Research article

Examining teachers’ self-regulation practice in secondary school science teaching: the case of South Gondar Zone, Ethiopia

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ABSTRACT

The problem of quality education is a burning worldwide issue nowadays. Teachers’ teaching quality and effectiveness is one of the major contributing factors for quality education. Self-regulated teaching is becoming the new innovative strategy for quality teaching. Hence, the purpose of this study was to investigate the practice of self-regulated science teaching in the secondary schools of South Gondar Zone of Ethiopia. Nine (9) secondary schools were selected randomly. After selecting the schools, all science teachers, 322 (chemistry, biology and physics) in the selected schools were taken as participants using comprehensive sampling techniques. 302/322 = 93.8% (of which 71 (23.5%) were females, 231 (76.5%) were males; 98 (32.5%) chemistry, 100 (33.1%) Biology and 104 (34.4%) Physics) teachers completed the questionnaire. One sample t-test, independent sample test, descriptive statistics and multiple regression analysis were used for data analysis. The findings indicated that there is a positive significant difference between the expected and observed mean of teachers’ self-regulated science teaching and it is not by chance. Moreover, teachers are found implementing phase one or preparatory phase (forethought) phase (goal setting, performance goal orientation, mastery goal orientation and intrinsic interest) more than other phases. The study results also showed that there is a significant difference in the implementation of self-regulated science teaching between male and female teachers (females are found better than males). However, gender and teachers’ experience together were not found a significant predictor of self-regulated science teaching. The study needs further evidence using observation and interview and the result would have a message for teacher educators to further investigate and adapt in their training manuals to improve teachers’ teaching quality.

1. Introduction

The problems of students’ learning and achievement can be attributed to internal and external factors to students. From the external factors, problems related to teachers’ professional skills are the most prominent and influential factors for students’ learning. To mention a few, the teaching strategy they apply in the classroom, their motivation, commitment and attitude are examples of teachers’ factors. Due to this, currently quality of education is becoming a burning issue in Ethiopia especially in science subjects in secondary schools. For instance, the majority of the students in secondary schools of Ethiopia even could not pass the national exam in their science subjects according to the national learning assessment results (Girma Woldetsadik, 2013). Due to this, Ethiopia in this endeavor gets serious complaints from different concerned parties though many efforts have been implementing to improve teachers’ quality. Habtamu (2017), Negassa (2014), and Ashebir and Bereket (2019) for example conducted a survey research in North Gondar, in Oromia, Amhara and South Nation and Nationalities of Ethiopia secondary schools respectively to assess quality of science education; and their independent study results showed that lack of motivation, commitment, teaching strategy they are using, and interest of teachers, as factors affecting teaching science subjects in addition to other factors.

Though it is difficult to judge the instructional strategy teachers use in their classroom as good or bad, teaching with self-regulation has emerged as a central concept in psychology that shows how individual teachers become effective by integrating and regulating their cognitive, motivational, affective and behavioral components in their classroom. Therefore, teaching with self-regulation/or teachers’ self-regulation is directing and leading the classroom teaching process to improve or attain the teaching goals independently. Research on self-regulation has also

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focused on the individual's capacity to monitor and modify behavior, cognition and affect, and the individual’s environment in order to achieve the desired goal. Therefore, this study was focused to investigate the practice of self-regulated teaching and the relationship it has with teachers’ years of teaching experience and their gender.

The origin of self-regulation is Bandura’s (1977) social cognitive theory by which a human being achieves its goal as a result of the interaction between a person, behavior, and environment. He proposed a triadic approach of reciprocity in which the individuals influence the environment and the environment influences the individuals and the behaviors as well. In turn, behavior influences both the individuals and the environments. Moreover, the theory of self-regulation involves three phases: self-observation, self-judgment, and self-reaction (Bandura, 1977). During self-observation, individuals monitor and record aspects of their performances; in self-judgment, performers observe, evaluate and compare their performances against standards or goals; and self-reactions include their feelings of self-efficacy (i.e., perceived capabilities) and affective reactions to their performances (e.g., satisfaction). Self-regulation is about thoughts, emotions and actions planned and guided to achieve personal goals. Self-regulation is closely related to the ability to gain the skills of focusing one’s attention, using time effectively and efficiently, developing self-confidence, connecting the information units, setting one’s learning objectives and strategies, achieving one's own learning objectives and organizing one's learning. According to van Eekelen et al. (2005), self-regulation includes: putting particular proximal goals for the task to be performed, selecting appropriate strategies for attaining those goals, monitoring and recording one's performance, reconstructing one's learning context in line with one’s goal, managing one's resources effectively, self-assessing one's methods and its effectiveness by relating outcomes with attribution, and adopting or modifying future approaches.

Drawing on Bandura’s (1977) work, Zimmerman (1986) developed self-regulated learning theory and explained it as ‘the process whereby students activate and sustain cognitions and behaviors systematically and interdependently phases.

The forethought/preparatory phase(phase one) is one of the Zimmerman's (2000) phases by which individuals ask themselves about their intrinsic interest, motivation, knowledge and skills they have, to conduct a specific task, set a proximal goal, prepare strategic plan and select an appropriate strategy to achieve the desired goal. In this sense, teachers ask themselves about their self-awareness, the content and subject matter knowledge they have, and the motivational level they have to conduct the lesson. They also take into consideration the resources, the classroom conditions, and students' characteristics. Generally, task analysis, goal setting, strategic planning, selecting and designing objectives, self-motivation beliefs (Self-efficacy, outcome expectation, intrinsic interest/value, goal orientation).

The performance or volitional control phase (second phase) includes self-controlling, monitoring of activities, self-instruction, self-observation, self-recording, self-experimentation, asking help when needed. Besides these, teachers reflect and analyze about the functionality of the strategies, their effectiveness, like: Does the process as per the plan? Are the strategies functional? What needs to be added? What about the performance? What do I learn from this task? Do I need support from others? What do I learn from the process? Does it activate students? How can I resist or defend the obstacle that emerges? (Nilson & Zimmerman, 2013)?

Self-reaction or self-reflection Phase (the third phase); under this phase, performers reflect on their process and outcomes obtained and feel satisfaction or despair. This phase includes; outcome evaluation, self-judgment, self-evaluation against the standard or model and self-reaction, causal attribution also takes place. For example, questions in the teachers' self-regulation can be asked like: How well did I achieve my goal? How well did I master what I set out to teach? How well did I avoid sources of interference and stay on task? What approach or strategy worked well? What didn't work? What were the most important points I learned from the lesson? What am I still having trouble in conducting the lesson? How can I relate to other contents? How much do students are satisfied? Did the strategy address all types of learners? What do I learn from the assessment result? These and other questions are raised and answered by the teachers themselves to improve their instructional skill. Teachers' self-regulation is adapted from the analogy of self-regulated learning and its effectiveness in students’ learning and achievement. Hence, many researchers conducted a study on teachers’ self-regulatory teaching (e.g., Cape-Aydin et al., 2009; Ghonsooly & Ghanizadeh, 2011; & Arrastia, 2015). Therefore, self-regulated teaching or teacher's self-regulation is a conscious, deliberate total-engagement activity involving multiple activities of the brain starting from the preparatory phase up to the feeling of satisfaction or despair to improve their instructional effectiveness. This activity encompasses full attention and concentration, self-awareness and introspection, genuine self-evaluation, openness to change, professional self-discipline, and acceptance of responsibility for one's performance (Nilson & Zimmerman, 2013).

Hence, teachers' self-regulation or teaching with self-regulation is being perceived as a new pedagogical innovation currently and can be effective when teachers recognize their limitation and ineffectiveness and become ready to change their teaching approach to correct their limitations (Bakkenes et al., 2010). Self-regulated teaching (teachers’ self-regulation) decreases the unjustifiable reason for the delay of academic tasks or procrastination. Because, being self-regulated increases intrinsic motivation, responsibility and investing more time for their academic task (Iwamoto et al., 2017). Self-regulated teachers are mostly described as (pro)active agents who trigger certain educational beliefs, construct appropriate instructional practices accordingly and proactively control the teaching environment and conditions (Peeters et al., 2014). Since the teaching profession and teaching science deals with problem-solving, critical thinking and creativity, it is vital for teachers need to get familiar with and adapt the notion of self-regulation in their day-to-day instructional activities; because quality of education is mainly in the hands of teachers’ effectiveness. The reason is that, if teachers are committed, motivated, responsible and self-directed, they might devote their maximum effort in organizing, planning and leading their teaching activities and hence quality may be maintained. Michalsky (2012) also emphasized its importance that being self-regulated is used to plan a lesson with procedural and conditional knowledge; to define the teaching goal or objective, to identify appropriate strategies to adapt the content to the learning context in teaching practice with the capabilities such as regulation, control, and evaluation of learning progress.

However, though it has multidimensional advantages, studies conducted on teachers' self-regulation particularly in in-service science teachers are scarce. For example, Peeters et al. (2014) studied on the role of teachers' self-regulatory capacities in the implementation of self-regulated learning practices and the result indicates that teachers’ own self-regulatory competencies as a critical determinant of SRL (self-regulated learning) implementation in primary school; Gol and Royaei (2013) conducted a study on the relationship between teacher self-regulation and job performance; and Ghanizadeh (2011) conducted a study on the relationship between teacher self-regulation and teacher competence and effort. The result revealed that a significant positive correlation between TSRS use (teachers' self-regulated strategy) and teacher competence, as well as effort. (Goal setting and intrinsic interest were the strongest correlates). But significant negative correlation between TSRS use and institutional supervision, as well as burnout was identified. Arrastia and Thompson (2014) as cited in
Arrastia (2015) also conducted a study on the relationship between teacher self-regulation and teacher internal and external responsibility. Confirmatory factor analysis and Pearson correlation results indicated that the presence of a significant positive correlation between TSRS use and internal teacher responsibility but no significant correlation between TSRS use and external teacher responsibility. On the other hand, Capa-Aydin et al. (2009) identified a significant positive correlation between TSRS use and TTSEB (teachers’ teaching self-efficacy belief) where TSRS accounted for 18% of the variance in TTSEB. A significant positive correlation between TSRS use and CTA (critical thinking ability) was also identified by Ghazizadeh (2011); whereas Toussi et al. (2011) identified a significant positive correlation between TSRS use and age as well as with years taught (teaching experience). This study result is similar with that of Ghansoly and Ghazizadeh (2011) which showed significant positive correlation between TSRS use and effectiveness and in this study, intrinsic interest, mastery goal orientation, and emotional control were the strongest correlates; Toussi and Ghazizadeh (2012) also identified a significant positive correlation between TSRS use and internal TLoC (teacher locus of control), intrinsic interest and mastery goal orientation were the strongest correlates, whereas a significant negative correlation between TSRS use and external TLoC was also detected. Besides these, studies show that self-regulated instruction increases students’ achievement (Miksza, 2015).

**Concerning the relationship between** self-regulated teaching and gender, though there is an individual difference among male and female teachers in their teaching effectiveness even among the same gender, different research results indicate that female teachers are behind male teachers in their science effective teaching. Especially in the advanced grades, females feel less competent than males in science (El-emadi et al., 2019) indicated in their study of ‘teaching style differences between male and female science teachers in Qatari schools’. But El-emadi et al. (2019) and Ibe et al. (2013) as cited in El-Emadi et al. (2019) identified that female science teachers provided better delivery in theory classes than males; whereas male science teachers demonstrate better performance in laboratory-based classes than females. Similarly, Thordsen and Turmo (2012) examined that females were observed using somewhat higher levels of mastery goal structure for students and mastery approaches to instruction, while male teachers were observed using a higher level of performance approaches to instruction. However, Islaí and Nasreen (2013) identified as there is no significant difference among male and female teachers in their effective teaching. Although there is no clear cut that shows the difference in female and males’ teaching effectiveness, the above scholars show that female teachers use collaborative learning approach, nurturing, caring, empathy, easy to communicate with their students, use student centered teaching approach and use linear relationship with their students. According to Kovacs (2019), the difference in gender is the use of diverse teaching methods, following teaching novelties and participation in high-standard further education, which are specifically a characteristics of women. The researcher added that this can be caused by several factors. For instance, it is possible that some of the male teachers stick more to the usual direct teaching methods while female teachers have a more positive attitude towards professional development, use new teaching methods, create a caring relationship, and allow collaborative learning. In addition to this, Studenska (2011) indicated that in their learning process, women generally report that they use self-regulatory strategies more intensively than man do.

However, Studenska (2011) added that the results of the studies concerning the relationship between gender and various self-regulation aspects are inconsistent. For example, Ghansoly and Ghazizadeh (2011); Partovi and Tafazoli (2016) identified that there were no relationship between teachers’ self-regulation and teachers’ gender. On the other hand, male teachers are authoritative; follow structured classroom, use lecture method, make students participate by asking questions.

**Teaching experience** has its own contribution to teachers’ use of self-regulated teaching strategy. Work experience is the skill and knowledge gained by the practitioners by learning through practice. It is logical to say that the more the experience teachers gain in their teaching, the more effective s/he will be. Because, as teachers spent more time in their teaching experience, they will be wealthy in their subject-matter knowledge, content knowledge and pedagogical skills and become more efficacious to implement new (innovative) instructional strategies in general self-regulated science teaching (SRST) in particular among teachers can be enhanced through time. This is because self-efficacy is an excellent predictor of behavior (Lekhu, 2013) which is gained through successful experience. Many studies were made to identify the relationship between teaching experience and self-regulation. For example, Ghanizadeh (2011) investigated the presence of significant correlations between teachers’ self-regulation, their teaching experience and their age. Bringman and Lee (2008) study’s result also identified that teaching experience was significantly related to competence in conducting developmental classroom lessons. Similarly, Ghansoly and Ghanizadeh (2011) identified a significant relationship between teachers’ self-regulation and self-efficacy beliefs; and a significant relationship between teachers’ self-regulation, their teaching experience and age; but there was no significant relationship with gender. In opposition to the above studies, Partovi and Tafazoli (2016) reported a positive relationship between the teachers’ reflective practices and their self-regulation but no significant relationships between teachers’ self-regulation and their experiences. In addition to Pazhoman and Sarkhosh (2019), Arrastia (2015) identified that there was no correlation between teachers’ teaching experience, their qualification, and the grade level they teach with their self-regulation in Caslers’ (2005) unpublished validating study. And in this study, the relationship between teachers’ teaching experience and their self-regulation practice was also identified.

However, teachers are not competent enough to implement self-regulated teaching due to lack of motivation and meta-cognitive strategies (Peeter et al., 2014, & Eker and İnce, 2018). Van Eekelen et al. (2005) also confirmed that teachers’ self-regulation in higher education is not as self-regulated, planned, reflective, or spiral as some assumes. Sometimes, the teachers’ learning was planned (self-regulated), but mostly it occurred in a non-linear (both external and self-regulated) or spontaneous (externally regulated).

Hence, the findings of the above studies showed inconsistent results on the relationship between teaching experience and self-regulation, gender and self-regulation. Moreover, the majority of the studies of teacher self-regulation are conducted with pre-service English foreign language teachers abroad. But studies conducted on secondary school science teachers that show the level of teachers’ self-regulated teaching practice especially in the Ethiopian context is almost none.

Therefore, the purpose of this study was to examine the practice of self-regulated teaching in secondary school science (Chemistry, Biology and Physics) teaching and its relationship with teachers’ teaching experience and gender, and to identify whether there is gender difference in the implementation process. Because studying on the issue might have an impact on teachers’ training system so that the teaching quality of teachers may also be improved. And it might give an insight for other researchers to further investigate its impact using different research approaches.

### 1.1. Research questions

1. To What extent do teachers implement self-regulated teaching in the secondary school science classroom?
2. Which dimension/s (Phases) do teachers mostly practice in their classroom teaching more?
3. Do teachers’ gender and year of teaching experience together significantly predict teachers’ self-regulation practice?
4. Is there a significant difference between male and female teachers in the implementation of self-regulated science teaching in the study area?
2. Methods

When the method of a research is taken under discussion, it is the theoretical organization of scientific activities to be performed to arrive at the researchers’ goal. Hence, a quantitative survey design was used to answer the above questions for this study. In this section, participants and their characteristics, the type of instruments used to collect the data, the analysis methods and results of the analysis with interpretation are organized.

2.1. Participants

The participants of this study were secondary school science teachers (Chemistry, physics, and Biology) found in the study area of South Gondar administrative zone of the Amhara region, Ethiopia. The total number of secondary schools found in the study area was 63 with 1186 teachers and nine secondary schools (14.3%) of the total population were selected using a simple random sampling method. And only 302 (98 = 32.5% Chemistry, 100 (33.1%) Biology, and 104 (34.4%) Physics) teachers out of 322 returned the questionnaire by filling all the items. Among these, 71 (23.5%) were females and 231 (76.5%) were males. Of the 302 teachers, 74.5% are degree holders and the other 25.5% were masters. Teachers were also categorized into 4 groups based on their career structure (teachers from 0 to 5 teaching year of experience are called ‘beginners and junior teachers’) and were made to be in group one; those of 6–10 teaching experience are called ‘teachers and Senior teachers’) were made second group; from 11–14-years of teaching experience are called associate lead teachers were made to be in third group; and the fourth group is those who have 15 years and above teaching experience called ‘Lead teachers’. Hence, the majority of the participants (46%) have 6–10 years teaching experience (second group); 26.2% have 11–14 years of experience (third group); 16.5% of them are 15 years and above (fourth group); and 11.3% are below 5 years of experience (first group) in secondary school science teaching were participated in the study. The following figures show a short graphical summary of participants’ background by subject they teach, year of experience and gender respectively (see Figure 1).

2.2. Instruments

A Self-report self-regulated science teaching questionnaire which was developed by Capa-Aydin et al. (2009) and validated by Arrastia (2015), Casler (2005) and others were adapted for this study. A Pilot test was conducted with 30 teachers and the internal consistency of the total 40 items was evaluated using Cronbach alpha and was found strong = .94. But when evaluated by its sub-scale, Goal setting = .76, Help seeking = .71, Intrinsic interest = .84, Mastery goal = .95, Performance goal = .65, Self-evaluation = .88, Self-instruction = .58, Self-reaction = .86, and Emotional control = .84. However, to make compatible with the study context, three items which were looked similar, redundant, and ambiguous (based on respondents’ feedback) and those with low item reliability (less than .50) were reduced and a total of 37 self-report items with Likert scale ranging from strongly disagree (1) to strongly agree (5) were distributed to 322 teachers and only 302 teachers completed and returned the questionnaire successfully.

2.3. Data collection procedure

Seven (7) data collectors who have had personal relationships were selected for data collection purposes and training on the purpose of the study, how to respond to the questionnaire and the ethical issues were given to those collectors to be aware and inform the participants. The data were collected within two weeks. After collecting the data, a rough check on the questionnaire’s completeness was done and 20 papers were found incomplete and excluded from preliminary analysis. After screening, the data were coded and entered to SPSS (statistical packages for social sciences) version 23.

2.4. Data analysis procedures and methods

Data obtained from participants were subjected for coding and labeling for the purpose of preliminary analysis. All the assumption tests required (presence of outliers, univariate and multivariate normality, homogeneity of variance, multi-collinearity of variables) using IBM SPSS were checked, the missing values were detected and substituted using imputation (series mean) method and outliers were adjusted by rounding to the next higher value not to lose cases (samples). Finally, it was checked that there was no serious violation of the assumptions detected.

To analyze the data, One sample t-test for comparison of the sample data with the expected population mean; independent sample test (to compare the implementation of SRTS use among males and females teachers) with effect size to compare the extent of the difference; and multiple regression analysis methods (to compute the predictive capacity of gender & experience); and descriptive statistics (to compare the implementation level of phases) were employed for the analysis. This is due to as many researchers recommended, a survey study whose...
continuous data were collected using a 5 Likert scale questionnaires, the analysis methods should be either inferential statistics like Pearson correlation, t-test, ANOVA or descriptive statistics like mean, standard deviation are appropriate (Joshi and Pal, 2015). Besides this, effect size is used to evaluate the extent of SRT (self-regulated teaching) implementation difference among gender based on Leech et al. (2005), which indicated that effect size value in, Cohen’s d > or = 1, is very large, .8 and above is large .5 and above is medium and .20 is small.

Since, the instrument was adapted and modified, the data obtained by the adapted instrument was subjected to factor analysis and the default factor analysis type, principal component analysis with varimax rotation was conducted. The reason the researcher preferred to use the principal component analysis method besides its default is, its psychometrically soundness, mathematically compatible and it decreases the problem related to factor indetermination (Byrne, 2016). The purpose of this factor analysis was to reduce the items so as to manage for further analysis. Because many authors suggested that it is not all sample size that needs to be factorized. Hence, two statistical measures were also generated by SPSS to help assess the factorability of the data.

Principal component analysis with Varimax rotation was used to explore the component structure of the attitudes towards the implementations of self-regulated teaching. Values of KMO(.78) and Bartlet’s test (Chi-square = 1253.79; df = 210; p < .001) permitted further analysis.

Hence, the two tests as indicated above explain the adequacy of the samples for factorizability to maximize interpretability and the solution, (the pattern of loadings). The Varimax rotation method was done because of its simplicity and interpretability; and is found to be preferable (Byrne, 2016) (Table 1).

The principal component analysis with iterated varimax rotation resulted teachers’ self-reported opinion regressed to a total of seven Components or Factors with an Eigen value > 1 and 59.00% of the total variance accounted for (by the components) are retained. In the commonality's matrixes, the self-reaction item number 3 (I get upset, when I am negatively evaluated in my profession) shares the highest variance proportion (.700) or is accounted for by the component. Whereas from self-instruction item number 2 (If the strategies I have used in my science teaching by science teachers of the study area) the mean of their reported data obtained by a 5 Likert scale questionnaire was computed against the expected population mean (3.0).

The reliability of the items by their factor grouping was found very good to poor (Cronbach α = .05 to .76; Factor one called Performance goal orientation α = .76; Factor two, or Mastery goal orientation α = .75; factor three or Help seeking α = .62; Factor four or Self-evaluation α = .63 (containing two items from self-instruction); Factor five or Intrinsic interest, α = .55; Factor six or goal setting, α = .49; Factor seven or Self-reaction α = .05) with the lowest reliability value,. The confidence level for statistical significance was determined to be 95% at alpha value p < .05. The rotated component matrix indicated that the highest variance is explained by factor one or component 1 (11.64%) which contains four performance goal orientation items and the lowest variance is explained by factor or component 7 (5.11%) which contains only two items of self-reaction. Items that have commonalities are regressed to be in the same factor.

### 3. Results

The participants of the study (302) responded to the questionnaire and the descriptive statistics indicated how their response trained on sample items is designated in the table below; (see Table 2).

The descriptive statistics and frequency of respondents indicate that nearly 50% and above of participants rate 4 (agree) and strongly agree (5) for sample items under each sub-scales. The means of the data of each items also explain that teachers’ performance is above the expected mean (3.0). The lowest mean (3.5) is observed under emotional control sub-scale item (I stay calm when I faced a problem while I am teaching) and the highest mean is recorded under intrinsic interest sub-scale item (I like science teaching profession).

The study was basically intended to examine the level of practice of self-regulated science teaching in the study area, and a survey self-report data was collected through 37 items of 5 Likert scale questionnaires. The principal component analysis factored out 7 components with 23 out of 37 items whose total items’ reliability was found to be α = .76. So, to determine the level of practice from the self-report data, the observed mean was compared with the test value of the scale (3, whose value given was uncertain).

Concerning objective one, to investigate the level of self-regulated teaching by science teachers of the study area, the mean of their reported data obtained by a 5 Likert scale questionnaire was computed against the expected population mean (3.0).

Hence, the observed mean of the self-reported data is found 3.97, SD = .39, when a one sample t-test analysis was done. So, the result indicates that there is a positive significant mean difference t (301) = 43.70, p = .000 two tailed, d = 2) The resulted mean is very approaching to 4 (leveled as Agree), implies that teachers’ response is agree indicating that they are being implementing SRST (self-regulated science teaching) strategy more than a test value of 3.0.

Related to objective two or question number 2, the self-report data when analyzed using mean comparison, the descriptive statistic indicates that teachers reported that they are implementing preparatory phase (phase one or forethought phase), Mean = 73.7, SD = 7.6 more than the other two phases (phase two or performance phase, M = 27.6, SD = 3.6 and phase three or self-reaction/self-reflection phases, M = 45.3, SD = 5.9). The result indicates that phase one which is forethought phase, or preparatory phase (goal setting, performance goal orientation, personal goal expectation, outcome expectation, intrinsic interest) were found with the highest mean of implementation than the other two phases, and the least performance is recorded in phase two from teachers’ self-reported data (Table 3).

To answer the predictive capacity of gender and teaching experiences for the implementation of self-regulated science teaching in the
Table 2. Frequencies of participant’s responses, Mean, Median, Mode and Standard deviation of sample items here.

| Sample items per dimensions | M    | ME   | MO   | SD  | F    |
|----------------------------|------|------|------|-----|------|
| GOAL SETTING               |      |      |      |     |      |
| I identify goals to be achieved by students | 4.23 | 4    | 4    | .77 | 151  |
| I decide on the instructional strategy appropriate for the topic | 4.19 | 4    | 4    | .76 | 155  |
| HELPSSEEKING               |      |      |      |     |      |
| I ask for help from my colleagues | 3.82 | 4    | 4    | 1   | 109  |
| I get help from my colleagues when needed | 4    | 4    | 4    | .88 | 185  |
| INTRINSIC INTEREST         |      |      |      |     |      |
| I like science teaching profession | 4.6  | 5    | 5    | .57 | 197  |
| It makes me happy to see my students learn science | 4.02 | 5    | 5    | .65 | 154  |
| MASTERY GOAL ORIENTATION  |      |      |      |     |      |
| Successful science teaching improves students' learning | 4.42 | 5    | 5    | .66 | 155  |
| It is important to be a successful teacher | 4.43 | 5    | 5    | .66 | 157  |
| PERFORMANCE GOAL ORIENTATION |      |      |      |     |      |
| Effectively science teaching enables me to get promotion | 3.97 | 4    | 4    | .95 | 119  |
| I have to teach effectively to get appreciation from others | 3.58 | 4    | 4    | 1   | 120  |
| SELF-EVALUATION            |      |      |      |     |      |
| I learned from the mistakes I made in science classes | 4.13 | 4    | 4    | .82 | 149  |
| I try to evaluate whether I have met my lesson goals or not | 4.08 | 4    | 4    | .76 | 154  |
| SELF-INSTRUCTION           |      |      |      |     |      |
| I direct myself to use time effectively | 4.38 | 4    | 4    | .63 | 151  |
| I utilize alternative strategies | 3.54 | 4    | 4    | 1   | 141  |
| SELF-REACTION              |      |      |      |     |      |
| I get upset when I am negatively evaluated in my profession | 3.9  | 4    | 4    | .89 | 165  |
| If I realize that I am not successful in my teaching worries me | 3.93 | 4    | 4    | .96 | 154  |
| EMOTIONAL CONTROL          |      |      |      |     |      |
| I stay calm when I faced with a problem while I am teaching | 3.5  | 4    | 4    | 1   | 137  |
| I do not upset when a problem occurs during my instruction | 3.8  | 4    | 4    | 1   | 139  |

secondary schools of the study area, a standard or simultaneous multiple regression analysis method was used. In the analysis procedure, both the two variables (gender and teaching experience) were entered and analyzed simultaneously using general linear model (GLM) statistical technique including linear regression method (see Table 4).

Table 3. Descriptive statistics.

|                | phase1 | phase2 | phase3 |
|----------------|--------|--------|--------|
| Mean           | 73.6   | 27.5   | 45.29  |
| N              | 302    | 302    | 302    |
| SD             | 7.6    | 3.6    | 5.9    |

Multiple regressions was conducted to determine the best linear combination of gender, and teaching experience for predicting teachers' self-regulated science teaching in secondary schools. The means, standard deviations, and inter-correlations were determined. But the result indicated that both variables (gender and teaching experience were not found a significant predictor of the model F (2,299) = 2.971, p = .053 as indicated in the table above. Moreover, the inter-correlation result showed that the correlation between self-regulated science teaching and teachers' teaching experience is zero or do not have correlation.

The purpose of this study was to investigate the level of self-regulated science teaching in secondary schools; the type of phase/s more implemented; gender difference in implementing SR strategy use, and the relationship between SR strategy use with teachers' gender and teaching experience. A quantitative survey study was conducted and a self-report data were collected from 302 (71 = 23.5% females and 231 = 76.5% males) of nine secondary schools' science teachers (chemistry, Biology and Physics) which were selected using a random sampling method schools wise to answer research questions. The self-report data on self-regulated science teaching was subjected for principal component factor analysis with iterated Varimax rotation and an Eigen value > 1 and seven factors with 23/37 items were retained. Whereas the self-regulated instrument in the study of Capa-Aydine et al. (2009) and Arrastia (2015) was factored into 9 factors which is different from this study. This may be due to the reduction of items and context difference (eg nature of subject, teachers, country, etc.). So, it needs a validation study in Ethiopian context.

Multiple regressions was conducted to determine the best linear combination of gender, and teaching experience for predicting teachers' self-regulated science teaching in secondary schools. The means, standard deviations, and inter-correlations were determined. But the result indicated that both variables (gender and teaching experience were not found a significant predictor of the model F (2,299) = 2.971, p = .053 as indicated in the table above. Moreover, the inter-correlation result showed that the correlation between self-regulated science teaching and teachers' teaching experience is zero or do not have correlation.

To identify the level of self-regulated science teaching among male and female teachers, the independent one sample t-test was conducted and the analysis result showed that there is a significant mean difference (M = 3.94, SD = .39, t (300), = -2.44, p = .015 two tailed) and females' M = 4.07, SD = .39 in the implementation of self-regulated teaching between male and female science teachers as indicated in the table below (Table 5).

However, the effect size is examined using the square root of pooled variance (Brace, et al., 2009) to show the extent of the difference among gender, effect size (Cohen’s d) due to sample size differences is used and found to be d = 0.1 (10%), which is very small effect size. From the table above, as the output indicates, female teachers are practicing self-regulated science teaching strategy in their classrooms more than their male counterparts are not by chance. The Levens test of equality of variance also meets the assumptions.

4. Discussion

The purpose of this study was to investigate the level of self-regulated science teaching in secondary schools; the type of phase/s more implemented; gender difference in implementing SR strategy use, and the relationship between SR strategy use with teachers' gender and teaching experience. A quantitative survey study was conducted and a self-report data were collected from 302 (71 = 23.5% females and 231 = 76.5% males) of nine secondary schools' science teachers (chemistry, Biology and Physics) which were selected using a random sampling method schools wise to answer research questions. The self-report data on self-regulated science teaching was subjected for principal component factor analysis with iterated Varimax rotation and an Eigen value > 1 and seven factors with 23/37 items were retained. Whereas the self-regulated instrument in the study of Capa-Aydine et al. (2009) and Arrastia (2015) was factored into 9 factors which is different from this study. This may be due to the reduction of items and context difference (eg nature of subject, teachers, country, etc.). So, it needs a validation study in Ethiopian context.

From the descriptive statistics of Table 1, more than 50% of the participants rated 4 (agree) and strongly agree indicating that they are implementing self-regulated science teaching in their classroom instruction. In addition to this, the means of the items under each sub-scale explain that teachers' implementations of SRTS (self-regulated science teaching strategy) may lead to say more than the expected population means (3.0). This result seems in line with the previous study results' of Capa-Aydine et al. (2009) and Arrastia (2015). However, further investigation with observation and interview instrument may validate this study's result.

So, to answer the first question which deals about the level of practice of self-regulated sciences teaching in secondary schools, a one sample t-test was conducted. The result showed that there is mean difference between the expected mean and observed mean (M = 3.97, SD = .39, with effect size, d = .2 (2% )) which explains the degree of difference between the observed mean and the expected mean. The result indicates that teachers in secondary schools of the study area are found implementing self-regulated science teaching (see Table 5).

Teachers who apply innovative strategies in their teaching are ready for their own learning for teaching, because self-regulation helps for learning and teaching. This result is in line with that of Arrastia and Thopson (2014) as indicated in Arrastia’s (2015) showed that in-service
teachers responded to self-regulated items were high in U.S. but lower when compared with that of the pre-service teachers of the same country. From the result, it is also possible to say that teachers are using an innovative strategy like SR (self-regulation) to achieve their objectives in order to enhance their instructional skill and students' learning (Iwamoto et al., 2017). Similarly, teachers who apply innovative strategies are efficacious, professionally interested and had adaptive strategies towards their performance (Capa-Aydin et al., 2009). Self-regulation is a key issue for teachers. Self-regulatory competency is used to help teachers maintain both their well-being and professional commitment. Gol and Royaei (2013); Toussi et al. (2011) also confirmed that there is a strong positive relationship between teachers' self-regulation and their job performance and their effectiveness. But this study result seems better in the implementation of self-regulated science teaching than the study results conducted in other countries which says teachers are not competent enough to implement self-regulated teaching due to lack of motivation and meta-cognitive strategies (Eker & Ince, 2018; Peeters et al.,2014); teachers' self-regulation in higher education. are not as self-regulated, planned, reflective, or spiral as some assume; the knowledge they have and their classroom practice is low (van Eckelen et al., 2005; and Supreme and Bol, 2014). Researchers and science educators contend that teachers who are unable to implement SRS (self-regulated strategy) in their own learning not only lose their effectiveness but also have difficulty to see on their students Michalsky (2012). The confidence interval lies between .9 and 1 which indicates as large differences. The effect size also confirms the presence of a huge difference between observed sample mean and expected population mean which is 2 (Leech et al., 2005). But this may not guarantee the frequency of their implementation which needs further investigation using observation and interview methods because the data for this study were obtained from teachers' self-report only.

Concerning the second research question in continuation of the first question, the purpose was to identify which phases or dimensions do teachers implement more in their self-regulated science teaching. To answer this question, the factored items were categorized under their own respective phases (phase one or preparatory phase which contains, goal setting, performance goal orientation, mastery goal orientations, and intrinsic interest subscales); Phase two or performance phase which contains help seeking and self-instruction with two items, and Phase three or self-reaction phase which contains self-evaluation and self-reaction dimension were analyzed with mean comparison and the self-report data descriptive statistics result showed that teachers are observed implementing phase one or the preparatory phase (M = 73.7,SD = 7.6) better than phase two or performance phase (M = 27.6,SD = 3.6) by4.0 standard deviation, and phase three or reflective phase (M = 45.3,SD = 5.9) by 1.7 standard deviation. According to teachers' self-report data, the Phase two or the performance phase which concerns about the recording, observing and self-instructing of how the teaching-learning process is going on as compared to the planned one is scored the least performance. This result is in line with Ghansoily and Ghani zadeh (2011); Toussi et al. (2011) to some extent. Their study identified that Intrinsic interest, mastery goal- orientation, and emotional control were the strongest correlates whereas the current study identified that goal setting, performance goal orientation, mastery goal orientation and intrinsic interest as teachers implementing more. This indicates that teachers seem more likely concerned with (preparatory or forethought phases) by identifying their objectives, selecting appropriate strategies to achieve their objectives and at the same time planning to see their students' learning outcomes obtained from their instruction possibly. Though the level of implementation of the performance phase as compared to the forethought and reflective phases is low, teachers' self-report data indicated that they are evaluating their performance (I learned from the mistakes I made in science classes; At the end of instruction, I try to evaluate whether I have met my lesson goals or not; and I use students' feedback to improve my instruction; During instruction, I always adapt my instructional strategies based on students' needs.). But, they reported that they react differently based on their performance and the result of the evaluation given to them (for example, I get upset when I am negatively evaluated in my profession; If I realize that I am not successful in my teaching worries me). This adaptive and defensive reflective practice may not seem that teachers are ready to improve the deficiency they had and to improve students' learning which needs further investigation. Whereas the government and other stakeholders are complaining about the quality of education especially students who have low achievement in science subjects which may not go in line with the self-regulatory practice of teachers of the current study area.

The third objective was intended to examine the prediction capacity of teachers' gender and teaching experience teachers have for self-regulated science teaching in secondary schools. To answer this question, a standard or simultaneous multiple regression analysis was used. The result indicated that both gender and teaching experience were not found a significant predictor. Moreover surprisingly, the correlation matrix showed that there is no relationship between teachers' teaching experience and self-regulated science teaching practice which does not go in line with logical assumptions, the researcher's experience and theoretical arguments which argue that when teachers get more and more experienced, they would have a chance of implementing new teaching strategies that enhances teachers' effectiveness and students' achievement as well (Chao and Chou, 2017). Therefore, it needs further investigation. However, this research result is partially congruent with that of Ghansoli and Ghanizadeh (2013) which says there is no relationship between teachers self-regulation and gender; but a positive significant relationship with teaching experience; Pazhoman and Sarkhosh (2019) no relationship between self-regulation and teachers' teaching experience; Partovi and Tafazoli (2016) no relationship between gender and self-regulated teaching, but positive relationship with teaching experience. Some of the findings of the study conducted by Liu et al. (2011) in Handan indicated that the status of self-regulated learning behavior of chemistry teachers is the same between male and female teachers, across all school levels but different among teachers' experience, which says young teachers' self-regulated learning behavior better than old teachers which is contrary to Partovi and Tafazoli's (2016), and (Chao and Chou, 2017) studies' result. The above results indicate that there is inconsistency regarding the correlation between gender, teaching experience and teachers' self-regulation practice. This may be due to differences in the study context which needs further investigation globally.

The last research objective was focusing on the investigation of the difference in the implementation of self-regulated science teaching among male and female teachers. To answer the questions, the data were subjected for comparison of mean difference using an independent sample test. The result of the analysis indicated that there is a statistically significant mean difference between male and female teachers in their

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Table 5. Independent sample test of gender difference in SRST.

| Group Statistics | sex of participants | N  | Mean  | Std. Deviation | Std. Error Mean | F     | Sig. | t    | df     | Sig. (2-tailed) |
|-----------------|--------------------|----|-------|----------------|-----------------|-------|------|------|--------|----------------|
|                 | male               | 231| 3.9404| 0.38157        | 0.02511         | 0.01  | 0.91 | -2.438| 300    | 0.015          |
|                 | Female             | 71 | 4.067 | 0.38631        | 0.04585         |       |      |      |        |                |

*P < .05 margin of error.
self-regulated science teaching practice, \(t(300) = -2.44, P = .015, (M = 3.9, SD = 0.38\) of males' and for females, \(M = 4.07, SD = 0.39\). This result is in line with that of the unpublished dissertation work of Arrastia (2015), being a teacher of English/Language Arts and a female were significant predictors of higher TSRS responses for eight subscales of self-regulation; Kovács (2019) indicated that gender difference is the use of different teaching methods, using teaching novelties and participation in high-standard further education, are measurably more important for women. Similarly, it is in line with El-Emadi, Said and Friesen (2019), females teachers are more competent in theoretical classes than their counterparts; Thronsden and Turmo (2012) examined that females were observed using somewhat higher levels of mastery goal structure for students and mastery approaches to instruction. This can be caused by several factors. For instance, it is possible that some of the male teachers stick more to the frontal or direct teaching methods while female teachers have a more positive attitude towards professional development and for the implementation of new teaching methods. The study result of Studenska (2011) is also in line with the current study result in that female teachers generally report that they use self-regulatory strategies more intensively than men in their learning process. However, this study result is in opposition to many study results which show no gender difference in the implementation of self-regulated teaching and as there is no relationship between self-regulated teaching and gender (Liu2011; Partovi & Tafazzoli, 2016; Ghonsooly & Ghanizadeh, 2011; and Islahi and Nasreen, 2013).

5. Conclusion

The purpose of this study was to investigate the status of self-regulated science teaching in secondary schools of the study area and its relationship with gender and teaching experience. Using a 5 Likert scale (ranges from 1-strongly disagree to 5-strongly agree) self-regulated science teaching questionnaire was distributed to 302 secondary school science teachers to provide their self-report responses. According to the self-report data analysis result, it was observed that secondary school science teachers are applying self-regulated teaching strategy. In addition to this, the descriptive analysis result showed that teachers reported that they are practicing the Phase one or preparatory phases or forethought phases from (Zimmerman’s (2000)) cyclical self-regulation phases (which involves the planning and goal setting stage) more than the other two phases.

Moreover, the study tried to examine the relationship between self-regulated teaching practice and teachers’ background (gender and teaching experiences). The multiple regression analysis result confirmed that the background variables, both teachers’ gender and teaching experience were not found to be a significant predictor of self-regulated science teaching. However, when a comparison was made between male and female teachers, female teachers reported that they are implementing self-regulated science teaching better than their male counterparts and the difference is significant. But research results of other studies showed different results regarding the relationship between self-regulation and gender, self-regulation and teaching experience. The difference in the result may be due to cultural difference, in general context difference or researchers' limitations. However, the study results may be contradictory with the stakeholders’ question of quality education. Had teachers been implementing a self-regulated teaching strategy practically, the problem of quality education would have been enhanced. Because it is believed that self-regulated teachers are more committed, responsible and are always ready to improve their students' learning. Hence, the researcher recommends other researchers to use observation, interview, and students' achievement scores to have full data about the status and level of teachers 'self-regulated science teaching in secondary schools; and the relationship that teachers’ gender and teaching experience, especially the latter variable have with self-regulation. The study result may have an impact on teachers' teaching quality if applicable in teachers’ training institutions and for students' learning and achievement.

Declarations

Author contribution statement

Mekuria Mengistnew Teshome: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Amare Sahile Abebe: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Dawit Asrat Getahun: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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