

Examining practices and challenges of authentic learning in Mathematics lessons in upper primary schools

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Abstract

The study aimed at examining the practice of employing authentic instruction and identifying predictors in upper primary mathematics lessons in Bahir Dar Special Administrative Zone, Amhara National Regional State, Ethiopia. The study employed a mixed-methods exploratory sequential design. Data were collected through observation, interviews, and questionnaires from upper primary school mathematics teachers. The authentic learning questionnaire was pilot tested, and the internal consistency was found to be .766. Qualitative data from interviews and observations were analyzed using content analysis while quantitative data from observations were analyzed using a one-sample t-test; on the other hand, quantitative data from questionnaires were analyzed using a one-sample t-test and hierarchical multiple regression. The results revealed that there was lack of effort to practice authentic instruction; the instruction did not situate learning in a real-life setting. The dimension level analyses showed that all ten dimensions of the authentic instructional model were poorly practiced. The findings also revealed that among several challenges, four factors appeared to be significant predictors: lack of understanding and skills in authentic learning, less suitability of mathematics curriculum, inflexible and short schedule and period, and large class size. The researchers recommended that responsible government bodies and teacher training institutions exert greater effort to change the situation. Training should be given for teachers to improve their understanding and skills, and the curriculum should be suited for authentic learning.

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Introduction

Many modern instructional assumptions focus on authentic learning that helps learners put together the required attitudes, knowledge, and skills; organize individual skills that incorporate difficult tasks that can be performed with sustained investigation; and transfer their in-school learning to real-world or work situations (Rule, 2006). According to Trivedi et al.

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(2017) and Christmas (2014), some educationists exerted effort and called for paradigm change from the conventional method to authentic pedagogy that supports real-life learning. Authentic learning contextualizes learning tasks in the context of real-world milieus and, in doing so, provides opportunities for learning by allowing students to experience the same problem-solving challenges in the curriculum as they do in their daily endeavors (Herrington et al., 2014). Authentic learning requires employing social and cognitive tactics, including investigating, collaborating, and expressing opinions; associating learning context requires participative and active students and teachers who use various approaches (Roelofs & Terwel, 1999).

Authentic learning demands students to engage in complex problem-solving processes in groups over an extended period of time, fostering learners' cognitive development. Authentic learning improves student achievement (Newmann et al., 2007); helps learners be motivated and persist in their task (Lombardi, 2007; Sawyer, 2006); and stimulates their intrinsic motivation (Sukumaran, 2012). It helps engage students in topics that have real-world, personal, or social relevance (Herrington & Oliver, 2000; Preus, 2013). Authentic learning also raises the application of learning by students and inspires them to develop applicable competencies and make use of what they learned for various aspects of their lives (Sawyer, 2006).

This study focused on mathematics. Mathematics is a relevant subject by itself, although it can be applied to other subjects. Because the quality of mathematics and science education (MSE) at the basic level is a key to developing human resources that can contribute to scientific and technological development, many African countries have been exerting greater effort to advance the quality of MSE at the primary and secondary levels (Mataka et al., 2014). However, a number of African countries are faced with challenges in MSE, one of which is students' poor achievement in national examinations (Matachi & Kosaka, 2017).

The Curriculum Framework of FDRE emphasized that mathematics is a useful subject matter whereby students need to actively acquire knowledge through doing and problem solving pertinent to their day-to-day lives (MoE of FDRE, 2009). It is also underscored that general education should focus on science and mathematics with content that emphasizes research and relevant knowledge (MoE of FDRE, 2002). Mulugeta (2023) emphasized that mathematics is one of the core subjects that play indispensable role in national development. As indicated in the different learning assessments and regional examinations, students' mathematics achievement is poor as compared to other subjects and the national policy standard, i.e., 50% (MoE of FDRE, 2010; MoE of FDRE, 2015). Students' lower scores have been mostly evident in mathematics and mathematics-related subjects compared to other school subjects (Dawit et al., 2016). Mathematics is considered as one of the most challenging subjects that requires high level of cognitive engagement, perseverance, great expenditure of effort to master it and competence Yalew (2005).

Realistic Mathematics Education (RME) claims that mathematics is essential to be in close contact with learner-oriented cases taking place in daily life (Karaka & Ozkaya, 2017).

Authentic learning is closely related to RME. A realistic approach is an approach that uses realistic problems as the starting point of mathematics learning based on the idea that mathematics is a human activity and that it must be linked significantly to the context of the student's everyday life as a source of development and as an application area (Karaka & Ozkaya, 2017; Wahyudi et al., 2017). One of the tenets of realistic mathematics education is its applicability by familiarizing students with mathematical approaches to everyday settings, and mathematical tasks should be contextualized with mathematical ideas by connecting them to real-world situations (Cobb et al., 2008). One of the problems characterizing the Ethiopian education system has been lack of relevance and decline in quality and standard (MoE of FDRE, 2002). Hence, it is underscored that students should become active participants in their own learning through exploring, observing, experimenting, and practicing rather than simply being passive receivers of knowledge and the content should be related to everyday life so that all students appreciate the relevance of their education (MoE of FDRE, 2009).

Many practices of conventional schooling consider knowing and thinking to go in the minds of individual secluded from the intricacies of the outside world (Herrington & Herrington, 2008). The conventional methods of teaching (lecturing) have been blamed for students' failure to transfer the learned knowledge into real-life situations; most students join the world of work hardly able to transfer learning to real-life situations (Bransford et al., 1990; Christmas, 2014). Herrington et al. (2010) indicated that numerous tasks undertaken by students are unconnected with the kinds performed by learners in their everyday work. Sukumaran (2012) believed that the conventional method of teaching results in the collapse of endeavors in passing on knowledge and developing skills to prove the qualities and competency required for a learner or graduate; this is mainly because education is not being practiced with purpose and values. According to Herrington and Herrington (2006), in conventional approaches, there are few opportunities for reflection, collaboration, and articulation; the majority of school and university learning continues to involve competitive relations. Hence, if the instructional problem is not clearly examined and measures are not taken, the problem perpetuates. However, there was no research that examined the practice of authentic learning in the area. This research was conducted to fill this gap.

Statement of the Problem

One of the problems in the educational systems of different countries is the detachment of learning from real-life situations. Schoolwork is often quite distinct from authentic activity or the ordinary practices of society; many of the activities undertaken by students are unconnected (not related) to the kind performed by learners in their everyday work (Herrington et al., 2010). King et al. (2009) noted that subject matter may be covered but not examined in ways that produce deep conceptual understanding. Reality and real-world practice are scarcely ever used as alternative views in learning settings (Herrington et al., 2003).

The major challenge for educators is connecting learner needs and pedagogy in order to build more participative, employable, and learner-centered environments that advocate 21st

century skills and promote self-governing learning (Parker et al., 2013). Bransford et al., (1990) similarly argue that one of the key challenges for educators is to teach relevant content in a way that facilitates thinking. Many students face problems applying the knowledge and skills attained through formal learning to everyday contexts (Lave & Wenger, 1991). In international instances, authentic learning was not practiced by most students and schools in the USA (Newmann et al., 2007), Germany (Fremerey & Bogner, 2015), the Netherlands (Roelofs & Terwel, 1999), and Turkey (Acat et al., 2010). In de-contextualized formal learning experiences, the acquisition of facts is secluded from the milieus in which they derive meaning (Cognition and Technology Group at Vanderbilt, 1993). Greatly de-contextualized and simplified knowledge leads to inflexible, incomplete (imperfect), and naive (immature) ideas (Spiro et al., 1991).

There were different studies that depicted the prevalence of conventional methods of instruction in Ethiopia. Conventional instructional methods (lectures) have the problem of being secluded, unrelated, and marginalized from mainstream real-world activity and performance (Herrington, 1997). To begin with, a study conducted at Jimma University depicted that lecturing is still the dominant teaching method teachers often use in mathematics classes (Kassahun, 2013). According to Solomon and Endalew (2015), the practices of constructivist teaching approaches in the secondary schools of Kamashi Zone of Benishangul Gumuz National Regional State were low. As indicated in the theoretical framework section, authentic learning is based on the assumptions of constructivism, mainly social constructivism. If a constructivist approach to teaching is not implemented, it is hardly possible to implement authentic instruction. Asrat (2017) found that the application of constructivism in primary schools is low.

The preceding paragraph expounds that there were some instances that revealed the prevalence of conventional methods of instruction at the national level in general and at the regional level in particular. These instances do not represent the national or the regional prevalence of conventional methods of instruction. In addition, the above studies focused on the status of the practice of constructivism and the challenges that affect it; they were not directly related to authentic learning. To clearly understand the situation, the researchers needed to systematically collect data and analyze it by taking a representative sample. Because of its accessibility and constraints on different resources, the current researchers focused on the Amhara National Regional State, mainly Bahir Dar Special Administrative Zone. The immediate factor that motivated the researchers was the passive instructional approach that they found out in the study area in 2017/18 academic year in Grades 7 and 8. This instance did not represent the Zone. Hence, representative data need to be collected and analyzed. There is a paucity of research conducted to assess the practice of authentic learning approaches in mathematics subjects in Ethiopia in general and Amhara Regional State in particular. Hence, the current researchers were set to conduct research that could involve a representative sample of schools and students. The researchers were also interested in identifying the possible challenges that may inhibit the practice of authentic learning in the study area. Based on the

above arguments, the following research questions were raised: (1) what is the status of the practice of authentic learning? (2) What are the challenges that may inhibit practicing authentic learning? (3) Which of the factors are significant predictors of the practice of authentic instruction in upper primary school mathematics?

Theoretical Framework

The idea of authentic learning was drawn from the theory of social constructivism (Lasry, 2006; Ozur & Duman, 2019). Under the umbrella of social constructivism, authentic learning has originated largely from the model of situated learning (Herrington et al., 2010) and other instructional approaches, mainly cognitive apprenticeships and anchored instruction (Herrington & Herrington, 2006; Herrington et al., 2010). There are different frameworks for authentic learning. The current researchers employed the authentic instructional model, which was developed by Herrington and Oliver (2000) and has nine dimensions, which were indicated in Herrington et al. (2010) and Herrington et al. (2014). This is because this framework is more holistic, comprehensive, and more applicable in classroom situations than other contexts. The nine dimensions of this framework are authentic context, authentic activity, access to expert thinking and modeling, multiple perspectives and roles, collaborative construction of knowledge, reflection, articulation, coaching and scaffolding, and authentic assessment. Authentic learning was founded on a constructivist viewpoint in which students build understandings of new knowledge and practices by integrating their earlier experience (Roach et al., 2018; Bhagat & Huang, 2018). Prior knowledge is one of the most powerful predictors of student learning because new information is processed through the lens of what one already knows, believes, and can do (Ambrose & Lovett, 2014). Hence, the current researchers added one dimension (application of prior knowledge) drawing on the instrument developed by Alt (2014). The researchers adapted the characteristics to develop the instrument to collect data on the practice of authentic learning.

Methods

Design

The design of the present research was mixed-methods, mainly exploratory-sequential. The researchers employed this design because they were interested in exploring the possible factors that may affect the practice of authentic learning by first conducting interviews and then measuring these possible factors. This type of mixed-methods research begins with collecting and analyzing qualitative data and then describing the data quantitatively. The exploratory sequential mixed methods design involves first gathering qualitative data to explore a phenomenon, followed by collecting quantitative data to explain relationships found in the qualitative data (Creswell, 2012). The primary objective of this study was to examine the practice of authentic learning and then identify the challenges that may hinder its practice. The researchers first collected and analyzed qualitative data about the practice of authentic teaching

and the challenges that might inhibit the practice of authentic instruction. Then, they employed quantitative data collection and analysis methods to examine the practice and its challenges and explain their relationship.

Sampling

The participants of the study were upper primary school mathematics teachers in Bahir Dar city administrative zone. The upper primary schools in Ethiopia are the bridge to secondary education; that means, these grade levels are transitions from primary schools to secondary schools. For psychological reasons, the middle school years are the time when many students develop negative and incapacitating emotional responses to mathematics (Grootenboer & Marshman, 2016). The total number of teachers teaching mathematics was 68. Cluster sampling technique was used to take sample from the 68-teacher population. Seventeen schools out of 31 were chosen using simple random sampling. Then, at least one teacher from each grade level was chosen. In some large schools, where more than one teacher was available for each grade level, a teacher who had a large number of sections was selected; if the number of sections was equal, the participant was selected using simple random sampling. Hence, a total of 46 teachers were selected for the study. At least two participants from randomly selected eight schools were randomly selected for interviews and observations to collect qualitative data. Hence, a total of 16 mathematics teachers were observed at least twice while conducting lessons. Their instructional approach was evaluated against the guidelines of authentic learning.

Data Gathering

Interview

The researchers interviewed 16 grade 7 and 8 mathematics teachers to get pertinent information on the implementation and/or challenges of the instructional approach/ authentic learning. The researchers selected eight schools using simple random sampling, and on average, two mathematics teachers were interviewed. An unstructured interview guide was used to conduct the interview. The interviews were conducted flexibly by a data collector, probing possible factors. The interviews were arranged and conducted in the schools' compounds. With the consent of the participants, tape recordings were made. The interviews with each participant lasted 45 minutes on average.

Observation

In order to collect relevant data on the application of authentic learning, observation of the practice was conducted using an observation guide. Authentic instruction guidelines were used to conduct the observation. The levels of the scales were five: (5) *extremely observed*; (4) *adequately observed*; (3) *moderately observed*; (2) *slightly observed*; (1) *not at all observed*. The observations were conducted while mathematics teachers were teaching mathematics in grades seven and eight. The researchers conducted observations in eight schools. At least two

mathematics teachers were selected for observation from each school. Hence, sixteen mathematics teachers were selected, and they were observed at least twice. Finally, a total of 36 instructional lessons were observed. The observations were conducted by two data collectors who were given a half-day short training for the job. Based on the observation checklist, the data collectors qualified the ratings in words to help easily understand the meaning.

Questionnaires

The researchers used the guidelines of Herrington and Oliver (2000) model of authentic learning in preparing the questionnaire to evaluate the practice of authentic instruction then added items from "Application of prior knowledge." This questionnaire was original on its own. After preparing the items and adapting them, the researchers gave the questionnaire to experts for their judgment on content validity, and some revisions were made based on their evaluation. Accordingly, one item was moved from one dimension to another. In addition, two characteristics of coaching and scaffolding were merged.

The relevance of the items was judged using the scales "very relevant" (4), "relevant that needs minor revision" (3), "item needs some revision" (2), and "not relevant" (1). The clarity of the items was judged using the scales "very clear" (4), "clear but needs minor revision" (3), "item needs some revision" (2), and "not clear" (1). Based on the Lawshe (1975) method of judging the relevance of the items, the item level and scale level content validity were found acceptable. Regarding the clarity of the main instrument, except for one item (item 2.2), which yielded an I-CVI of 0.8; all the items have indices of 0.9 and above. The item, which had an index of less than 0.9, was subjected to revision for clarity. After revision, the item was accepted and included in the instrument. The scale-level index for clarity was 0.98. The questionnaire had a total of 46 items. The items were closed-ended, and respondents replied to them by using a Likert scale ranging from "always" (5) to "never" (1). The authentic instructional approach questionnaire was pilot tested, and it had a 0.766 alpha coefficient. The sub-scales yielded moderate to high reliability indices.

Another questionnaire was used to investigate the factors that may affect the practice of authentic learning in mathematics. The items were prepared after the researchers identified the possible factors using a qualitative data collection procedure that was interview. After the researchers identified the possible factors using the qualitative method, they prepared a questionnaire which was subjected to experts' judgement. The items were on a five-level Likert scale, ranging from "most serious problem" (5) to "not at all a problem" (1).

Data Analysis

To examine the practice of authentic learning, the researchers used qualitative and quantitative data analyses procedures. Qualitative data that were collected using interviews and observation were analyzed using content analysis. The quantitative observation data were analyzed using descriptive statistics (mean) and a one sample t-test. The questionnaire data were analyzed using a one-sample t-test. To investigate the factors that may hinder the practice

of authentic learning, the researchers employed qualitative and quantitative data analyses. First, the researchers collected data using interviews and analyzed the data using content analysis. This helped the researchers identify the possible factors that may affect the practice of authentic instruction and prepare a questionnaire to measure these possible factors. Then, the researchers collected data using this questionnaire and analyzed the data using a t-test. To identify the significant predictors of the practice of authentic learning, the researcher employed hierarchical multiple regression analyses.

Before conducting quantitative data analyses both observation and questionnaire data were entered into SPSS-version 23 for windows. The researchers then conducted exploratory data analysis (EDA) to check whether the data were free from errors, The researchers verified that the data were error-free by proofreading both the original and the SPSS-entered data. The researchers also checked the minimum and maximum values, means, and standard deviations.

Checking Assumptions

The questionnaire data were checked for assumptions. In a missing value analysis for authentic instruction, it was found that there were four missing values in the variables, and they were not above 5%. Hence, the values were replaced by series means. The Little's MCAR test did not turn significant ($\chi^2 = 305.082$, $DF = 315$, $Sig. = 0.645$) suggesting missing completely at random. There was no any case that could be taken as a univariate outlier in all the items of authentic learning variables (items). was saved to detect multivariate outliers. Examination of Mahalanobis distances showed no multivariate outlier either in authentic learning variables or in the possible challenges. Skewness and kurtosis values did not suggest deviation from normality in the total score or in the sub-scales of the instrument. The researchers also checked the bivariate correlations and they confirmed that there was no problem with multicollinearity. Scatterplots were sketched with the criterion variable (TAL-Grand Total) and each of the predictor variables. Because the scatter plots were nearly oval, elliptical, or rectangular in shape, there was no problem of linearity.

For the possible challenges, two missing values in the variables were identified; the percent of missing values for each variable was not greater than 5%. The Little's MCAR test: Chi-Square= 47.617, $DF = 50$, $Sig. = 0.570$, was not significant, indicating that MCAR may be inferred. The researchers substituted the missing values using the series means. No case that was identified that could be taken as a univariate outlier in all the items of the factors. Analysis of Mahalanobis distances showed no multivariate outlier in the challenges that may affect authentic instruction. Skewness and kurtosis statistics showed little deviation from normality. Multicollinearity was not a problem because the bivariate correlations between the predictors were not high. Because the scatter plots were nearly oval, elliptical, or rectangular in shape, there was no problem of linearity.

Ethical Considerations

The present researchers tried to consider two major ethical issues: the protection of research participants and the avoidance of research misconduct. The researchers respected the autonomy of individuals by respecting personal dignity and valuing the honor and will of participants and their perspectives and ideas. This was achieved by obtaining informed consent from the participants. For example, consent to be a participant with the right to withdraw at any time from participation and consent to use a tape-recorder in interviews, etc. were obtained. Protecting participants from psychological harm and maintaining their privacy, confidentiality, and anonymity were observed as well. In addition, the researchers adhered to the research principles and avoided research misconduct.

Results

Qualitative Result on the Practice of Authentic Instruction

Interview results showed that majority of teachers do not employ authentic instruction. They rather dominantly use lecture (conventional) method of instruction. They reflected that they were not employing authentic learning as a method of instruction because of lack of understanding and skill. Even, some teachers reflected that they do not know authentic learning let alone practicing it. The textbooks are not largely suitable for applying authentic learning. Teachers always focus on the textbook tasks rather than relating the mathematical content to real-life situations. It was also found out that, the instructional activities were dominated by teachers though the participation of the students varies from lesson to lesson, The participant teachers stated that, they often revise the previous lesson, introduce the day's lesson, give explanations, and summarize it; they sometimes ask questions, or give class-work.

Analysis of observational data seem to confirm the results of interviews. Descriptions of syntheses of observational ratings on each of the assessed dimensions of authentic learning are presented on Table 1.

Table 1

Observation Data on the Authenticity of Mathematics Instruction

Dimension	Analysis Result
Providing authentic contexts	There was limited opportunity to provide real-world context that reflect the situation; the instructional process did not situate (connect) mathematics learning and knowledge with the real-life settings.
Providing authentic activities	Activities or tasks were not related to real-life; limited attempts were made to provide tasks that were related to real-life; the relevance of activities to the real world was minimal. Teachers did not engage students in sustained investigation of single, ill- defined, and difficult problems.

Dimension	Analysis Result
Access to expert performances and modeling	The instructional process did not provide access to expert performances or the modeling of processes. It did not enable learners to model processes or engage in expert thinking.
Providing multiple roles and perspectives	The instructional procedure did not provide multiple roles and perspectives. Similar, simple, and routine tasks were given, usually from the text, which did not enable students to see different perspectives and multiple roles.
Collaborative construction of knowledge	There was little endeavor made to support the collaborative construction of knowledge. Activities were not given in pairs or groups; individual activities dominate.
Promoting reflection	There was very little opportunity given for students to reflect. Students did not know the objectives of the lesson, and they did not contemplate checking the attainment of the objectives.
Promoting articulation	Students were not given the opportunity to organize ideas and express their ideas in front of other students and the teachers.
Providing coaching and scaffolding	There was little attempt to provide coaching and scaffolding; students had no collaborative groups to help each other. Teachers did not support students as per their need.
Application of prior knowledge	The application of prior knowledge was very limited. Teachers rarely help students construct knowledge and understand from prior knowledge in mathematics and other subjects.
Providing authentic assessment	There was no reliability of context for learning and no opportunity was available for students to be effective performers with acquired knowledge and to craft polished performances or products. There are no complex and well-structured challenges given by teachers. The assessments are not seamlessly integrated with the activity. Teachers do not set multiple indicators of learning that are valid and reliable with appropriate criteria for scoring varied products.

Quantitative Result

In order to get pertinent information on the practice of authentic learning, observation was conducted. Since two observers conducted the observation, it was commendable to conduct item-rater reliability using intra-class correlation (ICC). ICC performs a reliability analysis for two or usually more raters who have rated the same somewhat subjective behavior. The examination of the means in the Items Statistics table indicated that rater 1 rated authentic learning ($N = 36, M = 1.2953, SD = .15705$), which was lower than rater 2, which was ($N = 36, M = 1.3273, SD = .13452$). Hence, the researchers decided to use the average of the two ratings to get the final data to use in the study, given the two ratings had high reliability. In the ICC table (Table 2), the "average measures" indicated the reliability of the average scores between the two raters. The ICC was found to be 0.92, which was significant and very high. Therefore, the researcher conducted the analysis to examine the status of the application of authentic learning by averaging the two ratings. Results of the reliability analysis are presented in Table 2.

Table 2*Cronbach Alpha and Intra-class Correlation Coefficient (ICC)*

	ICC	95% Confidence Interval		F test with			
		Lower Bound	Upper Bound	True Value	df1	df2	Sig.
Single Measures	.920 ^a	.849	.958	24.035	35	35	.000
Average Measures	.958 ^c	.918	.979	24.035	35	35	.000

To examine the practice of authentic learning two one-sample t-test (one for observational data and another one for questionnaire data) of comparison of observed mean and expected mean was used. Results (Table 3) of observational data ($t = -70.72$, $df = 35$, $p = .000$) and questionnaire data ($t = -31.42$, $df = 45$, $p = .000$). showed that the status of the implementation of authentic learning was poor in general terms.

Table 3*One-sample t-test Practicing Authentic Instruction*

Data source	N	M (SD)	Expected Mean	Df	t	p
Observation	36	60.32 (10.38)	138	35	-70.72	.000
Questionnaire	46	89.92 (10.38)	138	45	-31.42	.000

Authentic learning dimension wise analysis of both observational and questionnaire data paint similar pictures. The t-tests conducted based on both observational and questionnaire data depicted that the observed mean of all ten dimensions was significantly lower than the expected mean suggesting the status of the implementation of each of the dimensions of authentic learning was low or nearly absent. While Table 4 presents dimension wise results of observational data Table 5 shows that of questionnaire data

Table 4*One-sample t-test Practice of Authentic Learning for each Sub-scale based on Observational Data*

Variables	N	M (SD)	Expected Mean	df	t	p
Authentic context	36	4.19 (.497)	12	35	-100.25	.000
Authentic activity	36	9.22 (1.61)	21	35	-43.77	.000
Access to Expert Performance & Modeling	36	4.64 (.65)	12	35	-67.91	.000
Multiple Perspectives & Roles	36	4.60(.83)	9	35	-31.96	.000
Collaborative Construction of Knowledge	36	4.47 (.72)	12	35	-63.03	.000
Providing Reflective opportunity	36	5.93 (1.13)	15	35	-47.95	.000
Providing opportunity for Articulation	36	3.69 (.99)	9	35	-31.10	.000

Variables	N	M (SD)	Expected Mean	df	t	p
Coaching & Scaffolding	36	4.38 (.82)	9	35	-33.73	.000
Application of Prior Knowledge	36	10.00 (.78)	18	35	-61.24	.000
Authentic assessment	36	9.19 (1.23)	21	35	-57.76	.000

Table 5

One-sample t-test on the Practice of Authentic Learning for each Sub-scale based on Questionnaire Data

Variables	N	M (SD)	Expected Mean	df	t	p
Authentic context	46	7.45 (1.97)	12	45	-15.68	.000
Authentic activity	46	13.26 (3.66)	21	45	-14.35	.000
Access to Expert Performance & Modeling	46	7.50 (2.03)	12	45	-15.03	.000
Multiple Perspectives & Roles	46	5.96(1.19)	9	45	-17.32	.000
Collaborative Construction of Knowledge	46	7.65 (2.25)	12	45	-13.09	.000
Providing Reflective opportunity	46	10.00 (2.29)	15	45	-14.81	.000
Providing opportunity for Articulation	46	5.91 (1.44)	9	45	-14.51	.000
Coaching & Scaffolding	46	6.02 (1.77)	9	45	-11.41	.000
Application of Prior Knowledge	46	12.70 (2.72)	18	45	-13.25	.000
Authentic assessment	46	13.47 (3.42)	21	45	-14.92	.000

There was a difference between the observational quantitative data and the questionnaire data. The mean of the observation data was 60.32, and the mean of the questionnaire data was 89.92. The observation data were obtained by observations conducted twice for each teacher while teaching; whereas the questionnaire data were obtained from teachers' perceptions based on their long teaching experience. Hence because of limited observations the observational mean might have underestimated or the questionnaire mean might have overestimated the actual practice,

Identifying the Challenges

To identify the factors (challenges), the researchers first systematically collected data on the possible factors using individual interviews. The data obtained through the interview were analyzed using content analysis. Eighteen possible variables were listed by the participants. These variables were mentioned either by many respondents, some respondents,

or one respondent. Among these variables, researchers identified ten that were listed by at least half of the respondents.

Then the researchers prepared a questionnaire on the possible predictors of the practice of authentic teaching. Using the questionnaire data, the researchers ranked the predictors based on their mean. The first-ranking predictor was lack of understanding and skill in authentic learning; the second-ranking predictor was large class size. The third-ranking predictor was poor English language competence of students; the fourth-ranked predictor was students' lack of subject background knowledge; while the last- ranking predictor was poor motivation of students for their learning. Table 6 presents the factors along with their ranks.

Table 6

Mean and Mean Rank of the Ten Possible Predictors

Predictor	Valid Cases	Mean of each Predictor	Rank of Mean for Predictors
Teachers' lack of understanding and skills in authentic Learning	46	4.12	1
Large class size	46	4.1	2
Poor English language competence of students	46	4	3
Students' lack of subject background knowledge	46	3.99	4
Influence of the way teachers are taught and trained	46	3.95	5
Lack of different necessary resources and materials	46	3.91	6
Less suitability mathematics curriculum	46	3.8	7
Inflexible and short schedule or period	46	3.66	8.5
Lack of confidence of students in mathematics	46	3.66	8.5
Poor motivation of students for their learning	46	3.61	10

The ten variables mentioned in Table 6 might predict the practice of authentic instruction. However, the significant predictors are not yet known. To identify the best predictors of the practice of authentic instruction, the researchers employed hierarchical multiple linear regression analysis. Each independent variable is assessed at its own point of entry in terms of the additional explanatory power it contributes to the equation (Ho, 2006). In hierarchical regression (also called sequential regression), the independent variables are entered into the equation in the order specified by the researcher based on theoretical grounds (Pallant, 2010; Tabachnick & Fidell, 2013). Variables or sets of variables are entered in steps (or blocks), with each independent variable being assessed in terms of what it adds to the prediction of the dependent variable after the previous variables have been controlled for (Pallant, 2010). In the present study the dependent variable was the practice of authentic instruction, which was designated by TALGrandTotal.

Before running the regression analysis, the researchers first identified factors that were significantly correlated with the practice of authentic learning by using bivariate correlation to identify predictors to be included in the regression. Table 7 indicates the bivariate correlations of seven possible predictors that were significantly correlated with the dependent variable.

Table 7*Correlation Matrix of the Dependent Variable with the Predictors*

Correlations		TAL Grand Total	Sig. (2-tailed)	N
LackUndSkT	Pearson r	-.50**	.000	46
InfTaughtTrainedT	Pearson r	-.20	.176	46
LackMaterT	Pearson r	-.26	.076	46
LessSuitCurrT	Pearson r	-.47**	.001	46
PoorMotT	Pearson r	-.39**	.008	46
InfScheduT	Pearson r	-.41**	.005	46
LackConfT	Pearson r	-.31*	.035	46
LargeClassSizeT	Pearson r	-.40**	.005	46
PoorEngCompT	Pearson r	-.29	.054	46
LowBackgroundKnT	Pearson r	-.38**	.010	46

Note.

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

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

TALGrandTotal: The total score of all the 46 items of authentic learning

LackUndSkT: Teachers' lack of understanding and skills in authentic learning

InfTaughtTrainedT: Influence of the way teachers are taught and trained

LackMaterT: Lack of different necessary resources and materials

LessSuitCurrT: Less suitability of mathematics curriculum

PoorMotT: Poor motivation of students for their learning

InfScheduT: Inflexible and short schedule or period

LackConfT: Lack of confidence of students in mathematics

LargeClassSizeT: Large class size

PoorEngCompT: Poor English language competence of students

LowBackgroundKnT: Students' lack of subject background knowledge

Variables which were significantly correlated with the dependent variable were teachers' lack of understanding and skills in authentic learning, less suitability of curricula in mathematics to apply authentic learning, poor motivation of students for their learning, inflexible and short schedule or period, lack of confidence of students in mathematics, large class sizes, and students' lack of subject background knowledge. The need to examine the bivariate correlation was to screen the predictors that might have the power to predict the criterion variable (practicing authentic instruction). Variables that have no significant bivariate correlation cannot predict the dependent variable, and were therefore excluded from the equation.

For regression analysis, considering the sample size was an important requirement. The numbers of participants in the study were 46. Different authors use different numbers of cases

as a requirement in regression analysis. It is suggested that $n > 20 + 4m$ be the minimum sample size in regression analysis (Tabachnick & Fidell, 2013). In this suggestion, n stands for the number of cases required for a given number of predictors, and m stands for the number of predictors. Using this formula, the researchers took five predictors based on the strength of their correlations with the criterion variable (practicing authentic instruction). Even though their correlations were significant, two possible predictors, namely the lack of confidence of students in mathematics and their lack of subject background knowledge, were not entered into the regression analysis. This was because they had the lowest magnitude of correlation with the dependent variable. Moreover, it was found to have high multicollinearity with the other predictor variables, poor motivation of students for their learning with its low eigen value (.005) and high condition indexes (36.13) was dropped from the hierarchical regression test. Hence, the remaining four predictors were entered in the regression analysis.

To run the hierarchical regression, the researchers logically ordered the independent variables. Accordingly, a four-stage hierarchical regression was conducted. At the first stage, teachers' lack of understanding and skill in authentic learning was entered in the regression. Understanding and skill are very essential factors in the design of authentic learning. Even if other variables are fulfilled, if there is no understanding and skill, it is difficult to practice authentic learning. At stage two, the variable less suitability of mathematics curriculum to apply authentic learning was entered. The curriculum either facilitates if it is prepared to enhance authentic learning or inhibits if it is not suitable to practice authentic learning. The curriculum usually dictates the instructional approaches teachers may employ while teaching students. At the third stage, an inflexible and short schedule or period was added and entered in the regression. If it is not flexible and longer in duration, teachers may not begin authentic learning because authentic learning needs reasonable time for student engagement and a flexible schedule. A large class size was entered at the fourth stage, and poor motivation among students for their learning was entered at the fifth stage.

As indicated in Table 8, the hierarchical multiple regression revealed that at Stage 1, teachers' lack of understanding and skills in authentic learning contributed significantly to the regression model: $F(1, 44) = 14.619$, $p < .001$, and the adjusted R^2 was .232, suggesting that 23.2% of the variance in the design of authentic learning was contributed for by this variable. Introducing the second independent variable, less suitability mathematics curriculum to apply authentic learning, raised the coefficient of determination by an additional 12.8% which was a significant change $F(1, 43) = 8.879$, $p < 0.05$. Adding the third predictor, inflexible and short schedule or period, to the regression model explained an additional 9.3% of the variation in practicing authentic instruction, which was a significant raise in R^2 ($F(1, 42) = 7.364$, $p < .05$). Inclusion of the last predictor (large class size) in the model, explained an additional 7.7% of the variation in practicing authentic instruction, and this change in R^2 was significant, $F(1, 41) = 7.001$; $p < .05$. In this model the adjusted R^2 was .504, meaning that 50.4% of the variance in the practice of authentic instruction can be explained by all the predictors (teachers' lack of understanding and skills in authentic learning, less suitability of mathematics curriculum,

inflexible and short schedules or periods, and a large class size) in the model. In this hierarchical regression analysis, the most important predictor of the practice of designing authentic learning was teachers' lack of understanding and skills in authentic instruction, which uniquely explained 24.9% of the variation in the practice of authentic instruction, followed by less suitability of mathematics curriculum to apply authentic learning, which uniquely explained 12.8%. It is essential to note that the beta coefficients of the predictors were negative, depicting inverse relations.

Table 8*Summary of Hierarchical Regression Analysis for Variables Predicting the Practice of Authentic Instruction*

Variable	B	St. Error	β	t	Sig.	R	R ²	Adjusted R ²	ΔR^2	ΔF	df1	df2	Sig. F Δ
1 (Constant)	126.41	9.64		13.12	.000	.499 ^a	.249	.232	.249	14.619	1	44	.000
LackUndSkT	-2.96	.77	-.50	-3.82	.000								
2 (Constant)	154.41	12.93		11.95	.000	.615 ^b	.378	.349	.128	8.879	1	43	.005
LackUndSkT	-2.41	.74	-.41	-3.28	.002								
LessSuitCurrT	-2.28	.77	-.37	-2.98	.005								
(Constant)	167.67	13.02		12.88	.000	.686 ^c	.471	.433	.093	7.364	1	42	.010
3 LackUndSkT	-2.52	.69	-.43	-3.66	.001								
LessSuitCurrT	-1.70	.75	-.27	-2.27	.029								
InfScheduT	-2.86	1.05	-.32	-2.71	.010								
4 (Constant)	185.39	13.90		13.34	.000	.740 ^d	.548	.504	.077	7.001	1	41	.011
LackUndSkT	-2.20	.65	-.37	-3.36	.002								
LessSuitCurrT	-1.79	.70	-.29	-2.55	.015								
InfScheduT	-2.45	.10	-.27	-2.46	.018								
LargeClassSizeT	-2.84	1.07	-.29	-2.65	.011								
5 (Constant)	185.70	13.99		13.28	.000	.744 ^e	.553	.498	.006	.495	1	40	.486
LackUndSkT	-2.09	.67	-.35	-3.11	.003								
LessSuitCurrT	-1.75	.71	-.28	-2.47	.018								
InfScheduT	-2.19	1.072	-.24	-2.04	.048								
LargeClassSizeT	-2.75	1.086	-.28	-2.54	.015								
PoorMotT	-.67	.947	-.08	-.70	.486								

Note.

LackUndSkT: Teachers' lack of understanding and skills in authentic learning

LessSuitCurrT: Less suitability of mathematics curriculum

InfScheduT: Inflexible and short schedule or period

LargeClassSizeT: Large class size

Discussion

Qualitative results revealed that authentic instruction was nearly absent in the study area. Mathematics teachers employed instructional methods that were completely alienated from real-life milieus or contexts. The instructional process did not situate learning in real-life settings (milieus); activities, tasks, or problems that were given by teachers were not related to real-life; the instructional process did not provide access to expert performances and the modeling of processes and multiple roles and perspectives were non-existent. Mathematics teachers reported that there was little endeavor to support the collaborative construction of knowledge, to encourage reflection and articulation, and to provide coaching and scaffolding. Moreover, application of prior knowledge in the instructional process and authentic assessment were not observed. The output for the t-test of the practice of authentic learning observation and questionnaire showed that the mean of the average of the total sample for the whole scale was significantly lower than the expected mean at a $p = .000$. The dimensional level analysis of the one-sample t-test results of the observation and questionnaire data also showed that the practice in all ten dimensions was significantly lower than the expected mean, at $p = .000$. The score of none of the ten dimensions was significantly above the expected mean, implying very low or little practice of authentic learning.

Learning experiences in schools are often quite distinct from authentic activities or the ordinary practices of society (Herrington et al., 2003; Herrington et al., 2010). Roelofs and Terwel (1999) found that in the Netherlands, none of the schools scored highly on the characteristics of authentic pedagogy; in Germany, as indicated by Fremerey and Bogner (2015), authentic instructional approaches were not common. King et al. (2009) and Newmann et al. (2007) indicated that for most students in most schools in the USA, the usual work demanded of students is hardly ever meaningful, noteworthy, or worthwhile. The approach taken by many teachers was simply a result of the way they were taught; they were repeating a tradition of formal teaching that ignored more recent theory and research into the way people learn (Herrington & Herrington, 2006). Learning contexts in Turkey were not real-life-related; they did not sufficiently recount students' experiences (Acat et al., 2010). Herrington and Herrington (2008) argued that knowing and thinking, in the conventional view, are assumed to go on in individual minds secluded from the intricacies of the outside world. In traditional pedagogy, students' abilities to think and reason and deep learning are not being developed (Cognition and Technology Group at Vanderbilt, 1993).

To investigate the possible predictors of the practice of authentic instruction, an interview was used. The interview helped identify eighteen possible factors. However, the factors that were common to more than half of the interviewees were ten. These ten possible predictors were ordered based on the mean rank of the factors as follows: The first-ranking predictor was lack of understanding and skill in authentic instruction, the second- large class size the third poor English language competence of students, the fourth students' lack of mathematics background knowledge, the fifth influence of the way teachers are taught and

trained, the sixth lack of different necessary resources and materials, the seventh less suitability of mathematics to apply authentic learning followed by two predictors, an inflexible and short schedule or period and a lack of confidence in students in mathematics. The last ranking predictor was poor motivation of students for their learning.

Seven factors were significantly correlated with the dependent variable, and then, considering the sample size, four possible predictors were considered to be included in the regression analysis based on the magnitude of the bivariate correlation, examination of multicollinearity. A four-stage hierarchical regression was conducted by logically ordering the independent variables. At Stage 1, teachers' lack of understanding and skills in authentic learning contributed significantly to the regression model, contributing 23.2%. The addition of the second predictor (less suitability of mathematics curriculum) in stage 2 raised the adjusted R^2 to 0.349, meaning 34.9% of the variance was contributed by the two variables in the model. As pointed out by Mulugeta (2023), in designing curriculum, emphasis needs to be given to the knowledge, skills, and dispositions relevant to the world of the profession or job. Mulugeta (2023) further indicated that education policymakers and curriculum developers in Ethiopia need to critically deliberate and consider the relevance of the curricula. Adding the third predictor variable (inflexible and short schedule or period), to the regression model, the adjusted R^2 was 0.433, suggesting that 43.3% of the variance in practicing authentic learning is jointly explained by those three variables in the model. When the fourth predictor variable (large class size in terms), was added to the model, the change in R^2 was significant. The adjusted R^2 was 0.504, meaning that 50.4% of the variance was accounted for by all the predictors in the model. Corroborating the results of the present study large class size is found to be one of the hitches in the educational sector that developing countries have been facing with (Grace et al., 2016). In Ethiopian context too class size is one of the most repeatedly stated challenges in using effective teaching methods (Dawit, 2023).

. The most important predictor of the practice of authentic instruction in the present study was teachers' lack of understanding and skills in authentic learning, which uniquely explained 23.2% of the variation, followed by a less suitability mathematics curriculum in, which uniquely explained 12.8% of the authentic learning practice.

Conclusion and Implications

The findings obtained from both qualitative and quantitative data revealed that authentic instruction was not applied in the upper primary schools in mathematics subjects in the study area. There was no implementation of authentic instruction. The researchers also attempted to identify the factors that might affect the implementation of authentic instruction using interviews and hierarchical multiple regression. Based on the interview, ten factors were identified. The output of the hierarchical regression analysis showed that four factors significantly predicted the application of authentic instruction. These four factors were: lack of understanding and skill in authentic learning; a less suitable curriculum of mathematics to apply

authentic learning; an inflexible and short schedule and period; and a large class size. So, what do these findings imply? In order to fully implement an authentic education framework, sound intervention attention of many stakeholders, including the government and major educational organizations, is required.

Hence, to enhance the practice of authentic instruction and mitigate the possible challenges, concerned bodies like the Ministry of Education, Education Bureau, Zonal Education Directorates, and teacher training institutions must exert greater effort in developing curriculum suited to authentic instruction. In addition, as the major stakeholders, mathematics teachers need to familiarize themselves with contemporary learning approaches, especially authentic instruction. Pre-service and in-service teacher training programs must include authentic instructional approaches. The schedules and period allotments must be convenient to implement authentic instruction. The number of students in one class should be minimized. More comprehensive researches that aim to examine the practice of authentic instruction and to identify the possible challenges that hinder its implementation shall be conducted in a wider context.

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