Metacognitive awareness, knowledge and regulation of cognition factors among Lithuanian university students

Tomas Butvilas
Institute of Educational Sciences and Social Work, Mykolas Romeris University, Vilnius, Lithuania

Deimantė Žilinskienė
Business Innovation School, Kazimieras Simonavicius University, Vilnius, Lithuania

Remigijus Bubnys
Siauliai Academy, Vilnius University, Siauliai, Lithuania

Jordi Colomer
Department of Physics, Institute of Sciences Education, University of Girona, Girona, Spain

Dolors Cañabate
Department of Specific Didactics, Institute of Sciences Education, University of Girona, Girona, Spain, and

Marjan Masoodi
Independent Researcher, Vilnius, Lithuania

Abstract
Purpose – The importance of metacognitive awareness in learning, on the one hand, and the necessity of considering demographic variables, on the other hand, have encouraged the researchers to conduct this research. This research aims to initially determine the relationship between the level of metacognitive awareness and demographic variables of students from three Lithuanian universities, such as age, gender and area of study.

Design/methodology/approach – The quantitative research strategy was applied in this study using the survey with the students scoring the Metacognitive Awareness Inventory (MAI). The research involved 296 students from three universities in Lithuania. Data were analysed using statistical analysis methods to compare different groups of subjects according to selected criteria.

Findings – It became evident that two demographic variables of age and the field of study had a relationship with knowledge of cognition. Conditional knowledge had a positive relation with the variables of age and the field of study. Procedural knowledge was the second area which had a relation with the area of this study. Therefore, it maybe be concluded that under specific circumstances, declarative and procedural knowledge is at the same level of performance while conditional knowledge revealed the highest relation with metacognitive awareness. Furthermore, no statistically significant difference was found with gender in all metacognitive subcomponents despite the initial assumption.

Research limitations/implications – One of the limitations of this study is that the research did not address the actual application of metacognitive strategies during teaching and learning. The research would benefit from in-depth class observation and triangulation of data from various sources. The teaching model should be tested in a larger population to obtain aggregated results for a vast population.

Originality/value – Results are significant in identifying students’ cognitive abilities which can be attributed to various factors such as creativity, which in turn may efficiently foster students’ potential. Metacognitive awareness can be developed by explicitly informing students about the importance of metacognition and lifelong learning. Lecturers’ role-modelling induce students to continuously assess, monitor, plan and reflect on...
their own learning process as well as to recognize cognition along with metacognitive prompts, questions, checklists, reports and discussion of topics in the learning process.

Keywords Cognition, Metacognitive awareness, Regulation of cognition, University students

Paper type Research paper

1. Introduction

The paradigm for acquiring skills has changed somewhat in the last 20 years to accommodate the transition from a teaching-centered to a learning-centered approach to instruction. As a result, the most cutting-edge educational approach has been shifted from teaching to learning. Metacognitive awareness has been identified as the key factor contributing to this shift and success in learning since it promotes future competencies such as reflective competencies, self-management, learning literacy, personal agency and self-efficacy (Conyers and Wilson, 2016; Mastrothanais et al., 2018; Kleimola and Leppisaari, 2022). The metacognitive awareness perspective on learning, which regards learning as a dynamic process including active control over the cognitive process and empowers the learner to take control of his actions, has had a significant impact on this transition. Based on this view, the learner is seen as a self-directed individual who knows how, when, where and why to use each metacognitive strategy effectively for both promoting lifelong learning and higher academic achievement (Conyers and Wilson, 2016; Fleming, 2014).

Metacognitive awareness encompasses two main components: knowledge of cognition with three subcomponents of declarative, procedural and conditional knowledge and regulation of cognition with five subcomponents of planning, information management, comprehension monitoring, debugging and evaluation (Schraw and Dennison, 1994; Schraw et al., 2006; Ma and Baranovich, 2015). Knowledge of cognition plays a significant role in monitoring the productivity of metacognition, first, by tackling the questions “what”, “how”, “when” and “why” (Ma and Baranovich, 2015), second, by assessing cognition and third, by reflecting on what is happening in the brain while looking for the solution in formal education. Declarative knowledge, as the basic part of cognition, is the knowledge of what one knows as well as the knowledge of how to learn and what aspects affect the learning process. In fact, it constitutes the person’s insights about his or her learning processing ability and the factors that affect one’s performance (De Backer et al., 2011). Individuals can feel this knowledge when they detect a gap between their understanding and the demands of the tasks or when they know their weaknesses in applying procedural knowledge. A learner with declarative knowledge about a specific strategy is more critical in using that strategy repeatedly.

Learner’s low efficacy or low self-motivation may be due to a lack of procedural knowledge, the second subcomponent of knowledge of cognition (Ma and Baranovich, 2015). Procedural knowledge is as a method applied to get a learning goal by providing the learner with a sense of security in tackling a learning problem. Procedural knowledge is the ability to deal with strategies to improve performance, which can be considered as a mechanism for learners to get access to the new scientific knowledge (Zoupidis et al., 2016).

Conditional knowledge, the third subcomponent of cognition knowledge, is regarded as the highest level of cognition and employs particular procedures under learner’s proper settings. It is an inductive reasoning based on facts (Kiesewetter et al., 2016). Conditional knowledge has a great impact on the implementation of the cognition regulation, (the second main component of knowledge of cognition) and is expected to move the individual’s conditional knowledge to a higher position than his/her declarative and procedural knowledge. It is regarded as the knowledge which develops faster than other knowledge, making a great impact on the level of the individual’s metacognitive awareness. Conditional knowledge serves as a requirement for declarative knowledge to become functional in order to learners to profit from strategies (Cikrikci and Odaci, 2016). Any new learning/training
requires the application of suitable strategies stimulating the development of conditional knowledge. A wide range of new situations involve the development of creativity and creative thinking, both of which are considered components of conditional knowledge (van de Kamp et al., 2016).

Age is an effective factor in the development of the knowledge of cognition. Adults generally have higher levels of knowledge of cognition than children and adolescents (Schraw et al., 2006).

2. Theoretical background

2.1 A discourse on metacognitive awareness in university studies

Metacognitive awareness and its components. This section presents the theoretical and conceptual framework of this study and owes a lot to Schraw and Dennison’s theory (1994). Metacognitive Awareness includes awareness of the learning process, learning evaluation, creation of metacognitive strategies and their implementation. This term consists of two different but interrelated parts: knowledge of cognition and regulation of cognition (Schraw and Dennison, 1994; Schraw et al., 2006). Knowledge of cognition refers to what individuals know about their own cognition. This component has three subcomponents: declarative, procedural and conditional knowledge (Harris et al., 2010; Ma and Baranovich, 2015; Schraw and Dennison, 1994; Young and Fry, 2008). Individuals’ cognitive knowledge which includes their attitudes towards their capabilities is regarded declarative knowledge. Therefore, we can say that attitude is a subcategory of declarative knowledge. Procedural knowledge refers to the individual’s awareness, considering how to employ strategies in order to solve problems. Conditional knowledge means that an individual knows when and why to apply declarative and procedural knowledge. Regulation of cognition refers to activities that assist learners in regulating their learning and include five subcomponents: planning, monitoring, evaluation, debugging and information management (Schraw and Dennison, 1994; Schraw et al., 2006). Suitable strategies and cognitive skill selections for a good outcome are called planning which encompasses target setting, application of related background knowledge, allocation of resources and time management. Information management constitutes application of a chain of strategies to process information properly. Monitoring includes identification of errors and their correction before the evaluation stage if something goes wrong in completing a task. During evaluation the learner evaluates his/her own learning process. The use of any strategy for correction of errors or asking for help upon encountering any problem is referred to as debugging.

Other scopes of metacognitive awareness. The metacognitive awareness construct is not completed without Self-Regulated Learning (hereafter SRL), which assists to control one’s own behavior and connects cognition and metacognition (Zimmerman and Moylan, 2009; Schraw et al., 2006; Zimmerman and Schunk, 2011). SRL involves an underlying sense of self-efficacy, motivational and emotional constructs and is the means to modify self-belief towards learning (Sperling et al., 2010; Tanner, 2012). In fact, these factors influence metacognitive awareness, at the same time being affected by metacognitive awareness (Clark, 2014). Papaleontiou Louca (2008) and Flavell (1979) metacognitive awareness is more psychological and affective than cognitive.

Students’ and lecturers’ attitudes. Attitudes as a confusing and messy concept affect making sense of the world, perceiving, accepting and rejecting new information and how knowledge is employed (Borg, 2009; Mansour, 2013). Understanding one’s attitudes requires recognition of the underlying mind state of that person, which is not an easy task since that person may be unable or unwilling to express his or her attitudes (Borg, 2009; Bullock, 2010; Mansour, 2013). This causes inconsistency between attitudes and practices (Mansour, 2013).
Identification of students’ attitudes can assist lecturers not only to reflect on their teaching and creatively modify it based on their students’ requirements and expectations but also to guide the students to get rid of their detrimental notions in learning (Bernat, 2008). Lecturers’ attitudes are a more crucial factor than their knowledge of effective teaching (Xu, 2012). Lecturer values and perceptions of students are inextricably intertwined, and many students act in the way their teachers expect them to act, even if it is unconsciously and nonverbally (Hornstra et al., 2010; Klehm, 2013). Attitudes are also associated with learning and teaching expectations (Bernat, 2008) and class practices (Borg, 2009; Bullock, 2010; Mansour, 2013; Zheng, 2013).

2.2 Relation between knowledge and regulation of cognition

In a broad perspective, metacognitive awareness is postulated in two clusters of interconnected (Schraw et al., 2006) components. The first cluster is related to students’ states of awareness of their learning process while the second cluster pertains to control components regulating this process.

Schraw and Dennison (1994) proposed that the two essential components of metacognitive awareness are inextricably linked. The research of Azevedo and Aleven (2013), Cho and Cho (2013) and Schraw and Dennison (1994) were significant in demonstrating that the three subcomponents of knowledge of cognition are related to each other and can predict and provide insights into each other. If one subcomponent of cognition knowledge is at a high degree, the others are as well. However, Maftoon et al. (2012) found some unskilled learners who were aware of the writing cognitive process yet unable to monitor and control the process, which could have been due to other factors, such as their attitudes.

Scott and Levy (2013) and Abdellah (2015) did not find any correlation between knowledge of cognition and regulation of cognition. Scott and Levy (2013) observed substantial differences in the regulation of cognition of graduate and undergraduate students, but not in the knowledge of cognition component. Graduate and undergraduate students did not differ in relation to knowledge of cognition, differences between them were found with regard to their regulatory skills. Investigating Turkish student population, Roussos et al. (2016) found ample use of subcomponents of knowledge of cognition instead of regulation of cognition subcomponents. These findings put forward research results of Schraw and Dennison (1994) and Abdellah (2015) who found that adult learners tended to differ with regard to the use of metacognitive regulatory skills and there were less differences with regard to metacognitive knowledge skills.

2.3 Influence of demographic variables on metacognitive awareness

Although there are several studies which indicated the relationship between the level of metacognitive awareness and gender in favor of female students (Aljarah and Obeidat, 2011; Atay, 2014; McMullen, 2009; Öztürk, 2014) in many countries in the university settings, gender differences were not reflected in quite a few of studies, for example, studies conducted by Adigüzel and Orhan (2017), Al-Hamouri and Abu Mokh (2011) and Öztürk (2014). However, these results opposed the findings of Jaberi and Gheith (2015), showing that some differences existed based on gender in the evaluation subcomponents in favor of males; and in planning, in favor of females. Yunus et al. (2009) discovered that female students had a higher level of metacognitive awareness than men on the debugging subcomponent alone.

There is no consensus on the connection between the two key components of metacognitive awareness and age. There is a popular idea that children learn better than adults. On the other hand, some researchers (Lee and Oxford, 2008) are less certain about the superiority of juveniles in the learning process, arguing that the oldest students were not the weakest, nor the youngest were the best. Though many scientists (Aljarah and Obeidat, 2011;
Atay, 2014; Öztürk, 2014; Kiesewetter et al., 2016) also supported this idea, there is enough evidence about the influence of age on learning which is unclear and inconclusive. McMullen (2009) and Memnun and Akkaya (2009) argued that the increased scores of metacognitive awareness from freshmen to seniors could be due to the differences in the study sample characteristics. Colomer et al. (2021) found that students acquired higher awareness of self-knowledge over the years although there was a decreasing need for self-reflection and self-regulation for acquisition of competencies.

Furthermore, experts in the field of metacognitive awareness have discovered the main areas of learners’ characteristics that can have a profound effect on the level of the metacognitive awareness, the choice and frequency of deployed metacognitive strategies (Conyers and Wilson, 2016; Fleming, 2014; Adigüzel and Orhan, 2017). Therefore, demographic variables that have been proved to have an impact on the level of metacognitive awareness are motivation for learning, level of language proficiency, learning duration, gender, age, cultural background, attitudes and beliefs, learning and cognitive styles, nationality as well as areas of study (Conyers and Wilson, 2016). However, the relationship between the level of metacognitive awareness and learners’ individual differences among Lithuanian university learners has not been analysed.

Thus, the importance of metacognitive awareness in learning (Conyers and Wilson, 2016; Fleming, 2014), on one hand, and the necessity of considering demographic variables (McMullen, 2009; Lee and Oxford, 2008), on the other hand, have encouraged the researchers to conduct this study. Moreover, drawing on the assumption of Schraw et al. (2006) that both metacognitive knowledge and regulation are necessary and complementary for learning, it is significant to know the relation between two main components of metacognitive awareness – knowledge of cognition and regulation of cognition. This has been taken as another rationale for defining this research.

3. Research methodology

3.1 Research scope, aim and research questions

The aims of this study are initially to determine the relation between the level of metacognitive awareness and the age, gender, area of study and type of university with regard to the relation between the two components of metacognitive awareness, i.e., the knowledge of cognition and the regulation of cognition. Being more specific in terms of those two key components – knowledge of cognition and regulation of cognition, we may refer to the research done previously; i.e., Aydin and Ubuz (2010) in their study support the theoretical distinction of the two terms – metacognitive knowledge (Flavell, 1979) and metacognitive regulation (Brown, 1987). Metacognitive knowledge refers to acquired knowledge in terms of person, task and strategy (Flavell, 1979) while Brown (1987) classifies it into subcomponents as declarative, conditional and procedural knowledge. Flavell (1979) proposes a unified theory of metacognitive regulation referred to as conscious use of strategies of planning, monitoring and controlling. Brown (1987), on the contrary, presupposes the existence of planning, selecting, monitoring, evaluating and debugging processes without the necessity of awareness.

As a result, the following two research questions were developed:

RQ1. What differences exist in the level of metacognitive awareness among Lithuanian university students?

RQ2. Is there a link between the two main metacognitive awareness components: the cognition knowledge and the regulation of cognition for university students?

3.2 Participants

The target population of this study was 296 first to fourth year bachelor’s degree learners of 3 state universities (chosen randomly from the biggest universities located in Vilnius,
Lithuania – U1 (87 students, 29.4%), U2 (151 students, 51.0%), U3 (58 students, 19.6%). All participants’ home and official languages were Lithuanian and according to the research ethics, research participants provided an informed consent.

Students involved in the research were selected randomly. The student sample size in the quantitative study is reliable. To this end, to provide evidence to determine whether the sample size of 296 (out of total population at that time N = 1384) is sufficient to get the correct results, a Sample Size Calculator was used. This calculator is presented as a public service of Creative Research Systems survey software. First, the confidence interval (the margin of error) was calculated by considering the three factors of sample size, population and percentage. Then, the results were entered into another table to calculate the sample size needed. The results showed that this study sample size to reflect the target population was precise enough. This means that 302 or more measurements/surveys are needed to have a confidence level of 95% so that the real value is within ±5% of the measured/surveyed value. After the survey, 6 completed questionnaires were rejected due to incorrect completion. Researchers gathered the data using an online survey platform, asking students to fill it while they were attending a course of English for Specific Purposes or any other English course.

Gender distribution of those who took part in the study is similar: 44.9% male and 55.1% female. The highest percentage of participants by age was between 21 and 22 years old – 37.8%, followed by 28.4% between 18 and 20 years old, 20.9% between 23 and 25 years old, 6.1% between 29 and 39 years old and 6.8% between 26 and 28 years old. The highest percentage of students opted for social sciences (47.7%) which is followed by humanities (18.8%), engineering (29.4%) and arts (4.1%).

3.3 Procedures and instrument reliability
Learners’ demographic data including their age, area of study, gender and university were identified at the beginning of the questionnaire to see their relations with the learners’ metacognitive awareness. To collect the required data, the Metacognitive Awareness Inventory (MAI), designed by Schraw and Dennison (1994), named “Assessing metacognitive awareness”, was employed. The questionnaire consisted of 52 items classified into eight sub-components subsumed under two broader components: knowledge of cognition with 3 sub-components and regulation of cognition with 5 sub-components. The answers to this questionnaire were structured in the form of statements. 5-point Likert Scale was used to rate the items, in which 5 stands for strongly agree; 4, for agree; 3, for neutral; 2, for disagree; and 1, for strongly disagree.

The Cronbach Alpha reliability index was calculated as an index of reliability for the metacognitive awareness questionnaire. The reliability value for the MAI scale for 52 items was 0.88; for the knowledge of cognition component, 0.85; and for the regulation of cognition component, 0.92. Therefore, it can be concluded that the questionnaire was optimally reliable to conduct the study.

3.4 Data collection procedures
This study was conducted observing the guidelines in both Code of Ethics and Conduct of the British Psychological Society and the APA Code of Ethics of the American Psychological Association, which respect and protect the rights of all participants. Research participants were informed about the aims of the study and that all data gathered would be treated anonymously and confidentially. All students signed the declarations of consent. Then, they were given 20 min to respond to the MAI questionnaire. The questionnaire was submitted to the quantitative analysis using SPSS 23.0, which included both the use of descriptive (means and SD) and inferential statistics (Kendall’s tau-b correlation was used to assess whether there was any relationship between two main metacognitive awareness components of
knowledge of cognition and regulation of cognition. In addition, eight \( t \)-tests were used to see if any significant differences existed between the overall score of the metacognitive awareness or any eight sub-components (i.e., Declarative, Procedural, Conditional, Planning, Comprehension monitoring, Information management, Evaluation and Debugging); a Mann Whitney \( U \) test was performed to find any relation between the participants’ gender and their metacognitive awareness.

Participants were assured that their participation was voluntary and that all data gathered would be treated anonymously and confidentially. To build rapport with the participant, the survey was continued by asking demographic questions about the participant’s age, gender, academic background.

4. Results
4.1 Group with higher level of metacognitive awareness
The first null hypothesis tested in this study was: There are no differences in the overall score of the metacognitive awareness or any eight subcomponents (Declarative, Procedural, Conditional, Planning, Comprehension monitoring, Information management, Evaluation and Debugging) among Lithuanian university students. Given that the data were normally distributed and having rather a small sample size, determining the distribution of the variables, it was important for choosing an appropriate statistical method. Therefore, a Shapiro-Wilk test was performed and did not show evidence of non-normality (\( W = 0.92, p = 0.11 \)). Based on this outcome and after visual examination of the histogram of chosen variables’ plot, we decided to use a parametric test. Also, the mean with the standard deviation was used to summarize the variables. Eight \( t \)-tests were used to analyse the first null hypothesis. To test this null hypothesis, the academic context of the university students was used as the independent variable. There were nine dependent variables for the first null hypothesis including the overall score of the metacognitive awareness and its eight subcomponents including Declarative, Procedural, Conditional, Planning, Comprehension monitoring, Information management, Evaluation and Debugging.

Table 1 specifies the mean, the standard deviation and the standard error of participants on the three subcomponents of knowledge of cognition and the mean, standard deviation and the standard error of the five subcomponents of regulation of cognition.

Independent \( t \)-tests were separately run to compare the mean scores on the knowledge and regulation of cognition subcomponents. The probability associated with the \( t \)-observed value (0.000) was lower than the significance level of 0.05, and it can be concluded that there was a significant difference between the mean scores on the knowledge and regulation of cognition subcomponents.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of cognition subcomponents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declarative</td>
<td>22.18</td>
<td>3.24</td>
<td>0.18</td>
</tr>
<tr>
<td>Procedural</td>
<td>13.37</td>
<td>2.52</td>
<td>0.14</td>
</tr>
<tr>
<td>Conditional</td>
<td>10.67</td>
<td>2.35</td>
<td>0.13</td>
</tr>
<tr>
<td>Regulation of cognition subcomponents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>26.4</td>
<td>4.02</td>
<td>0.23</td>
</tr>
<tr>
<td>Planning</td>
<td>19.03</td>
<td>3.20</td>
<td>0.18</td>
</tr>
<tr>
<td>Comprehension monitoring</td>
<td>18.73</td>
<td>3.32</td>
<td>0.19</td>
</tr>
<tr>
<td>Information management</td>
<td>26.4</td>
<td>4.02</td>
<td>0.23</td>
</tr>
<tr>
<td>Debugging</td>
<td>13.16</td>
<td>2.86</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Table 1. Statistics on the knowledge and the regulation of cognition subcomponents (\( N = 296 \))

Source(s): Author’s own creation/work
4.2 The relation between metacognitive awareness and age
The probability associated with Pearson Chi-square of learners (0.043) was lower than the significance level of 0.05 (see Table 2); therefore, there was a slight relationship between the participants’ age and their metacognitive awareness.

The following finding may lead to a possible statement that the more focus on participants’ age factor, the more successfully students’ needs, expectations and preferences can be met and the types of metacognitive activities that are appropriate for specific students can be selected. In other words, each age period is different from another and requires different metacognitive interventions and practices. In light of this result, lecturers should design the learning environment, curriculum, educational methods and material in accordance with students’ demographic variables and align their teaching practice accordingly to reach more enjoyable classes with deep and durable learning.

As it can be seen in Table 3, comparing the probabilities associated with Pearson Chi-square of both components (0.011 and 0.086), there was a relation between the age and the knowledge of cognition component.

Using the three subcomponents of the knowledge of cognition, i.e., conditional, declarative and procedural respectively and their probabilities (0.000, 0.304 and 0.055), it has been stated that there was a relationship between the participants’ age and the conditional subcomponent. Therefore, comparing the mean scores, it can be concluded that students are stronger in both the knowledge of cognition and regulation of cognition subcomponents.

4.3 Relationship between metacognitive awareness and area of study
According to Table 4, since the probabilities associated with Pearson Chi-square of (0.000) were lower than the significance level of 0.05, this implies a relationship between the participants’ area of study and their metacognitive awareness.

Since the probabilities associated with observed values were lower than the significance level of 0.05, it can be safely concluded that these groups of students differ significantly on metacognitive awareness and the area of study.

<table>
<thead>
<tr>
<th>Table 2. Chi-square tests of metacognitive awareness and age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value</strong></td>
</tr>
<tr>
<td>Pearson chi-square</td>
</tr>
<tr>
<td>Likelihood ratio</td>
</tr>
<tr>
<td>Linear-by-linear association</td>
</tr>
<tr>
<td>N of valid cases</td>
</tr>
</tbody>
</table>

Source(s): Author’s own creation/work

<table>
<thead>
<tr>
<th>Table 3. Chi-square tests of knowledge and regulation of cognition and knowledge of cognition subcomponents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge and regulation of cognition</strong></td>
</tr>
<tr>
<td>Pearson chi-square</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Source(s): Author’s own creation/work

<table>
<thead>
<tr>
<th>Knowledge of cognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson chi-square</td>
</tr>
<tr>
<td>Conditional</td>
</tr>
<tr>
<td>Declarative</td>
</tr>
<tr>
<td>Procedural</td>
</tr>
</tbody>
</table>

Source(s): Author’s own creation/work
As Table 5 indicates, by comparing the probabilities associated with Pearson Chi-square of both components (0.023 and 0.525), just there was a relation between the area of study and the knowledge of cognition component.

Considering the mean scores of the subcomponents, the sequence of the strongest to the weakest subcomponents is as follows: knowledge of cognition subcomponents among students: Declarative, Conditional and Procedural; regulation of cognition subcomponents: Evaluation, Planning, Comprehension monitoring, Information management and Debugging. Considering the three subcomponents of the knowledge of cognition, it has been stated that there was a relation among the participants’ area of study and the conditional and procedural subcomponents. Between these two subcomponents, this relation is highest to the conditional subcomponent.

**4.4 Relationship between metacognitive awareness and gender**

As Table 6 shows, a Mann Whitney U test was performed to find some relation between the participants’ gender and their metacognitive awareness.

Since the probability associated with Mann–Whitney test (0.775) was higher than the significance level of 0.05, it was concluded that there was no relationship between the participants’ gender and their metacognitive awareness. Learners’ level of metacognitive awareness can potentially be affected by various factors. Four individual factors, such as a

<table>
<thead>
<tr>
<th>Source(s): Author’s own creation/work</th>
</tr>
</thead>
</table>

---

**Table 4.** Chi-square tests of metacognitive awareness and area of study

<table>
<thead>
<tr>
<th>Source(s): Author’s own creation/work</th>
</tr>
</thead>
</table>

---

**Table 5.** Chi-square tests of knowledge and regulation of cognition subcomponents

<table>
<thead>
<tr>
<th>Source(s): Author’s own creation/work</th>
</tr>
</thead>
</table>

---

**Table 6.** Mann Whitney test of gender

<table>
<thead>
<tr>
<th>Source(s): Author’s own creation/work</th>
</tr>
</thead>
</table>
demographic characteristic, which have held some significant promise for the learning process, were carefully considered in this paper. The aim of considering these variables which are interlocked in a complicated structure is not to indicate that any university, study field, gender or age is prominent. In other words, it does not necessarily mean that students at some universities or fields of study are better experts in learning. The reasons for such differences may be very sophisticated and further research across various contexts may be required.

4.5 Relationship between metacognitive awareness and students from selected universities

Based on the data in Table 7, since the probability associated with Pearson chi-square (0.010) was lower than the significance level of 0.05, there was a relationship between the participants’ university and their metacognitive awareness.

As it can be seen in Table 8, comparing the probabilities associated with Pearson chi-square of both components (0.131 and 0.011), there was just a relation between the university and the regulation of cognition component.

Considering the five subcomponents of the regulation of cognition, it has been stated that there was a relation among the participants’ university type and the subcomponents of debugging, evaluation and information. As proved in Table 8, the order of this relation from the lowest to highest is debugging with the probability of (0.000), information management (0.001) and evaluation (0.004).

4.6 The correlation between knowledge and regulation of cognition

This section investigates if there is any relationship between the two main metacognitive awareness components of knowledge of cognition and regulation of cognition. Kendall’s tau-b correlation was run to probe the relationship between the two components of knowledge and regulation of cognition. As Table 9 indicates, the R-observed value is 0.34 and the probability associated with R-observed value (0.000) was lower than the significance level of 0.05.

<table>
<thead>
<tr>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson chi-square</td>
<td>156.546</td>
<td>118</td>
</tr>
<tr>
<td>Likelihood ratio</td>
<td>170.568</td>
<td>118</td>
</tr>
<tr>
<td>Linear-by-linear association</td>
<td>25.221</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7. Chi-square tests between university students

<table>
<thead>
<tr>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>76.78</td>
<td>64</td>
</tr>
<tr>
<td>Regulation</td>
<td>121.21</td>
<td>88</td>
</tr>
</tbody>
</table>

Table 8. Chi-square tests of knowledge and regulation of cognition and its subcomponents of different universities

<table>
<thead>
<tr>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
<td>59.66</td>
<td>34</td>
</tr>
<tr>
<td>Planning</td>
<td>33.24</td>
<td>36</td>
</tr>
<tr>
<td>Comprehension monitoring</td>
<td>45.36</td>
<td>36</td>
</tr>
<tr>
<td>Information management</td>
<td>82.52</td>
<td>46</td>
</tr>
<tr>
<td>Debugging</td>
<td>67.28</td>
<td>28</td>
</tr>
</tbody>
</table>

Source(s): Author’s own creation/work
Kendall’s tau-b correlation was run to probe the relationship between the two components of knowledge and regulation of cognition. As Table 9 indicates, the R-observed value is 0.34 and the probability associated with R-observed value (0.000) was lower than the significance level of 0.05.

Based on the results, it can be concluded that there is a significant positive relationship between the two main components of metacognitive awareness, that is, knowledge and regulation of cognition.

5. Discussion
Recent studies have elaborated on the ingenious role of metacognition in transforming old concepts, problem solving (Ghorbani and Farvardin, 2019), critical and creative thinking (Gok, 2010) and learning achievement (Cheng, 2011). The most common approach among all the definitions considers metacognition as a componental rather than a uni-dimensional one. Flavell (1979), who coined this concept, introduced it as “one’s knowledge concerning one’s own cognitive processes and products” (p. 232), while Schraw and Dennison (1994) described it as of cognition and regulation of cognition with more focus on its pedagogical implications.

The present study sought to deeply explore the relationship between individual variables of age, gender, area of study and university type and the components of the metacognitive awareness. Additionally, it determined the relationship between the knowledge of cognition and regulation of cognition. The level of metacognitive awareness for the students participating in this study can potentially be affected by various factors. The aim of considering these demographic variables which are interlocked in a complicated structure is not to indicate that any university, study field, gender or age is prominent. In other words, it does not necessarily mean that students at some universities or areas of study are better experts in learning. The reasons for such differences may be very complex and further research across various contexts may be required. However, some beliefs are mostly true which could well influence responses to the research situation such as older generation conservative behavior, women’s cautiousness and the reserved behavior of some university institutions. Among the four demographic variables analysed, the variable academic studies (Conyers and Wilson, 2016; Fleming, 2014; Adıgüzel and Orhan, 2017; Dennis and Somerville, 2022; McWilliams et al., 2023; Tuononen et al., 2023) strongly determined that metacognitive awareness level improved with age that, in turn, had a specific domain dependence. It means that when a learner has a higher level of metacognitive awareness, it can be extended/generated to other domains, this process either being driven by self-reflection (Conyers and Wilson, 2016) or self-knowledge (Colomer et al., 2021). These studies revealed the relation between age and metacognitive awareness and proved the superiority of the metacognitive awareness level of older people, which is in line with the present research indicating that age influences metacognitive awareness, specifically the conditional subcomponent of learners belonging to the age group of 18–29. Additionally, the degree to which metacognition

<table>
<thead>
<tr>
<th>Kendall’s tau_b</th>
<th>Knowledge</th>
<th>Correlation coef</th>
<th>Regulation</th>
<th>Sig.</th>
<th>N</th>
<th>0.345**</th>
<th>0.000</th>
<th>296</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Correlation coef</td>
<td>Regulation</td>
<td>Sig.</td>
<td>N</td>
<td>0.345**</td>
<td>0.000</td>
<td>296</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>Correlation coef</td>
<td>Knowledge</td>
<td>Sig.</td>
<td>N</td>
<td>0.345**</td>
<td>0.000</td>
<td>296</td>
<td></td>
</tr>
</tbody>
</table>

Table 9. Correlations between knowledge and regulation of cognition between universities

Note(s): **Correlation is significant at the 0.01 level (2-tailed)
Source(s): Author’s own creation/work
generalises across cognitive domains may itself change with age due to increased experience with one’s own abilities (McWilliams et al., 2023) by probably creating more accurate self-appraisal and control of procedural competencies and managing time on structuring tasks (Colomer et al., 2021).

The more intense application of conceptual knowledge in individuals with high metacognitive activity may be enhanced through the control of cognitive action, which seems to correlate with increasing age (Kiesewetter et al., 2016). According to Schraw et al. (2006), age has a greater impact on the knowledge of cognition compared to regulation of cognition. It induces the development of conditional knowledge by promoting the development of creativity (Kiesewetter et al., 2016) and the inductive reasoning (van de Kamp et al., 2016). It has been proved that metacognitive ability improves with age over the course of adolescence (Weil et al., 2013).

Inconsistent with the result of most of the studies (Aljarah and Obeidat, 2011; Atay, 2014; Lee and Oxford, 2008; McMullen, 2009; Öztürk, 2014) the female group learners in this research reported equal levels of metacognitive awareness compared with those of males. That may align with the fact that knowledge and regulation of cognition could not be differentiated at a significant level. The participants of this study were not aware of regulating declarative, procedural and conditional knowledge and posing the question that students with different study profiles may need different types of support for the metacognitive awareness of their own learning processes (Tuononen et al., 2023). It is suggested that the learning activities used at the universities, which had a lower relation with metacognitive awareness, need to optimize cognitive knowledge, especially their conditional knowledge, when students are dealing with a learning problem such as problem-solving tasks.

The analyses of the findings on the category of area of study in our research have revealed that some learners tended to facilitate the learning process by fostering metacognitive awareness compared to others. In parallel with our findings, some studies confirmed the positive relation between the level of metacognitive awareness and the area of study (Aljarah and Obeidat, 2011; Aljaberi and Gheith, 2015). In the current study, there was a relationship between the participants’ area of study and the conditional and procedural subcomponents of cognition where conditional and procedural knowledge was the most significant. As high efficacy and motivation can be related to procedural knowledge (Ma and Baranovich, 2015) and give the learner a sense of security in tackling a learning problem (Zoupidis et al., 2016), a high positive relation was found between the procedural knowledge and the area of study. It may imply that there is a connection between efficacy and motivation and the area of study, which requires further research.

Interestingly, the results observed from students at three universities showed that knowledge of cognition seemed to correlate positively with regulation of cognition. This finding did not support the one of Schraw and Dennison (1994), who found that adults tended to differ with regards to the use of regulation of cognition and not with knowledge of cognition, but agree with other students at university level (Colomer et al., 2021). These research results are significant in discovering students’ cognitive abilities which can be attributed to various factors such as creativity and helping learners to manage their potential efficiently. Teaching then can be diverted towards fostering metacognitive awareness and deploying metacognitive strategies, which is less time-consuming, costly and possession of a fixed framework for a stimulating variety of tasks compared to even more complicated tasks designed for improving creative thinking. Metacognitive awareness can be fostered by training through explicitly informing students about the importance of metacognition and life-long learning, which is very inspiring and encouraging for them, lecturers’ role-modelling, which is gradually shifting their roles from a mere instructor to a facilitator, assisting students to continuously assess, monitor, plan and reflect on their own learning process,
which encompasses skills for recognition of cognition along with metacognitive prompts, questions, checklists, reports and discussions of topics in the learning process. All of these lead the learners to become autonomous, take the responsibilities for their own learning, gain enough self-confidence and reach the goal of learning which is training an independent learner and attaining lifelong learning.

6. Conclusions and implications
The data analysis of students’ attitudes towards their own level of metacognitive awareness reveals that students think that their level of metacognitive awareness is rather medium. Moreover, it can be concluded that there was a significant positive relationship between the two main components of knowledge and regulation of cognition. Furthermore, the sequence of strongest to weakest subcomponents in knowledge of cognition is “declarative, conditional and procedural” in the participants’ group. Also, research participants would consider themselves weaker in “information management” and “debugging” than in the other subcomponents of regulation of cognition. In addition, through our large-scale metacognitive awareness measurement and rigorous analysis in each group, we got access to in-depth explicit and predictive information. The findings of this research provided a hint as to where to start investigating the problematic areas in students’ metacognitive awareness and determined what type of metacognitive knowledge and regulation skills the students reportedly utilized or required while learning.

According to the results of the study, it becomes evident that two individual variables of age and fields of study had a relationship with knowledge of cognition. As a matter of fact, conditional knowledge had a slight positive relation with age and area of study variables. Procedural knowledge was the second area which had a relation with the area of study. As there was no relation displayed between declarative and procedural knowledge with the variable of age, we can conclude that under specific circumstances, declarative and procedural knowledge are at the same level of performance while conditional knowledge revealed the highest relation with metacognitive awareness. Furthermore, we have not found any statistically significant difference with gender in all metacognitive subcomponents despite the initial assumption. In addition, there were relations between U1, U2 and U3 universities and three subcomponents of evaluation, information management and debugging respectively. It is suggested that the learning activities used at the universities, particularly at U2 and U3, which had a lower relation with metacognitive awareness, need to optimize cognitive knowledge, especially their conditional knowledge, when students are dealing with a learning problem such as problem-solving tasks. Moreover, it can be concluded that there was a significant positive relationship between the two main components of knowledge and regulation of cognition.

The practical significance and the meaning for the stakeholders of this study is that it will not only contribute to both lecturers’ and students’ development of metacognitive awareness but will also guide the design and implementation of future metacognitive awareness programs for lecturers. The findings can increase lecturers’ pedagogical knowledge, which is associated with their teaching practice. The outcome can not only lead to the reformation of methodology but also contribute to formulation of future interventions to change attitudes towards students’ metacognitive awareness, to increase lecturers’ instructional abilities by cultivating the use of appropriate and required metacognitive awareness strategies and removing those which obstruct learning. The findings will also be useful for curriculum designers, policy makers and educationalists by helping them to gain an insight into this phenomenon.

The results of study should be interpreted bearing in mind several limitations. The findings appear to reflect a quantitative analysis of the data gathered employing a
questionnaire. Application of other tools for getting access to qualitative data which leads to in depth and more comprehensive results may be required. Besides, as the sample population presented here were limited to only three universities that are in Vilnius, this restricts the generalizability of the findings to other universities in other cities; therefore, it might be recommended to avoid interpreting them as definite. This is an applied research and its results have practical value to specific institutions, but at the same time, it reveals certain trends that should be tested in the future in a larger population to generalize the results to a national or similar population.

References


Oztürk, G. (2014), *The Role of Metacognitive Knowledge and Metacognitive Learning Strategies in Tertiary Level EFL Students’ Language Learning*, (Master’s Thesis), Ataturk University, Institute of Educational Sciences, Erzurum.


Further reading


**Corresponding author**

Remigijus Bubnys can be contacted at: remigijus.bubnys@sa.vu.lt

---

For instructions on how to order reprints of this article, please visit our website: www.emeraldgrouppublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com