Biology Teachers' Metacognitive Awareness of Teaching: The Case of Biology Teachers in Postgraduate Diploma in Teaching Program

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Abstract

Metacognitive awareness of teachers has been considered as an important focus area of educational research. The objective of this study was to examine metacognitive awareness of biology teachers. The study used a descriptive research method. The study involved 90 biology teachers enrolled in summer I and II postgraduate diploma in teaching program. Data were collected using the 24-item Metacognitive Awareness Inventory for Teachers (MAIT) developed by Balcikanli (2011). The analysis was made using an independent sample t-test and a one- way ANOVA. The results revealed that the biology teachers have a high level of metacognitive awareness of teaching. No significant differences were found in metacognitive awareness in relation to teachers' gender, bachelor degree program and teaching experience. However, a significant difference was found out between gender, bachelor degree program and teaching experience in the planning sub-component of metacognitive awareness. The finding indicated that female teachers were better aware of planning than males with respect to bachelor degree program and experience. Moreover, there was a significant difference in awareness to the subcomponents of knowledge of cognition. The result indicated that Biology teachers were more aware of declarative knowledge than procedural knowledge. Although there was a variation in some components of metacognition, biology teachers attending postgraduate program had high metacognitive awareness.

Keywords: *Biology teachers, Metacognitive awareness, PGDT program*

Introduction

Education plays a key role in the social, political and economic development of society. Teachers are one of the most important determinant actors in an education system. Quality and access of education depends on the quality of teachers. Since 1994 the Ethiopian government has made numerous changes in teachers training programs to solve various problems and prepare quality teachers. But still now, there is no stable teachers training program in the country. As a result, there has been continuous change in teachers' training program such as Teacher Education System Overhaul (TESO), Postgraduate Diploma in Teaching (PGDT) and currently Bachelor of Education (B.Ed.) degree program.

In the 21st century, teachers are expected to adapt themselves to using modern teaching approaches that put the students at the center of the teaching learning process so as to enhance their performance. Ethiopian teacher education program lacked the integration of pedagogical and psychological aspects of education with the content they teach. This raised a question about teachers' qualification and competence in teaching profession. Since 1994 the Ethiopian government has made a lot of changes in the education system to solve different problems. It has given great emphasis to science and mathematics education, the student-centered approach and teacher training program (MoE, 2002; Education and Training Policy, 1994). Despite the fact that

the government did a lot, many problems in our education still remained unsolved. For instance, in relation to academic achievement, students are still unable to attain even the minimum learning competencies expected of them by the Ministry of Education. This is evident when we look at the Ethiopian Baseline National Learning Assessments of Grades 10 and 12, 2009 (NAE, 2010) and Ethiopian 4th National Learning Assessment of Grades 4 and 8 achievement results (NEAEA, 2013; 2018, 2021).

According to Mai (2015), although there are many factors regarding the problem of teaching and learning process, teachers are among the first people that will be questioned when it comes to problems or students' low performance. Of course, students' performance depends on how teachers have been trained and how they manage their teaching and their students' learning. It is highly believed that knowing what teachers know about their own teaching and the learning of their students are important issues in teacher preparation (Balcikanli, 2011). Teachers' ability to know about their own teaching and their learners learning depends on their metacognitive awareness (Yavuz & Memiş, 2010). Hence, metacognition is an important concept in the teaching-learning process.

Metacognition

Flavell (1976) defined metacognition as a person's knowledge about his or her own cognition and about the control he or she has over it. Moreover, metacognition refers, to the active monitoring and consequent regulation and orchestration of processes in relation to cognitive object or data (Choudhury & Chowdhury, 2015).

Metacognotion has two components, namely, knowledge of cognition and regulation of cognition (Brown,1987; Schraw & Dennison, 1994; Schraw & Moshman, 1995; Schraw, 1998; Schraw, *et al*., 2006; Choudhury & Chowdhury, 2015). Knowledge of cognition is knowledge about a person's cognitive processes and knowledge about strategies and when, how and where to use them (Brown, 1987; Jayapraba, 2013; Schraw, 1994; Titus & Annaraja, 2011). Knowledge of cognition has three subcomponents, namely, declarative, procedural, and conditional knowledge (Schraw, 1998; Sperling, *et al*., 2004; Schraw, *et al*., 2006).

Declarative knowledge refers to knowing ourselves and knowing what factors affect our performance (Schraw, et al., 2006) whereas procedural knowledge refers to knowing how to do things and knowing which one and how to use strategies (Schraw, 1998; Schraw, et al., 2006). Conditional knowledge refers to knowing the why and when aspects of cognition (Schraw, 1998). It directs us when and why to use these strategies according to the situation and to select the best strategy at the right time while performing a task (Schraw & Dennison, 1994; Schraw, et al., 2006). In short, conditional knowledge refers to knowing when and why to use declarative and procedural knowledge (Garner, 1990).

Regulation of cognition on the other hand refers to activities regarding self-regulatory mechanisms during an on-going process (Jayapraba, 2013; Schraw, 1994; Schraw, 1994; Titus & Annaraja, 2011). It includes at least three components, planning, monitoring, and evaluation (Jacobs & Paris, 1987; Schraw & Moshman, 1995).

Planning refers to the selection of appropriate strategies and allocation of resources that affect performance to achieve the desired outcome (Schraw, 1998). Planning includes goal setting, activating relevant background knowledge, and budgeting time. Previous research suggests that experts are more self-regulated compared to novices largely due to effective planning, particularly global planning that occurs prior to beginning a task (Schraw *et al.,* 2006). Monitoring is an on-line awareness and checking comprehension and task performance which include the self-testing skills necessary to control task performance (Schraw *et al.,* 2006). Evaluation is the appraisal of the performance outcomes and efficiency of one's task performance (Brown, 1980; Schraw *et al*., 2006). It also refers to assessing the products and regulatory processes of one's task performance. Typical examples include re-evaluating one's goals, revising predictions, conclusions and consolidating intellectual gains **(**Schraw, 1998; Schraw *et al*., 2006).

Role of Metacognition in Teaching

According to Mai (2015), metacognition plays an important role in teaching, learning, social cognition, attention, self-discipline, problem solving, communication and personality development. Metacognition has its own critical role for teachers to be successful in teaching and learning (Titus & Annaraja, 2011). A high level of metacognitive awareness is critical not only for teachers but also for students (Memnun, 2014). An effective teacher understands cognitive processes and features of the processes and structures and how to increase students' awareness of how those structures and processes can be used more effectively (Livingston, 1997). Metacognition enables teachers to regulate their teaching activities according to students, goals and situation (Hartman, 2001). It also helps the teachers to plan, monitor and evaluate thinking processes and products. Moreover, it equips the teachers with what information/skills/strategies they have, when, why and how to use them. Lack of metacognitive awareness limits teachers' ability to be effective in the classroom (Tüysüz *et al*., 2008).

Teachers face many challenges in the classroom while teaching, for instance, diversity of students in learning style, culture, background, etc. Therefore, they need to adjust their teaching strategies, materials and classroom environment to engage all learners. Conditional knowledge enables the teacher to adjust to the changing situational demands of each task in relation to diversity of students (Schraw, 1998). It helps them to selectively allocate resources and use strategies more effectively (Reynolds, 1992).

For successful teaching and learning process, teachers must be conscious and continually monitor and evaluate their own teaching behavior (Ya-Hui, 2012). This includes the manner in which the teaching process is developing, the efficiency of their teaching strategies, the quality of interaction

with students, understanding their own teaching and feelings, as well as the students' thinking and feelings, and changing teaching strategies if required. Moreover, studies indicated that the ability of teachers to reflect and think about their own teaching is a crucial part of self-regulation; monitoring and evaluation (Ya-Hui, 2012).

Titus and Annaraja (2011) indicated that teachers' planning of the way to approach a task, the way of monitoring and evaluation of the progress of a task helps them to improve their competency in teaching. This is because, according to Armour-Thomas (1989) the plans of teachers influence their perceptions and judgments of the objectives of instruction, the learning experiences they design for their students, and the procedures and resources they use for organizing and managing instruction.

Different scholars conducted researches at different times to assess teachers' metacognitive awareness and its effect on their success in teaching and found out that most teachers with high metacognitive awareness of teaching were successful in their work. Research conducted by Yavuz and Memiş (2010) pointed out that teachers have high levels of metacognitive awareness in teaching. Another research conducted by Choudhury and Chowdhury (2015) indicated that majority of teacher educators have average level of metacognition awareness. However, there is a difference in the extent to which teachers are thinking about how they think about their teaching (Tanner, 2012). Science teachers are aware of reasons for choosing each teaching technique, using teaching techniques that worked in the past, and setting teaching goals before start teaching (Mai, 2015).

According to the findings of the study by Choudhury and Chowdhury (2015), there is a significant difference between male and female secondary teacher educators in their metacognitive awareness. The study reported that mean score of male teacher educators is higher than female teacher educators in their metacognition awareness. However, a study conducted by Aydın and Coşkun (2011) shows that no significant difference was found in metacognitive awareness of male and female teacher educators.

Studies showed that teachers who demonstrate a wide range of metacognitive skills perform better in their teaching and complete work more efficiently (Titus & Annaraja, 2011). If teachers have metacognitive awareness, they think about their own thinking regarding instructional goals, teaching strategies, sequence, materials, students' characteristics and needs, and issues related to curriculum, instruction and assessment before, during and after lessons (Mai, 2015). Moreover, teachers think about how teaching will activate and develop students' metacognition, or thinking about their own thinking as learners (Rahman, 2011). This is an important ingredient of modern teaching learning process in which students are able to grasp knowledge that can help them in their day-to-day life and become self-directed learners. Hence, teachers should have to develop higher metacognitive awareness so that they perform their work efficiently and become successful

in their profession and can train their students to develop metacognitive awareness that helps them in successful learning.

Therefore, as it is clearly stated by Mai, (2015), metacognitive awareness of teachers is regarded as an important factor in increasing their career's success, their creative and critical thinking, and building self-confidence. However, despite the fact that metacognition in teacher education is a crucial issue, insufficient empirical research has been conducted on the use of metacognition by teachers (Ya-Hui, 2012). Similarly, there has not been any research examining the levels of metacognitive awareness of biology teachers in the literature in Ethiopian context. As a result, it is very important to determine the level of metacognitive awareness of biology teachers in Ethiopia.

Research questions

Previous research confirmed that those teachers who are metacognitively aware can perform their task effectively and they are successful in their teaching profession to enhance students' performance. Hence, investigating metacognitive awareness of teachers in Ethiopia becomes an important research area to enhance their success in their teaching. Accordingly, research questions for this study were as follows:

1. What is the level of metacognitive awareness of biology teachers in the PGDT program?
2. Is there any significant difference between biology teachers on their metacognitive awareness levels across gender and degree program attended?
3. Is there any significant difference on metacognitive awareness levels among biology teachers in terms of major components of metacognition?
4. Is there any significant difference on metacognitive awareness levels among biology teachers in terms of sub components of metacognition?
5. Is there any significant difference on metacognitive awareness levels among biology teachers in terms of teaching experience?

Research Method and Design

There are different research methods and designs used to uncover new information, create better understanding and solve problems in the world. In this study, quantitative research method and descriptive survey research design were used.

Research method

A research method is a strategy, assumption and process utilized in the collection of data to uncover new information for better understanding of a problem and it is used to implement a plan of a research. There are different research methods, namely, qualitative, quantitative and mixed research methods. In this study, quantitative research method was used because the research was aimed at generating knowledge about the level of metacognitive awareness of teachers using questionnaire as data collecting instrument.

The Research Design

Research design is a plan that shows how to collect data and analyze data to answer a research question by discovering new information to understand the problem. In this study, a descriptive survey design was employed. This is because a descriptive survey design allows a researcher to gain knowledge to make informed decisions about the research problem. It also enables the researcher to collect data from large population and allows respondents to answer questions freely. In this design, researcher developed questionnaire that helped to obtain quick information directly from the primary source was used.

Sources of Data

The sources of data in research can be primary or secondary sources. In this study, the sources of data were primary sources. Data were collected directly from biology teachers who were enrolled in the PGDT program in the Department of Science and Mathematics Education, College of Education and Behavioral Studies, Addis Ababa University.

Sampling

Using purposive sampling method, biology teachers were selected from science departments (chemistry and physics teachers) who were enrolled in the PGDT program. All biology teachers participated in the study because their number was considered manageable. The participants of the research were 90 biology teachers in the postgraduate diploma in teaching program at Addis Ababa University, College of Education and Behavioral Studies, Department of Science and Mathematics Education. Of the total number, 52 were males and 38 females. All of the participants have Bachelor's degree in biology but attended their programs in different delivery modes. That is, 43 of them obtained their Bachelor degrees in regular program while 47 of them obtained their Bachelor's degree in summer program.

Instrument

In this study, the researcher used Metacognitive Awareness Inventory for Teachers (MAIT) developed by Balcikanli (2011). This instrument consists of 24 items with 5-point Likert –Scale questions ranging from (1) "strongly disagree" to (5) "strongly agree". The highest point to receive from this 5-scale Likert type inventory is 120, the lowest point is 24. Balcikanli (2011), reported the Cronbach's Alpha results of the questionnaire internal consistency with alpha coefficient of 0.88. This means that the instrument has a good reliability and can be used to measure the science teachers' awareness about metacognition.

Techniques of Data Analysis

Data obtained through questionnaire were analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0 statistical software. Independent sample t test, and one way ANOVA were employed in analyzing the data.

Results

The main aim of this study was to investigate biology teachers' awareness about metacognition in teaching in general, and to investigate if there was a significant difference in metacognitive awareness between them in terms of their gender, program through which they obtained their Bachelor's degree in biology, service year and components of metacognition in particular.

After collecting data using metacognitive awareness inventory for teachers (MAIT), first the reliability of items and normality of the data were checked. The data were normally distributed and had acceptable internal - consistency reliability with Cronbach's Alpha of 0.87 which is similar with internal consistency Cronbach's Alpha of 0.88 reported by Balcikanli (2011). After checking the reliability and normality, inferential statistics such as independent t test and F test were used to see if there were significant differences among the various groups.

Table 1

Means and Standard Deviations Comparing the Metacognitive Awareness of Biology Teachers

Metacognitive awareness	N	M	SD	levels
General Metacognition Awareness	90	4.07	.53	High
Knowledge of cognition	90	4.04	.42	High
Declarative knowledge	90	4.17	.52	High
Procedural knowledge	90	3.90	.52	High
Conditional knowledge	90	4.05	.56	High
Knowledge of regulation	90	4.04	.54	High
Planning	90	4.08	.61	High
Monitoring	90	4.01	.61	High
Evaluation	90	4.03	.66	High

The first research question of this study was what is the biology teachers' metacognitive awareness level? The descriptive statistics result (Table 1) showed that, biology teachers have mean greater than 4 in general metacognitive awareness (M = 4.07) and in major components; knowledge of cognition (M =4.04) and knowledge of regulation (Mean = 4.04). This implies that biology teachers have high levels of metacognitive awareness in teaching. Biology teachers have slightly lower mean in procedural knowledge and higher mean in declarative knowledge of subcomponent of knowledge of cognition. Similarly, they have slightly higher mean in planning and lower mean in monitoring of subcomponent of knowledge of regulation.

The second research question of this study was about whether there was any significant difference between males and females in biology teacher' metacognitive awareness levels or not. From the results obtained, the mean within each of the two pairs looks somewhat different. But the result from the t-test analysis (Table 2) revealed that there was no statistically significant difference between male and female in general metacognitive awareness ($t(88) = -.606$, $p > 0.05$) and in all major and subcomponents of metacognition. This implies that both male and female biology teachers had similar level of metacognitive awareness. However, there was a significant difference between male and female in metacognitive awareness in one of the sub-components, planning

(t(88)= -2.343, p < 0.05). Female biology teachers had better awareness of planning than male biology teachers.

Table 2

Metacognitive Awareness of Biology Teachers in relation to gender

Variables	N	M	SD	t	df	p
Metacognitive Awareness						
Male	52	4.04	.54	.61	88	.55
Female	38	4.11	.53			
Knowledge of cognition						
Male	38	4.02	.44	.32	88	.75
Female	52	4.15	.52			
Declarative knowledge						
Male	52	4.15	.52	.27	88	.79
Female	38	4.18	.53			
Procedural knowledge						
Male	52	3.96	.49	1.14	88	.26
Female	38	3.82	.56			
Conditional knowledge						
Male	52	4.05	.52	.09	88	.93
Female	38	4.06	.62			
Knowledge of regulation						
Male	52	3.97	.53	1.50	88	.14
Female	38	4.14	.55			
Planning						
Male	52	3.96	.67	2.34	88	.02
Female	38	4.26	.49			
Monitoring						
Male	52	3.96	.55	.94	88	.35
Female	38	4.08	.68			
Evaluation						
Male	52	3.99	.66	.66	88	.50
Female	38	4.09	.66			

The third research question was whether there was any significant difference in biology teachers' metacognitive awareness levels in programs they had attended to earn their Bachelor's degree or not. From the results obtained, the mean of the two pairs seems different. But, the result from the independent sample t-test analysis (Table 3) revealed that there was no statistically significant difference between those who obtained their Bachelor's degree through regular and summer program in general metacognitive awareness (t(88) = -.458, p > 0.05) and in all major and sub components of metacognition. However, it was observed that a statistically significant difference existed between those who obtained their degree through regular and summer program in metacognitive awareness of planning (t (88) = -2.222, p < 0.05). Biology teachers who had obtained their degree in summer program had better awareness of planning than those who studied in regular program. This implies that biology teachers from the two programs had similar level of metacognitive awareness except awareness of planning.

Table 3

Metacognitive Awareness of Biology Teachers in Relation to their Degree Program

Variable	N	M	SD	T	df	p
Metacognitive Awareness						
Regular	43	4.05	.56	-.458	88	.65
Summer	47	4.10	.51			
Knowledge of cognition						
Regular	43	4.02	.41	-.457	88	.65
Summer	47	4.06	.43			
Declarative knowledge						
Regular	43	4.12	.54	-.873	88	.39
Summer	47	4.21	.51			
Procedural knowledge						
Regular	43	3.90	.49	-.028	88	.97
Summer	47	3.90	.56			
Conditional knowledge						
Regular	43	3.92	.98	-.195	88	.85
Summer	47	3.94	.98			
Knowledge of regulation						
Regular	43	3.94	.56	-1.709	88	.09
Summer	47	4.13	.52			
Planning						
Regular	43	3.94	.69	-2.222	88	.03
Summer	47	4.22	.50			
Monitoring						
Regular	43	3.89	.62	-1.710	88	.09
Summer	47	4.11	.58			
Evaluation						
Regular	43	3.99	.68	-.579	88	.56
Summer	47	4.07	.65			

The fourth research question was whether there was any significant difference in metacognitive awareness levels of biology teachers in terms of the two major components (knowledge of cognition and regulation of cognition) of metacognition or not. Unfortunately, the mean of the two was found to be the same (M=4.04) and hence there was no difference between biology teachers in metacognitive awareness of knowledge of cognition and regulation of cognition.

The fifth research question was about whether there was any significant difference in metacognitive awareness level of biology teachers in terms of sub components of knowledge of cognition (declarative knowledge, procedural, conditional) and regulation of cognition (planning, monitoring and evaluation). From the results obtained, the mean within each of the three sub components looks somewhat different as indicated in table 1. And further, the result from one way ANOVA analysis (Table 4) showed that there was statistically significant difference in metacognitive awareness between the first three sub components $F(2, 267) = 5.48$, $p < .05$.

To check in which sub component they differ, post hoc comparison was made and the result indicated that there was a statistically significant difference in metacognitive awareness for declarative knowledge and procedural knowledge ($p < .05$). The two groups means indicate that the mean of metacognitive awareness of declarative knowledge (M=4.17) was significantly higher

than the mean for procedural knowledge (M=3.90). This implies that biology teachers had better awareness on declarative knowledge than procedural knowledge. This enables biology teachers to know themselves and factors that affect their performance.

Table 4

One-Way Analysis of Variance Summary Table

	Metacognitive awareness				
Sub components	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.15	2	1.58	5.48	.01
Within Groups	76.77	267	.29		
Total	79.93	269			

There was no statistically significant difference among biology teachers between metacognitive awareness of declarative knowledge and conditional knowledge; procedural knowledge and conditional knowledge.

Table 5

Post Hoc Multiple Comparisons Summary Table

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
1 Declarative	2 Procedural	.26*	.08	.00
	3 Conditional	.11	.08	.33
2 Procedural	3 Conditional	-.15	.08	.15

The second subcomponent of metacognition includes planning, monitoring and evaluation. From the results obtained, the means of the three subcomponents seem to be different as indicated in table 1. To check this difference one way ANOVA was computed. The result from one way ANOVA analysis (Table 6) shows that there was no a significant difference in metacognitive awareness of planning, monitoring and evaluation $F(2, 267) = .34$, $p > .05$.

Table 6

One-Way Analysis of Variance Summary Table Comparing the Three Sub Components

	Metacognitive awareness				
Sub components	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.27	2	.13	.34	.71
Within Groups	104.91	267	.39		
Total	105.18	269			

The fifth research question was whether there was any significant difference in biology teachers' metacognitive awareness in terms of experience or not. From the results obtained, the mean of the three-year categories of experience are different (Table 7). The mean for experience of 1-5 year (M=4.07), experience of 6-10 years (M=4.04) and experience 11 and above year (M=4.12).

To check this mean difference, F-test was computed. The result from one way ANOVA analysis (Table 8) shows that there was no significant difference among the three categories of experience in general metacognitive awareness, $F = 2, 87 = 0.19$, $p > .05$ and in major and sub components except in sub component of planning, $F = 2, 87 = 3.42$, $p < .05$.

Table 7

Means and Standard Deviations Comparing the Three Experience Year Category

		General metacognitive awareness		Planning	
Experience	**N**	**M**	**SD**	**M**	**SD**
1-5years	43	4.07	.57	3.97	.69
6-10years	29	4.04	.52	4.08	.58
11 and above	18	4.12	.47	4.40	.31
Total	90	4.07	.53	4.09	.61

Table 8

One-Way ANOVA Table Comparing in Terms of Experience

Groups		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
MAL	Between Groups	.12	2	.06	.19	.82
	Within Groups	25.11	87	.29		
	Total	25.23	89			
PLAN	Between Groups	2.44	2	1.22	3.42	.04
	Within Groups	30.98	87	.36		
	Total	33.41	89			

To check this difference, post hoc test was computed and the result (Table 9) indicates that metacognitive awareness of planning for experience of 1-5 years and 11 and above differed significantly ($p < .05$). Moreover, there was a significant difference between experience of 6-10 years and experience of 11 and above years in metacognitive awareness of planning ($p < 0.05$,). Biology teachers with experience above 11 years had a high awareness of planning. But there was no statistically significant difference between experience of 1-5 years and 6-10 years in metacognitive awareness of planning. This implies that teachers with high experience had better awareness of planning.

Table 9

Post Hoc Analysis with Games-Howell Summary Table Comparing Experience for Planning

Dependent Variable	**(I) SYr**	**(J) SYr**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**
Planning	1-5yrs	6-10yrs	-.11	.15	.74
		>11yrs	-.44*	.13	.00
	6-10yrs	>11yrs	-.33*	.13	.04

Discussion

Research findings indicate that metacognition is very important concept in education and has an impact on teachers to be successful in teaching and learning process. It affects teaching and learning process of individuals and plays the main role in self-regulation which is necessary to be successful in teaching and learning. Hence, metacognitive awareness of teachers has an impact on teachers' effectiveness as well as on their students' success. For this reason, determining teachers' metacognitive awareness becomes necessary. That is, this study was aimed at investigating

metacognitive awareness of biology teachers enrolled in post graduate diploma program and to compare it in terms of their gender, degree program and service years.

In this study, it was found out that the levels of biology teachers' metacognitive awareness in teaching were high. They had similar awareness level in knowledge of cognition and regulation of cognition and in subcomponents of regulation of cognition (planning, monitoring and evaluation). However, they differ in metacognitive awareness level of sub components knowledge of cognition (declarative knowledge, procedural knowledge and conditional knowledge). Biology teachers had better awareness on declarative knowledge than procedural knowledge.

This high level of metacognitive awareness of biology teachers implies that biology teachers are effective in regulating their teaching activities, goals and situations and in planning, monitoring and evaluating their work and selecting and deciding when, why and how to use strategies/skills (Hartman, 2001). Teachers with high metacognitive awareness can think about their own thinking regarding instructional goals, teaching strategies, assessment strategies, sequence, materials, students' characteristics and needs before, during and after lessons (Mai, 2015) and how they activate and develop students' metacognition as well (Rahman, 2011). This enables students become independent, self-directed learners instead of solely depending on their teachers.

Diversity of students in learning style, in culture, background, etc is one of the challenges for teacher in classroom to address. Teachers need to adjust their teaching strategies, materials and classroom environment to engage all learners. Metacognitive awareness enables the teacher to adjust to the changing situational demands of each task, selectively allocate resources and use strategies more effectively in relation to diversity of students (Reynolds, 1992; Schraw, 1998). The higher metacognitive awareness of biology teachers, as indicated in the finding of this study, is evidence for teachers' ability to manage the diverse needs of learners and effectively run the teaching learning process.

It was found out that biology teachers had better awareness of declarative knowledge than procedural knowledge, the two sub components of knowledge of cognition. Declarative knowledge refers to factors affecting performance and knowledge about oneself (Schraw, et al., 2006). Procedural knowledge is one's knowledge about strategies and other procedures (Schraw & Moshman, 1995). Declarative knowledge is awareness of self-skills, intellectual capacity and capabilities an individual can attain this knowledge from presentations, demonstrations and discussions (Bulut, 2018). The apparent higher score in declarative knowledge than procedural knowledge might be due to the education system, which focuses on content knowledge. That is, teachers are mainly focused on content knowledge of themselves rather than other instructional issues like pedagogy and technology. The current education system emphasizes the integration of modern pedagogy and technology in actual teaching learning process. Hence, there is a need to work on teachers to increase their awareness on procedural knowledge.

The finding of the current study is supported by previous research (Yavuz & Memiş, 2010; Ya-Hui, 2012; Choudhury & Chowdhury, 2015; Mai, 2015; Batdi, 2016). These studies indicated that teachers at different levels and different disciplines have good metacognitive awareness of teaching. For instance, Yavuz and Memiş (2010) reported that teachers have high levels of metacognitive awareness in teaching. Besides, Batdi (2016) found that teachers have high levels of metacognitive awareness. On the other hand, Choudhury and Chowdhury (2015) indicated that majority of teacher educators have average level of metacognition awareness.

The findings of this study indicated that no significant difference was found across gender in general metacognitive awareness but female biology teachers had better awareness of planning than did their male counterparts. Planning of the way to approach a task, the way of monitoring and evaluation of the progress of a task help them to improve their competency in teaching (Titus & Annaraja, 2011). Because the plans of teachers influence their perceptions and judgments of the objectives of instruction, the learning experiences they design for their students, and the procedures and resources they use for organizing and managing instruction (Armour-Thomas, 1989). Planning emphasizes the selection of appropriate strategies and determination of cognitive skills for effective performance (Schraw & Dennison, 1994). Griffith et al. (2016) stated that the high level of metacognitive awareness of teachers about planning of teaching has a positive effect on their performance and the teaching learning process. Therefore, female biology teachers are better in metacognitive awareness of planning and hence successful in their teaching learning process than their counter parts.

This finding is supported by study conducted by Aydın and Coşkun (2011) that shows no significant difference in general metacognitive awareness of male and female teachers. Other studies reported a significant difference between the teachers' general metacognitive awareness levels in favor of female teachers (Asikcan & Saban, 2018; Rozendaal et al., 2003; Saracaloglu & Cengel, 2013). They reported that female teachers had better metacognitive awareness than male teachers' in general metacognitive awareness. These findings support better awareness of female with respect to planning. However, there are also research findings that reported that male teachers were better than females (Choudhury & Chowdhury, 2015). Hence, there is a need for further research to investigate this in consistency of findings.

The findings of this study revealed that biology teachers who obtained their degree in summer program have better awareness than those who studied in regular program in planning. This might be due to on-the-job experience teachers had.

Findings from teachers experience perspective support the above result. These findings indicated that biology teacher with experience above 11 years had higher awareness of planning than those with experiences below 10 years. But experience had no effect on other components of metacognition like that of degree program they attended and gender. The plans of teachers influence their perceptions and judgments of the objectives of instruction, the learning experiences

they design for their students, and the procedures and resources they use for organizing and managing instruction (Armour-Thomas, 1989). Teachers' planning of the way to approach a task, monitoring, comprehension and evaluate the progress towards completion of a task helps them to improve their competency in teaching (Titus & Annaraja, 2011).

The result obtained from this research is in parallel with findings of the research conducted by Win and Khaing (2011), in which experienced teachers were more aware of planning than inexperienced teachers but contradicts with findings in relation to general metacognitive awareness and other components. Hence, there is a need for further investigation.

Conclusion and Recommendation

The level of metacognitive awareness of biology teachers was high in general and with its indicators, knowledge about cognition and regulation of cognition as well. However, metacognitive awareness in planning varies according to gender, degree program and teachers experience. Female biology teachers who attended degree in summer program and those with high experience had better awareness of planning. Moreover, metacognitive awareness in declarative knowledge, procedural and conditional also varies. Biology teachers had better awareness of declarative knowledge. This implies that even though biology teachers are generally well aware of metacognition, there is a difference in awareness for some components. Teachers have to develop higher metacognitive awareness in all its dimensions so that they can perform their work effectively; help their students to develop metacognitive awareness that help them in successful learning and become successful teachers in their profession.

Hence, there is a need to consider the notion of metacognition in teachers training program, professional development programs and in short-term in-service training on method of teaching. Further research will be mandatory to fill some contradicting results.

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