-term training on the implementation of active learning techniques.	72(85.7)	12(14.3)	1.9
My department has a discussion group among mathematics lecturers on the implementation of active learning techniques.	73(86.9)	11(13.1)	1.8
The university has offered rewards to lecturers who are efficient at lectures.	78(92.9)	6(7.1)	1.7
My university discourages activity in large/big classes.	69(82.1)	15(17.9)	1.9

Table 6 reveals some of the reasons why lecturers did not implement active learning in class. Of the group, 81% and more revealed that the university did not allocate funding for instructional materials to facilitate group work; provide resources to lecturers for group work, or encourage mathematics departments to promote activity in their classes. In addition, university administrators did not prepare long-term training on the implementation of active learning techniques, and departments did not have discussion groups among mathematics lecturers on the implementation of active learning practices. More than two thirds of the respondents indicated that they did not receive relevant feedback from department heads on active learning, and that relevant continuous professional development was not offered.

Interviews confirmed that the training was inadequate, that there was a lack of funding for its support, and that administration was not committed to facilitate and support this approach. The majority of the interviewees commented on the improper use of active learning approaches in their teaching practice. Some believed that transformation from a lecture-centred classroom to an active learning classroom would be resisted, while others stated that it was an approach they already used.

4. Discussion of the results

The results of this study indicate that the implementation of active learning approaches in mathematics classes was poor. Classroom observations revealed that the lecturers mainly used lectures to teach mathematics. Little use was made of active approaches such as the inquiry method, problem-based learning and discovery methods that foster the critical thinking and problem-solving capacity of students. Students were not actively engaged in activities such as dialogue, debate, creative writing, discussion and problem-solving as well as higher order thinking such as analysis, synthesis and evaluation, although the advantages of these methods have been pointed out (Baines *et al* 2007: 674-6, Balim 2009: 16-8). Students listened to lectures, took notes and responded to questions. This is confirmed by the low mean values obtained for the lecturers' use of active learning approaches – their means are generally less than the prior validation mean of 3.12, as reported by McCombs (2002: 102-3).

Regarding assessment, lecturers did not seem to understand how to assess in active learning approaches, in particular as far as big classes and group work are concerned. The lecturers also believed that they had too much work to evaluate students continuously. The use of problem-solving, higher order thinking and open-type questions was limited. A few of the observed lecturers encouraged the students, discussed their work individually, or provided continuous feedback.

Lecturers' attitudes played a major role in inhibiting the use of active learning approaches, in confirmation of earlier studies (Gruber & Boreen 2003: 17-8, Lea *et al* 2003: 321-34, Zan & Martino 2007: 157-68). For some of the lecturers in this study, active learning approaches were simply too much effort. Others believed that students preferred lectures to active participation. This is consistent with the findings of some authors (Steckol 2007: 24-5). Culture played a role in that many students came from authoritarian backgrounds and would not argue issues with lecturers. Petrosino *et al* (2007: 117-8) confirm that some students found it difficult to state their ideas in class. Active learning approaches need "empathic, supportive relationships which free students to discuss their feelings and experiences" so that students are "actively involved in learning through the given opportunities to predict, infer, generalise, and evaluate" (Duffy & Kirkley 2004: 44). Lecturers also mentioned the following: a lack of classroom space and large classes prevented group work (also identified as a problem by McKeatchie & Svinicki 2005: 7-9); a lack of time to actively involve students (also found by Burns & Myhill 2004: 41-5); a large amount of content to be covered; rigidity of the timetable, and a lack of both resources and administrative support.

This study clearly revealed lecturers' conflicting views regarding active learning approaches. Although they expressed positive beliefs about active learning, they simultaneously believed in good lectures and classes in which students were quiet and learnt mathematics through repeated practice. This is associated with lecturers' lack of efficient training in active learning approaches. Such approaches demand lecturers to be experts in their fields and in effective pedagogical practices (Derebssa 2006: 136, Stead 2005: 124-6, Zan & Martino 2007: 160-2).

Many lecturers complained that they were poorly trained and received little support for active learning. Weimer (2002: 162-74) pointed out the importance of training and continuous support on active learning/student-centred approaches in addition to resources to help them succeed. Managers should supervise the effectiveness of the teaching approaches employed by lecturers and give them feedback. The lecturers should also be supported to evaluate the success of their educational programmes. The mathematics departments in this study had no such support and the universities did not have reward systems for lecturers who effectively implemented active learning approaches. For the effective implementation of active learning, managers need to recognise its advantages for lifelong learning and provide the support needed (Weimer 2002: 174). This includes providing relevant resources. Feden & Vogel (2003: 47) state that learning materials should contain numerous exercises and examples, and allow students to work at their own pace, using their own methods. Classrooms should be well equipped with movable furniture to enable students to move around the classroom (Arias & Walker 2004: 311-29).

5. Conclusion

This study is limited by its focus on four universities in one area only (Oromia) and by its relatively small sample (84 lecturers). Generalisations and conclusions regarding the implementation of active learning approaches in mathematics university classrooms in Ethiopia were thus made with caution. However, the mixed methods design of the study contributed significantly to the quality of the findings and discovered discrepancies between professed views/beliefs and actual classroom practices.

As in many other countries, Ethiopian government policies stipulate the implementation of active learning/student-centred approaches in education. It can be concluded that policymakers and practitioners are at variance in the education system of the universities involved in this project. Observation showed poor implementation of active learning approaches. This negatively influenced the quality of the teaching-learning processes in the mathematics classrooms.

To close the divide between policymakers and practitioners, the former need to effectively train and support practitioners to develop

a better understanding of effective teaching. Practitioners need to be involved in decision-making. Rather than mandating change, practitioners need to be charged with finding solutions to obstacles they experience such as classroom conditions; time issues; the rigidity of timetables; the amount of content to be covered; a high-stakes examination system that tends to steer lecturers towards lecturing and students towards memorising subject content, and traditional cultural values that prevent students from questioning and arguing with lecturers. Administration can influence the motivation to implement better teaching methods in various ways, for example by continuous discussions and workshops on issues that confront lecturers as well as a reward system for improved teaching. To this end, it may be necessary to periodically solicit student feedback. This creates organisations that encourage reform.

Improved teaching in mathematics and in all other subjects in any country can prepare students for the world of work and for lifelong learning. Transformed mathematics teaching, among others, may contribute to economic growth and poverty reduction through the critically thinking, autonomous and creative learners the universities deliver.

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