Exploring Metacognitive Scaffolding In Reading Comprehension Among Engineering Undergraduates

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ABSTRACT

The present research was undertaken at a public university in Pakistan. The reading course focuses on traditional classroom instruction based on grammar drills, vocabulary lessons, and the skills needed for solving de-contextualized reading comprehension questions. However, different tasks are used to evaluate one's knowledge; this enables students to measure the time and skills required for learning. This research aims at investigating metacognitive strategies in reading comprehension. Considerable research in education revealed that engineering students do not understand the basic concepts of different subjects in their undergraduate studies. The data was gathered through qualitative instruments using semi-structured interviews with 10 teacher respondents, focus group interviews with 8 groups of student respondents, and 12 classroom observation reports. This research study's data was organized using NVivo software version 08 to determine the reading comprehension of engineering students in Pakistan. The findings revealed that students used several strategies to develop their reading comprehension. Some students could not complete their reading tasks as they failed to use certain strategies. Additionally, the findings of classroom observations verified the results based on respondents' interviews and confirmed that metacognitive scaffolding and strategy use can improve students' reading comprehension. To sum up, this research study draws attention to the magnitude of the educational representatives to the offered behaviors in the classrooms, not only to the use of strategy in each classroom's setting but as a possible mark of an attachment in the existing metacognitive strategies.

Keywords: Metacognitive; scaffolding; reading comprehension; reading achievement; strategies.

INTRODUCTION

The study investigates metacognitive scaffolding and strategy use in reading comprehension among engineering students. Conversely, considerable research in education revealed that engineering students do not understand the basic

concepts of different subjects in their undergraduate studies including physics, electricity, statics, materials, and thermodynamics (Streveler, Litzinger, Miller, & Steif, 2008); (Krause, Kelly, Corkins, & Tasooji, 2009); (Steif, Lobue, Kara, & Fay, 2010). Similarly, (Streveler, Litzinger, Miller, & Steif, 2008) informed that most students do not understand engineering education, particularly within the thermodynamics, heat transfer, and fluid mechanics areas of engineering education. Therefore, related research is presented based on a conceptual understanding of different pedagogical skills to address these issues by developing tools for engineering students (Yang, Streveler, Miller, & Roman, 2009). This study (King & Kitchener, 2009) stated that metacognitive scaffolding and metacognitive strategy are used to develop conceptual knowledge.

METACOGNITIVE KNOWLEDGE

Metacognitive knowledge is based on the awareness of a person, the understanding of a task, and the information of a strategy (Flavell, 1979) and (Flavell J. H., 1987). Knowledge of a person refers to the knowledge of one's cognition based on skills, or abilities. Knowledge of a person further is divided into self-knowledge, others-knowledge, and universal knowledge (Flavell J. H., 1987). Self-knowledge is used for personal knowledge based on his/her abilities using personal cognition. Knowledge of others indicates the skills and abilities of others based on others' cognition. Similarly, knowledge of universals means people's awareness or knowledge related to universal concepts. Further, Knowledge of tasks indicates when people used to undertake different tasks to understand the level of difficulty and to know the relation of one task with that of other tasks (Flavell J. , 1979) and (Flavell J. H., 1987). However, knowledge of strategies indicates the knowledge of certain procedures which can be the most appropriate

and needed to accomplish a particular cognitive object. Further, (Kluwe, 1987) divided metacognitive knowledge into three processes including:

The declarative awareness process indicates the information or knowledge used through the word "what" by the people they know through their cognitive states at the time of certain activities. Cognitive activities identify the self-proficiency including complete comprehension of the information involving the knowledge of the domain (Brown, 1987).

This procedural process of metacognitive knowledge indicates that the information or knowledge can be used by the people involving thinking processes based on the word "how" the knowledge of the world is utilized; similarly, how the personal knowledge is used by following mental processes, and how the strategic knowledge is also carried out. Procedural metacognitive knowledge is further used for monitoring the level of selection by regulating certain tasks to solve certain problems within the domain of cognition (Kluwe R. , 1982).

This conditional knowledge process of metacognitive awareness indicates the knowledge and information carried out with the word 'when' to use the exact information and asked 'why' to apply to accomplish any activity. Moreover, the conditional category is used to make certain through the word 'how' for determining the knowledge effectiveness involving thinking processes. Further, (Hacker, 1998) informed that these three main processes are used to monitor the thinking process and used to direct other the processes of different thoughts. Therefore, (Flavell J. , 1979) gave an opinion by saying that metacognitive experiences can be involved the awareness of the cognitive process and its functions to develop the level of mind mapping in certain activities related to thought processes. Not only this, but these processes also bring certain changes in the process of thinking through integration of prior knowledge with that

of present approaches of metacognitive knowledge to be used for accomplishing the main targets and justifying all those through the activities and cause to change in motives as mentioned by (Hacker, 1998) to inform that these approaches increase the level of strength to make a new decision for achieving certain objectives which also would change the performance for future (Mazzoni & Nelson, 2014) objectives based on thought processes.

METACOGNITIVE REGULATION

It is used in the performances in which students used to manage their learning as reported by (Brown, 1987) idea. It is not clear to date what strategies ought to be integrated into the metacognition theoretical model (Veenman, Van Hout-Wolters, & Afflerbach, 2006). There are several strategies including to plan, monitoring, and evaluation are known as the most highly discussed and used strategies (Tarricone, 2011). Planning is used in activities involving a range of procedures to perform a task for learning, predict the effects of learning, and schedule the strategies for learning (Brown, 1987); (Whitebread, et al., 2009). However, monitoring refers to regular tasks to be performed by observing the level of knowledge of a person and determining it through testing before revising his/her knowledge using several strategies to complete various reading tasks (Whitebread, et al., 2009). Conversely, evaluation is used for checking the mode or a system by which several tasks are being completed and are regarded as the most well-organized and efficient when it is evaluated in line with certain decisive factors and standards (Brown, 1987).

Metacognitive knowledge mainly talks about knowledge and mindfulness of one's thinking practices for learning and solving different problems. Knowledge of a person indicates the ability to identify one's strengths and weaknesses based on the knowledge of a person. However, a task is used to evaluate one's

knowledge; this enables students to measure the time and skills required for learning. Similarly, Strategy refers to certain strategies which the individual can follow to complete the tasks effectively. However, Metacognitive regulation consists of knowledge to regulate one's knowledge for the acquisition of concepts to accomplish the reading comprehension objectives of first-year engineering students.

READING FOR ENGINEERING

Engineering education is based on initial perceptions and conceptions related to certain procedures, systems, structures, methods, and practices based on the decisive factors to overcome restrictions within the fields (Dym, Alice M. Agogino, Ozgur Eris, Daniel , & Larry , 2005). Engineers perform a series of processes based on defining and developing the problem and evaluating and realizing the solutions to the problem, and further experimenting to accomplish practical procedures (Atman, Cynthia J, et al., 2007). Following this assumption, researchers including (Friedland, Susan E. McMillen, & Pixita del Prado Hill, 2011) and (Pearson, Moje, & Greenleaf, 2010) proposed a general argument for the preparations of intentional readers as well as the preparations of science and math readers using certain methods and techniques. It is critical to say that in language learning, different techniques ought to be used; so students may further create their abilities in reading. Undoubtedly, these techniques are thought to be a medium for reading improvement which the students consider to be of extraordinary utilization. The principal motivation behind learning procedures is to review, validate, and heap new truths in learning. (Wenden, 1998) additionally expressed cognitive and metacognitive methods as the "learning methodologies are mental steps or operations that learner's utilization to take in another dialect and to direct their exertions to do so".

METACOGNITIVE IN ENGINEERING

Metacognition is considered the most essential strategy for engineering fields and curriculums at the undergraduate level (Colby, Macatangay, Sheppard, & Sullivan, 2006). However, the engineering curriculum is based on problem-solving knowledge, information integrated with certain notions, and several processes (Streveler, Litzinger, Miller, & Steif, 2008). (Colby, Macatangay, Sheppard, & Sullivan, 2006) asserted that problem-solving and conceptual knowledge can be added to engineering education to instruct engineering students to prepare them for engineering practice; though it is considered critical in problem-solving and conceptual knowledge and is considered difficult for learning because of the occurrence of vigorous misreading (Streveler, Litzinger, Miller, & Steif, 2008). It is vivid that metacognition is practical in developing students' understanding and familiarity with problem-solving as well as conceptual conceptions by omitting incorrect thoughts.

PROBLEM SOLVING

Problem-solving is considered an objective-based activity following uncertain means to some extent and needs students to think in a directed way for obtaining problem-solving goals (Dominowski, 1998) Metacognition knowledge is a mental process important for thinking in line with goal-directed guidance. These activities can be based on either theoretical or empirical shreds of evidence from numerous angles and fields. These fields can be included cognitive sciences, mathematics, reading comprehension, and physical sciences ((Davidson & Sternberg, 1998). Metacognition is revealed as a critical thinking process for problem-solving in engineering education. Further, (Litzinger, et al., 2010) investigated cognitive and metacognitive strategies used by students within problem-solving in the statics field involving students in

think-aloud sessions in line with statics problems. The participants of this study were divided into two groups i.e., strong problem solvers and weak problem solvers to solve two statics problems through think-aloud sessions. Metacognitive monitoring and evaluation were applied to count utterances for each problem done by respondents. The findings revealed that strong problem solvers used metacognition as compared to weak solvers to solve statics problems (Litzinger, et al., 2010).

RESEARCH METHODOLOGY

The methodology of this exploratory research within the interpretative is mainly based on three data collection methods. One is the Semi-structured interviews; the second is the focus group interviews, and the third is the class observation protocol. This study is based on qualitative analysis to produce an in-depth picture as the unit of analysis under study within the bounded system. In other words, this study aims to investigate metacognitive scaffolding and strategy use in reading comprehension by first-year engineering students who took functional English subject as compulsory in which reading comprehension was taught as the part of the subject in communication skills course of their 4-year university studies, at Quaid-e-Awa'am university of engineering, science, and technology, a public university located in Pakistan to focus on metacognitive scaffolding and use of reading strategies to explore the following research questions:

1. What metacognitive strategies do teachers use in teaching reading comprehension to engineering students in their first year?

2. What metacognitive strategies do engineering students use in reading comprehension in their first year?

THE RESEARCH CONTEXT

The present research was undertaken at a public university in Pakistan. At the university, engineering students are studying both functional English and communication skills as the compulsory subject course required for graduation. English is a compulsory subject for first-year students on the four-year university course, with an average of 3 hours of classes per week. At the end of their semester, students must take the final exam. The exam comprises reading comprehension as part of the paper with choices given. Because of reading, the curriculum of the university where the present research was conducted was set within this parameter. Therefore, the reading course focuses on traditional classroom instruction based on grammar drills, vocabulary lessons, and the skills needed for solving de-contextualized reading comprehension questions. The teaching method that the teachers in this university used is teacher-centered learning instead of student-centered in which teachers facilitate students. As a result, the knowledge of strategy use in reading comprehension upholds the triangular affiliation that subsists between the text, the learners, and the teacher to facilitate students' developing knowledge of strategy use in reading among engineering students.

THE PARTICIPANTS'S SECLECTION AND SAMPLING

The major reason for selecting this university as the research setting was the possibility of access. For being an English teacher in the English Language Centre of this university, first-year engineering students of four departments and teachers were asked to participate in this research. Forty students and ten teachers voluntarily participated in the research. Purposive sampling was undertaken using non-probability sampling in this research study as this sampling strategy is considered the commonly used method of choice in a qualitative study for selecting the participants. These 40 participants were divided

into 8 groups comprising of 5 participants in one group. This selection of the participants was critical because the present research aims to obtain a deeper understanding of these engineering learners' metacognitive scaffolding and their strategy use in reading comprehension to occur with consideration paid to texts of different types.

RESEARCH METHODS

Different data collection methods were used in the study to collect the data for this research. These methods included a semi-structured interview of teachers, a focus group interview of students, and class observations in the engineering departments of QUEST, Pakistan. Further, semi-structured interviews were conducted with 10 teachers of 4 departments. Similarly, focus groups interview of 40 students belonging to 4 departments were also conducted to know their opinions and the use of metacognitive strategies. These students were placed into 8 groups, based on their participation in activities at the time of 12 class observations.

DATA ANALYSIS

This study is based on qualitative methods which primarily deal with qualitative analysis with reference to the process of analyzing the data from the audio-taped semi-structured interviews and focus group interviews and field noted classroom observation. Therefore, the process of the qualitative analysis of the data obtained from instruments used in this research study was divided into three phases as recommended in (Strauss & Corbin, 1999) guidelines. Data from 10 teachers' interviews, 8 students' focus group interviews, and 12 observations were analyzed thematically to determine themes. However, NVivo software version 8 was used to organize the data.

RESEARCH FINDINGS

This research study presents an analysis of the information gathered from 10 semi-structured interviews (SSI), 8 focus group interviews (FGI), and 12 Classroom observations reports (COR) with the participants. Qualitative semi-structured interviews provided rich data that was supported by the findings of the focus group interviews, and observations. For each of the themes, there is an explanation regarding their emergence from the data. When analyzing the data, the following main themes emerged from the gathered data for the discussion of the results.

Table 1 Main themes of the study

Main themes	Research Methods
1. Rereading	FGI; COR
2. Text Skimming	FRI
3. Selecting the main ideas	SSI; COR
4. Selecting the topic Sentences	SSI; COR
5. Using Prior Knowledge	FGI
6. Text Summarizing	SSI
7. Questioning Strategy	SSI
8. Teachers support	SSI

REREADING TEXTS

Rereading text is the first theme in which most of the groups reported that they reread text to get enough knowledge about the text by getting exact information about the passages. This strategy makes them capable to know the main ideas and supporting ideas after the second or third time reading the text. If something important piece of information in the text is left or ignored in the first or second attempt, they know at the very third attempt of reading. These groups commented:

"We read again and again when we do not understand the difficult parts of passages…. We reread texts and underline difficult terms or phrases which we find from dictionary later…." [FGI]

"If we struck on the difficult parts…we read paragraphs again and again to apprehend the texts…." [FGI]

"We read passages at least three times and verify our reading ability. We skip all the difficult sentences and elaborate the text in our ideas and meaning…." [FGI]

Similarly, it was found in the classroom observation that teachers asked students to read again and again to understand the text and to find important information. Four of these observations revealed that students reread expository texts for comprehension and practice reading activities in class. Students focused on this strategy to find out the required data. These observations revealed:

"…. students reread expository text for getting information and comprehension correct meaning…." [COR]

"…rereading texts from engineering textbooks helps students to develop their technical and scientific information…." [COR]

"…reading, again and again, increase speed in reading and comprehension of the meaning…." [COR]

TEXT SKIMMING

For text skimming, more than half of the groups stated that they use text skimming at the time of reading tasks. Three of these groups revealed that they practice skimming the text properly to look over an article quickly. Three of the groups indicated that skimming is used to forecast the meaning of the text rapidly. These groups stated:

"…skimming strategy enables us to know the key information from the text…skimming would help readers to get knowledge of the text before they read in detail. The readers would read text with their eyes to get the bird's eye view of the text." [FGI]

"We should use the skimming technique to know the text quickly. We should read text with our eyes…." [FGI]

"…. readers would read through their eyes with speed…." [FGI]

"…. I suggest my peers for skimming by reading the first and the last paragraph completely and quickly…." [FGI]

Conversely, one informant revealed that students who lack skimming ability cannot develop a reading habit and cannot take an active part in reading activities. The student does not follow the guidance of the teacher:

"…if we lack skimming in reading then we cannot take part in activities…and escape from reading tasks." [FGI]

SELECTING THE MAIN IDEAS

Most informants claimed that proper reading needs to find ideas and thoughts which seem supportive to the text for developing comprehension. Two of them reported that they always underline the key sentences and main thoughts from every paragraph of the article for obtaining the main information of the text. If they could not find the main ideas from the very first sentences; they find supporting detail from the texts. One of them informed that practice for selecting supporting and central ideas from the text is very necessary and students may be guided on the way to select until and unless they could search independently at the time of reading practice in classroom activities. The informants noted:

"…. we think…the main theme or supporting ideas of the passage identify what the passage tells about in the reading article….so, the main idea makes our thoughts clear to avoid the misapprehension when the text would be too difficult… we consider the main idea as the most important…" [SSI]

"I emphasize to my students to search for the main ideas passage-wise in the text. If they search in the first reading, then the whole text will be easy for them to comprehend properly. If they could not succeed in finding the main ideas, means they would not understand the reading…." [SSI]

Remarkably, one of the interviewees reported that selecting supporting ideas from the text would enable readers to practice independently. Such readers follow Wh. questions to find supporting ideas from the article. One of them observed:

"You should go to look for the main ideas for better comprehension….to us…main ideas and supporting ideas are the same in terms of the sense. Students should be guided to underline the key sentences in every paragraph which has key information to comprehend…. this comes with practice and support of teachers in classroom activities…." [SSI]

Conversely, the data gathered in the classroom observation report revealed that first-year students selected the main ideas from the comprehension passages as guided by their teachers. The class observations report showed:

"Students practice on selecting the main ideas….and underline key ideas of the text…." [COR]

"Selecting main ideas from passages can benefit students and would increase reading speed or comprehension…." [COR]

SELECTING THE TOPIC SENTENCES

Selecting the topic sentences in reading is imperative in which students should apprehend the subject matter for obtaining important information from the text. Most informants reported that the first two sentences can generate the topic sentences in the passage and readers should highlight or underline the main points of the text at the time of reading. Three of the interviewees suggested that the readers should select topic sentences either from the first two sentences or from the last two sentences of the article. One of them asserted and commented if any reader fails to find topic sentences because of low reading proficiency; should guesstimate the main sentences and continue reading practice in a result this would be possible for readers to overcome reading difficulties and develop an interest in reading and would grow understanding ability. These interviewees commented:

"…. mostly…topic sentences remain hidden in the very first sentences of the article…." [SSI]

"…to me… topic sentence is the most important and readers should focus to find a correct sentence to develop their thoughts and opinions about the article…." [SSI]

Importantly, two of the interviewees pessimistically informed that reading is the most difficult skill in today's age of machines. Computers, laptops, iPhones, and tabs have taken place of books; now, books are not read and readers do regard books as a burden on their shoulders. As result, these readers do fail in classroom activities on reading. These two interviewees noted:

"…. practice makes perfect but this age of technology has reduced reading habit; therefore,

we lack the reading ability and cannot find topic sentences and main ideas in-class activity on reading…." [SSI]

"….to me, reading is the most difficult skill…. this difficulty is due to ignorance from reading practice on textbooks and text materials and as result, these readers cannot find the main ideas and topic sentences in classroom activities…." [SSI]

However, less than half of the classroom observation reports noted:

"…...the first few sentences indicate the overall information as these carry topic sentences…." [COR]

"Readers should focus on the first two sentences to know what the article is about…." [COR]

"…topic sentence is very important and should be focused for comprehension of the text." [COR]

"For topic sentences, readers should underline the important sentences in the text through getting an overall view of the sentences…" [COR]

USING PRIOR KNOWLEDGE

As for as using prior knowledge is concerned, most of the groups reported that they used prior knowledge to make their understanding easy and clear in terms of the proper meaning of the text. These groups asserted that they could collect huge knowledge of the text through this strategy. However, three of the groups having poor background knowledge due to government schooling could not use their background knowledge when reading text. It is because they already attained poor or limited prior knowledge. Groups with enough prior knowledge can respond better to reading passages and can use their previous information with that of reading texts. Three of these groups observed:

"We think using prior knowledge would be helpful to comprehend the written text. We use our previous experiences and interconnect our present knowledge with our past knowledge to judge or analyze what the text would be about…." [FGI]

"…. we should use prior knowledge to interconnect our personal experiences with the text." [FGI]

TEXT SUMMARIZING

The students are asked to reread the passages until they apprehend the texts fully; after that, they are asked to summarize them to assess their ability whether they can independently play an active part in reading activities or still need some teachers' scaffold. These interviewees reported that the students are taught to abridge or summarize the article to determine the accuracy of their comprehension. These interviewees reported:

"I teach my students to summarize the text after reading an article by selecting the main or important ideas in the mind. Text summarizing would enable them to judge their perception of the article and would be their evaluation…. this strategy [summarizing] would increase their reading competency…." [SSI]

"I guide my students to enlist all those important ideas either in their mind…...or on a piece of paper during their first reading and summarize the whole text after the end of their reading…..." [SSI]

"When they complete their reading, they summarize the article with the help of all those selected important points. They use their mother tongue while thinking and summarizing the text." [SSI]

Importantly, one of them informed me that the text summarizing strategy is very important to evaluate their accuracy and proficiency. The interviewee described:

"…. students should use to summarize the whole passage in their words…. I think, summarizing is important to evaluate the accuracy of thoughts…." [SSI]

SELF-QUESTIONING STRATEGY

Most of the interviewees asserted that readers should use a self-questioning strategy before, during, and after reading to evaluate their reading proficiency level and comprehension aptitude. Before beginning their reading of a passage, students should inquire about different questions to know what the text is about, what would be its title or heading, and what important data, ideas, and points should be recorded. Most of the informants informed that readers should use self-questions through wh-words including who, what, when, where, why, and how. This strategy would enable them to confirm whether they understand the text or not. Most of them explained:

"…. students should use self-questioning strategy in reading comprehension….they should use this strategy when they start reading, during, and after reading the passages. Self-questions would enable readers to assume the meaning before reading and after reading for developing their thoughts about texts…." [SSI]

"…when readers find difficult text, they may use self-questioning strategy to make their thoughts clear about the text. When readers ask self-questions before, during, and after reading, they would understand text clearly…. self-questioning would be useful to evaluate their self-performance…." [SSI]

Interestingly, one of the informants observed that self-questioning should be used when the text is based on complex or long sentences which seem very difficult for them to read and understand. Three of them stated:

"…students should use self-questioning strategy when they find complex sentences or very long sentences which they do not understand. If they found the text very easy, then they should perform directly. Questioning strategy would enable readers to evaluate their proficiency and to clarify the meaning of the text in the article for further practice." [SSI]

TEACHERS SUPPORT

More than half of the interviewees reported that teachers' support is very important for students in developing reading comprehension. Teachers' support helps readers to develop their pronunciation, reading speed, and clear understanding of the texts. Most of the interviewees reported that teachers' support can provide help to students in terms of sharing ideas and knowledge, transferring learning and improving attitudes, enhancing motivational skills, and the ability to increase reading proficiency. These informants noted:

"…. most students require the guidance of their teachers when they perform reading activities in class….they need teachers' support to carry on their class-work and to develop their reading proficiency and comprehension level. Teachers' support can develop pronunciation of students, their reading speed, and their understanding of text …" [SSI]

"… teachers' support is necessary to guide readers on how to read and comprehend…. Students at all levels need the support of their teachers all time in their academic life…" [SSI]

"I guide my students and help them to develop their reading through read-aloud and think-aloud activities…." [SSI]

 "To me…if students are weak and text is difficult…they should ask their teachers to help them...if they find simple sentences having no grammar issue, they should read independently…" [SSI]

DISCUSSION

The main target of this research was to investigate metacognitive scaffolding and strategy use in reading comprehension among engineering students in their first year. The appropriate methodological approaches are continuously debated in line of research study on metacognition as discussed by (Veenman, Van Hout-Wolters, & Afflerbach, 2006). This research study has supported the need for certain methodological advances in line with the study of

metacognition; the findings of this research study have supported the use of interviews of teachers along with students' interviews and classroom observations for the research of metacognition as qualitative methods. The qualitative methods for metacognitive strategies developed in this research study by providing a basis not only for further development of interviews and observation methods but also for the development of other qualitative measures to investigate metacognition. Researchers (Pritchard & Nasr, 2004); (Shanahan, et al., 2010) have confirmed that metacognitive strategies use in reading comprehension enhance students' reading comprehension. Research reveals that students' inadequate practice in reading texts can cause decreased reading comprehension (Ness, 2011). In addition, (Mokhtari & Reichard, 2002) stated that teachers use strategies in classrooms for the potential benefit to increase students' reading comprehension.

CONCLUSION

The qualitative data analysis procedures were followed to provide answers to the research questions. The responses to the interview questions were transcribed for identifying emergent themes. The interpretation and discussion of each of the themes are discussed in detail. The data analysis showed that the participants actively engaged in several reading strategies. Conversely, classroom observations verified interviews of both teachers and students. Similarly, the results of this research are matched with that of (Williams, 1996) and (Nuttall, 1996) research which report that the students should be provided with the necessary support to improve reading comprehension using various strategies. To conclude, this study shows how students understand and use metacognitive strategies in the classroom to develop reading using appropriate theories and models for learning.

ETHICS STATEMENT

This research study is part of the Ph.D. thesis of the first author at the University Malaysia Sarawak.

REFERENCES

Atman, Cynthia J, C. J., Robin S. Adams, S. A., Monica E. Cardella, E. C., Jennifer Turns, T., Susan Mosborg, M., & Jason Saleem, S. (2007). Engineering design processes: A comparison of students and expert practitioners. Journal of engineering education, 96(4), 359-379., 359-379.

Brown, A. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. Metacognition, motivation, and understanding.

Colby, A., Macatangay, K., Sheppard, S., & Sullivan, W. (2006). What is Engineering Practice? International Journal of Engineering Education, 429-438.

Davidson, J., & Sternberg, R. (1998). Smart problem solving: How metacognition helps. In Metacognition in educational theory and practice (pp. 61-82). Routledge.

Dominowski, R. (1998). Verbalization and problem solving. In Metacognition in educational theory and practice. In Metacognition in educational theory and practice (pp. 39-60). Routledge.

Dym, C., Alice M. Agogino, M. A., Ozgur Eris, E., Daniel , D. F., & Larry , J. L. (2005). Engineering design thinking, teaching, and learning. Journal of engineering education, 103-120.

Flavell, J. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. American psychologist, 906.

Flavell, J. H. (1987). Speculations about the nature and development of metacognition. Metacognition, motivation and understanding.

Friedland, E. S., Susan E. McMillen, E. M., & Pixita del Prado Hill, d. H. (2011). Collaborating to cross the mathematics–literacy divide: An annotated bibliography of literacy strategies for mathematics classrooms. Journal of Adolescent & Adult Literacy, 57-66.

Hacker, D. (1998). Self-regulated comprehension during normal reading. In Metacognition in educational theory and practice (pp. 179-206). Routledge.

King, P., & Kitchener, K. (2009). Reflective judgment: Theory and research on the development of epistemic assumptions through adulthood. Educational psychologist, 5-18.

Kluwe, R. (1982). Cognitive knowledge and executive control: Metacognition. In In Animal mind—human mind (pp. 201-224). Berlin: Springer, Berlin, Heidelberg.

Kluwe, R. (1987). Executive decisions and regulation of problem solving behavior. . Metacognition, motivation and understanding, 31., 31-64.

Krause, S., Kelly, J., Corkins, J., & Tasooji, A. (2009). The role of prior knowledge on the origin and repair of misconceptions in an introductory class on materials science and engineering. In 3rd Research in Engineering Education International Conference.

Litzinger, T., Meter, P., Firetto, C., Passmore, L., Masters, C., Turns, S., & Zappe, S. (2010). A cognitive study of problem solving in statics. Journal of Engineering Education, 337-353.

Mazzoni, G., & Nelson, T. (2014). Metacognition and cognitive neuropsychology: Monitoring and control processes. Psychology Press.

Mokhtari, K., & Reichard, C. (2002). Assessing students' metacognitive awareness of

reading strategies. Journal of educational psychology, 249.

Ness, M. (2011). Teachers' use of and attitudes toward informational text in K-5 classrooms . Reading Psychology, 28-53.

Nuttall, C. (1996). Teaching reading skills in a foreign language (New eds.). Oxford: Heinemann.

Pearson, P., Moje, E., & Greenleaf, C. (2010). Literacy and science: Each in the service of the other. Science , 459-463.

Pritchard, R., & Nasr, A. (2004). Improving reading performance among Egyptian engineering students: principles and practice. English for Specific Purposes, 425-445.

Shanahan, T., Callison, K., Carriere, C., Duke, N., Pearson, P., Schatschneider, C., & Torgesen, J. (2010). Improving Reading Comprehension in Kindergarten through 3rd Grade. In IES Practice Guide: What Works Clearinghouse. (pp. 2010-4038). IES Practice Guide.

Steif, P., Lobue, J., Kara, L., & Fay, A. (2010). Improving problem solving performance by inducing talk about salient problem features. Journal of Engineering Education, 135-142.

Strauss, A., & Corbin, J. (1999). Basics of qualitative research. SAGE Publication.

Streveler, R., Litzinger, T., Miller, R., & Steif, P. (2008). Learning conceptual knowledge in the engineering sciences: Overview and future research directions. . Journal of Engineering Education, 97(3), 279-294.

Tarricone, P. (2011). The taxonomy of metacognition. Psychology Press.

Veenman, M. J., Van Hout-Wolters, B. A., & Afflerbach, P. (2006). Metacognition and learning: conceptual and methodological considerations. Metacognition Learning.

Wenden, A. (1998). Learner strategies for learner autonomy. Great Britain: Prentice Hall.

Whitebread, D., Coltman, P., Pasternak, D. P, D., Sangster, C., Grau , V., Bingham, S., . . . Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. Metacognition and learning, 4(1), 63-85., 63-85.

Williams, E. (1996). Reading in the Language Classroom. Malaysia : Modern English Publication .

Yang, D., Streveler, R., Miller, R., & Roman, A. (2009). Repairing misconceptions: A case study with advanced engineering students on their use of schema training modules. In Annual Conference & Exposition , (pp. 14-1023).