

The metacognitive teaching and content analysis of high school third grade Biology book in 2014-2015

Mahnaz Hodaian ^{1,*}, Mohammad Javad Liaghatdar ²

¹M.Sc. student, faculty of Psychology and Educational Sciences, Islamic Azad University, Khorasgan branch, Isfahan, Iran.

²Assistant professor, faculty of Psychology and Educational Sciences, Isfahan University, Iran

Abstract: The present study tried to have content analysis of high school third grade biology book based on metacognitive teaching. The considered components of the study included knowledge of expressing, methodology knowledge, and conditional knowledge, planning, monitoring, evaluating and reviewing. The survey was conducted to study the book content in order to see the applicability of metacognitive components of teaching. William Romey's technique had been used for determining conflict coefficient and Shannon entropy method for analyzing the frequency of the used components. The paragraph analysis (text and picture) considered were totally 499 paragraphs in text and 123 pictures. The results of the study showed that the conflict coefficient was (0.023) in text and (1.35) for pictures. The result also showed the components like reviewing, evaluating and planning had the least frequency (almost 0) and components like knowledge of expressing had the highest frequency.

Key words: *Shannon entropy; Planning; Metacognitive knowledge; High school; Metacognitive control; William Romey's technique*

1. Introduction

One book as a written and framed base is considered the pivot of teaching in educational system. Moreover, the activities and experiences of teachers and learners are organized around this center and need analyses and discussions. One of the useful analyzing ways helping the lesson planning process, writers and officials is content analysis (Yarmohamadian, 2013). Analyses help to study concepts, principals, viewpoints, beliefs and all stated parts in the frame of book scientifically and compare and evaluate them with the goals of planned lessons (Dlavar, 2004). Unfortunately the course books of these days cannot present some information to the learners as they don't help the citizens to face with new life issues. Students should learn ways of exploration and prepared to encounter with life issues. This magnificent job is going to be done by course books. To decrease the distance between idea and performance, attracting the professional lesson planner of Iran toward the existed facts in teaching and giving solution for operational reactions, paying attention to this factor is necessary (Maleki, 2011). If students become familiar with metacognitive strategies, they can solve their problems independently without the help of their teachers (Aghazadeh and Ahadyan 1999). Learning how to learn is one of the main goals of twenty first century at the age as people face with situation, in which they cannot solve the problem by previous learned reactions (NiazAzari2004).

Metacognitive gives students those skills and knowledge they need to control their learning, and help them to be professional and curious for accomplishing future activities. In the other hand metacognitive teaching causes self-control and self-learning in the learners, so, as independent learners they can lead , control and modify their metacognitive and learning processes toward the determined goal (Ghanbaritalab, 2014).

There are many hypotheses about metacognition components. Martinze (2009) believes metacognition is a multi-dimensional concept including, knowledge, process and directions dealing with evaluating, controlling and monitoring cognition. White Bread and his co-workers (2009) believe that metacognition has three main components: metacognitive knowledge, metacognitive control and monitor and feeling control at the time of learning activity. Nancy (2006) considers self-thinking and self-organizing as the components of metacognitive. She believes this type of thinking as person's ability in "planning", "monitoring" and "evaluating" his action. Some other recent researches have considered metacognition as two independent components but interrelated; One is the metacognitive knowledge, the other metacognitive control (Sungur, 2007).

Schraw and Dinson (1994) have divided metacognitive components in to two general parts as metacognitive knowledge and metacognitive control. They define metacognitive knowledge as three components of the expressing knowledge, methodology knowledge and conditional knowledge. They also define metacognitive control components

* Corresponding Author.

as evaluating, planning, monitoring and reviewing. This study has considered their division for studying.

As the metacognitive awareness is a need for educational success and if it is not included in lesson planning that lesson has irretrievable results, there is a question about the present high school third grade biology book that whether this factor or how much this factor is considered in framing. To answer this question, the present study aim is to analyze the book to see how much metacognitive teaching components are considered in this book in the year 2014-2015.

Mahmoodianfard (2009) has directed his study "investigating the place of active methods in the content of high school math book of first and second grade". The results of study showed: base on the obtained conflict coefficient, text and questions in the book have not been presented actively, but the pictures have been. The level of students' involvement in both books is low. Safari and Marzoghi in (2010) through their study "evaluating the content of teacher's book and teaching goals of science book of guidance school base on the metacognitive components and metacognitive awareness of students" showed the average students' metacognitive awareness was 3.87; it was 0.20 coefficients for goals, 0.22 for teachers' books and 0.19 in the course book. In addition, based on the frequency distribution of metacognitive sub components in the book content, the highest level of frequency relates to methodology knowledge and planning and the lowest for monitoring and reviewing.

Amir Ahmadi, Iravani and Sharafi (2013) started their study "the analysis of primary school, fifth grade science book base on the video solving problems". Their study showed the coefficient of problem center content of the book did not have the satisfactory level. Also studying of the book for content organization base on the steps of video problem solving have been ignored in the attention of editors. More over the necessary skills of problem solving have been weak. Generally the book is more activity centers that survey center.

Karami (2012) did his study "the analysis of high school first grade math book base on William Romey's technique and Bloom cognitive field."

The result of study showed the conflict coefficient for text was 53% and 1.2 for pictures. These numbers reveal that texts and pictures of the book have been applied actively and the book has been activity center. In discussion part of the study, based on the bloom cognitive field, 81% of exercises and questions of the book were at the level of comprehension. There had not been a lot of attention to this cognitive field in the higher levels.

Kazemi in 2014 have done his study as "the content analysis of primary school books base on cognitive focus and metacognitive learning ". His aim was studying the analysis and discussions of science book in primary school for the level of concentration on cognition, learning and metacognition according to metacognitive skills conflict coefficient of student

and book content has been 1.01. The analysis of metacognitive components showed that the monitoring component, with 181 frequencies, had the highest frequency. The methodology component and evaluating component had the lowest frequency of zero.

1.1. Study questions

- 1- How much the involvement norm of students in text and picture of biology book is considered?
- 2- How much expressing knowledge has been involved in the content of high school biology book 2?
- 3- How much methodology knowledge has been involved in the content of high school biology book 2?
- 4- How much conditional knowledge has been involved in the content of high school biology book 2?
- 5- How much planning factor has been involved in the content of high school biology book 2?
- 6- How much monitoring factor has been involved in the content of high school biology book 2?
- 7- How much evaluating factor has been involved in the content of high school biology book 2?
- 8- How much reviewing factor has been involved in the content of high school biology book 2?

2. Methodology

The used method in this study is data analysis. Considering subject of study which is the analysis of the content of high school biology book, the department of paragraph (text and picture) is considered. The content of book is divided in to text and picture. Then the components of metacognition like the expressing knowledge, methodology knowledge, planning, monitoring, evaluating and reviewing have been studied.

The participants of the study for content analysis is the high school biology books of educational system of Iran, designed by the planning and editing course books of ministry of educational system in 2014-2015.

In this study, first the content analysis method of William Romey has been used to analyze the content of high school third grade biology book and to measure the conflict coefficient. The purpose is to see if this book has been edited and prepared in an active way. Through the idea of William, a course book can be active if its conflict coefficient is between 0.4 and 1.5, while the conflict coefficient of less than 0.4 shows that the book has just paid attention to giving scientific information and wants its reader to remind that information. On the other side, the conflict coefficient of more than 1.5 introduces a book which wants students to analyze each sentence, picture or question and to participate in the class. In the following part, the importance coefficient of each of the categories mentioned in the text and pictures is investigated through Shannon entropy.

3. Finding

Question 1: how much the involvement norm of students in text and picture of biology book is considered?

Table 1: Cognition and metacognition components of high school third grade biology book

Chapter number	Sum of all parts		Sum of non-metacognition parts		Sum of metacognition parts	
	picture	text	Picture	text	Picture	text
chapter1	11	37	6	36	5	1
chapter2	14	56	7	56	7	0
chapter3	10	37	4	35	6	2
chapter4	4	40	3	40	1	0
chapter5	5	33	2	32	3	1
Chapter6	9	47	5	46	4	1
Chapter 7	2	27	0	27	2	0
Chapter 8	6	83	3	77	3	6
Chapter 9	10	44	2	44	8	0
Chapter 10	5	40	0	40	5	0
Chapter 11	11	55	5	55	6	0
Total	87	499	37	488	50	11

According to table 1, the coefficient of conflict in high school biology book is calculated based on the formula 1.

$$\text{Coefficient of conflict} = \frac{\text{sum of the metacognition parts}}{\text{sum of non-metacognition parts}}$$

formula (1)

The coefficient of conflict in text and picture will be calculated according to the above mentioned formula.

$$\text{Coefficient of mental conflict in the text} = \frac{11}{488} = 0.023$$

$$\text{Coefficient of conflict in the picture} = \frac{50}{37} = 1.35$$

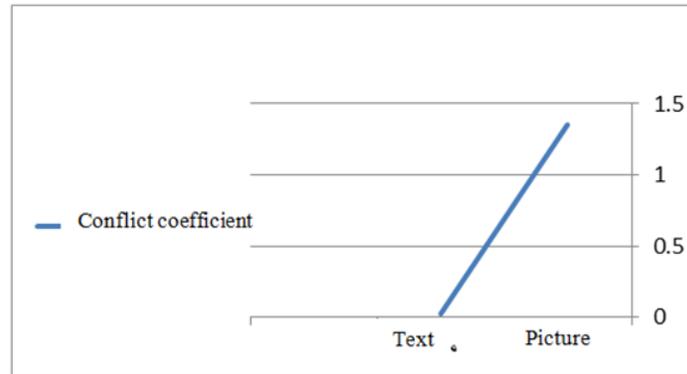


Fig. 1: Conflict coefficient

In the following, based on Shannon entropy method, the components of metacognition have been turned to norm, content of data for each one have been calculated and finally the rate of importance for each one have been calculated. Coefficient of conflict in the text of this book in relation with metacognition component was 0.023 and the coefficient of conflict in picture and in relation to metacognition was 1.35. In this study the obtained results, for the conflict coefficient in the text and in relation with metacognition factors were consistent with Safari(2010), Iravani(2004) and Kazemi and inconsistent with Mahmoodian Fard(2009), Dehghanpour (2012) and Karimi(2014). The conflict

coefficient of picture for metacognitive factors were consistent with Karimi(2014), Mahmoodian Fard (2009) and inconsistent with Dehghan Pour (2012) and Iravani(2004).

Question 2: how much expressing knowledge has been involved in the content of high school biology book 2?

According to this method, first, small components of methodology knowledge in the book were studied and presented in Table 2. Then base on the first step of Shannon entropy, the data turned to norm were presented in Table 3.

Table 2: The frequency of expressing knowledge components of high school third grade biology book

Expressing knowledge	Picture	Text	Sum
Definition	6	4	10
Concepts and meanings	2	14	16
Part	9	0	9
Sum	17	18	35

Table 3: The normative data of expressing knowledge of high school biology book

Expressing knowledge	Picture	text
Definition	0.6	0.4
Concepts and meanings	0.125	0.875
Part	1	0

Table 2 and 3 and Fig. 2 show that the highest levels of attention in this component have been dedicated to concepts and meaning components in the text and definition component for pictures.

Question 3: how much the methodology knowledge is considered in the content of high school biology book?

According to this method, first, small components of methodology knowledge in the book were studied and presented in table 4. Then base on the first step of Shannon entropy, the data turned to norm were presented in table 5.

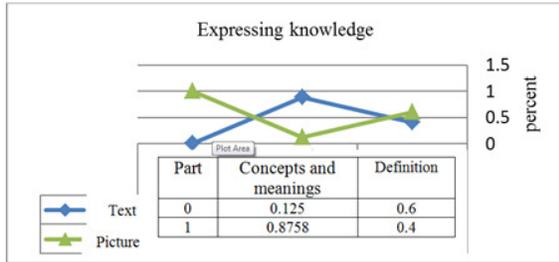


Fig. 2: The normative data of expressing knowledge of high school biology book

Table 4: The frequency of methodology knowledge of high school biology book

Methodology knowledge	Text	Picture	Total
Deduction and prediction	6	8	14
Process of performance	0	7	7
Steps of performing models	0	0	0
Steps of experiment	0	1	1
Total	6	16	22

Table 5: The normative data of methodology knowledge of high school biology book

Methodology knowledge	Text	Picture
Deduction and prediction	0.428	0.571
Process of performance	0	1
Steps of performing models	0	0
Steps of experiment	0	1

been toward deduction and prediction and for pictures toward the steps of performing the process and doing experiment

Question 4: how much conditional knowledge component is considered in the content of high school biology book?

Table 4 and 5 and figure 3 show that the highest level of attention in this component for the text have

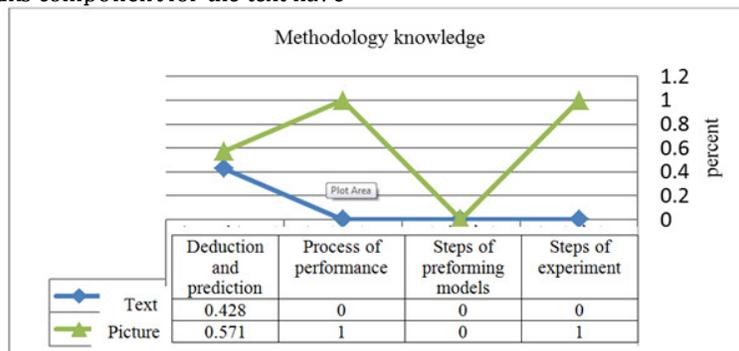


Fig. 3: The normative data of methodology knowledge of high school biology book

Base on this method, first, small components of conditional knowledge in the book were studied and presented in table 6. Then the data bases on the first

step of Shannon entropy turned to norm and were presented in table 7.

Table 6: Frequency of conditional knowledge of high school biology book

Conditional knowledge	text	picture	total
Couse and reason of a processes performance	2	0	29
Time of processes performance	0	3	3
Total	2	3	32

Table 7: Normative data of conditional knowledge of high school biology book

Conditional knowledge	text	picture
Couse and reason of a processes performance	0.069	0
Time of processes performance	0	1

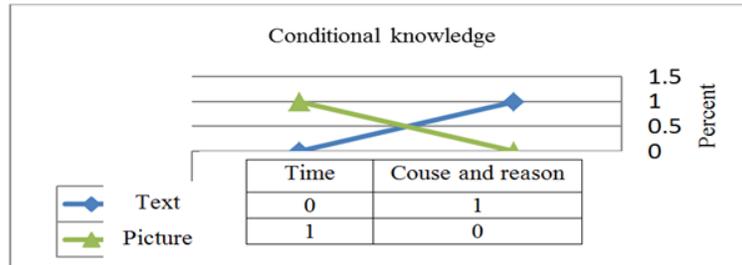


Fig. 4: Normative data of conditional knowledge of high school biology book

Table 6 and 7 and figure 4 show that the highest level of attention in this component in text have been toward cause and reason of a process performance component and in picture it have been to the time of doing the process.

Question 5: how much planning monitoring is considered in the content of high school biology book?

Base on this method, first small component of planning control in the course books were studied and shown in table 8. Then base on the first level of Shannon entropy the normative data were shown in the table 9. Then related table were preserved.

Table 8: Frequency of control planning of high school biology book

Planning	text	picture	total
Instruments	0	0	0
Designing model tools	0	0	0
Total	0	0	0

Table 9: Normative data of control planning of high school biology book

Planning	text	picture
Instrument	0	0
Designing model tools	0	0
Total	0	0

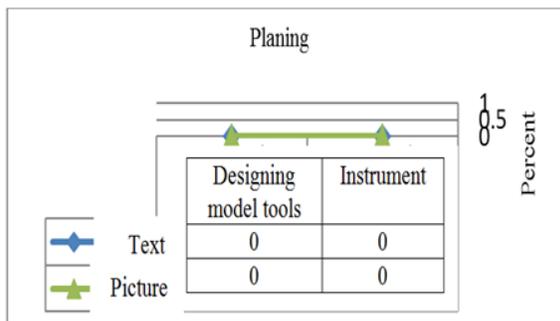


Fig. 5: Normative data of control planning of high school biology book

Question 6: how much does monitoring is the biology book in high school education have?

Base on this method, small components of monitoring in the book were studied and show in the table 10. Then according to Shannon entropy data turned to norm where shown in table 11.

Table 10: Frequency of monitoring control of high school biology book

monitoring	total	picture	text
Questions in the text	16	16	0
Comparison in the text	7	0	7
total	23	16	7

Table 11: Normative data of monitoring control of high school biology book

monitoring	picture	text
Questions in the text	1	0
Comparison in the text	0	1

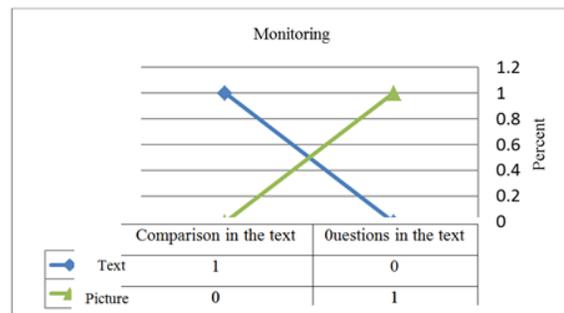


Fig. 6: Normative data of monitoring control of high school biology book

Table 10 and 11 and figure 6 show that the highest level of attention this component in the text related to comparison in text.

Question 7: how much monitoring is considered in the content of biology book in high school?

Base on this method first evaluation controlling components in the book were studied and presented in Table 12. Then according to the first step of

Shannon entropy data turned to norm were presented in table 13.the figure is drawn.

Table 12: Frequency of evaluating control of high school biology book

evaluating	total	picture	text
Comparison in the text	0	0	0

Table 13: Normative data of evaluating control of biology book in high school

evaluating	picture	text
Comparison in the text	0	0

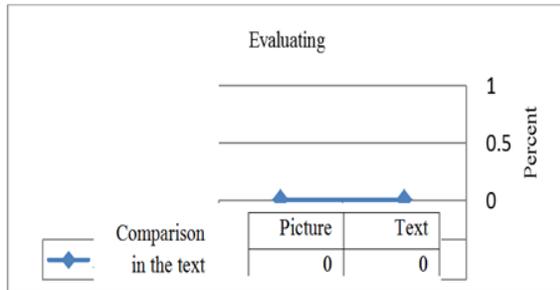


Fig. 7: Normative data of evaluating control of biology book in high school.

Table 12 and 13 and figure 7 show that in text and picture have not been any attentions to in text comparison norm.

Question 8: how much reviewing is considered in the biology book content in high school?

According to this method small components of reviewing in the book were studied and presented in Table 14. Then base on the first step of Shannon entropy data turned to norm were presented in table 15. The related figure is drawn.

Table 14 and 15 and figure 8 shows that in text were no attention in text and picture for above mentioned components. In the following the frequency table and normative data of all components are presented.

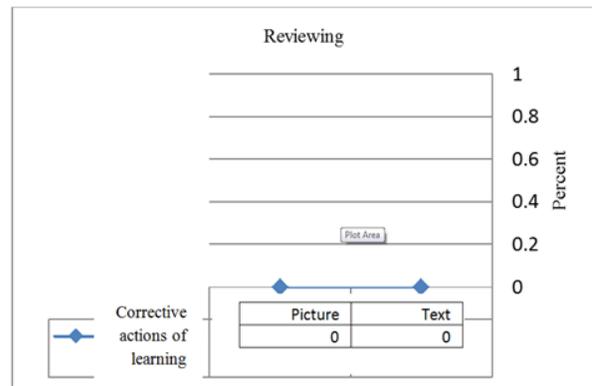


Fig. 8: Normative data of reviewing control of high school biology book

Table 14: Frequency of reviewing component in high school biology book

reviewing	Text	picture	Total
Corrective actions of learning	0	0	0

Table 15: Normative data of reviewing control of high school biology book

reviewing	Text	picture
Corrective actions of learning	0	0

Table 16: Frequency of metacognition components of high school biology book

Component	Expressing knowledge	Method knowledge	Conditional knowledge	Planning	Monitoring	Evaluating	Reviewing
norm							
Text	18	6	2	0	7	0	0
Picture	17	16	3	0	16	0	0
total	35	22	5	0	23	0	0

Table 17: Normative data of metacognitive components of high school biology book

Component	Expressing knowledge	method knowledge	Conditional knowledge	Plannin g	Monitoring	evaluati ng	Reviewi ng
norm							
Text	0.51	0.27	0.4	0	0.30	0	0
Picture	0.48	0.72	0.6	0	0.69	0	0

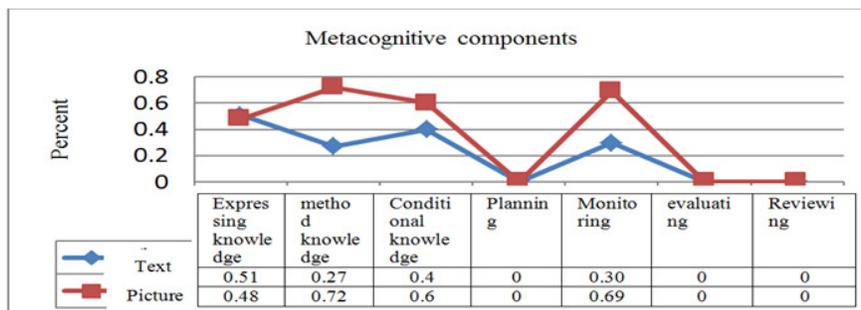


Fig. 9: Normative data of metacognitive c components of high school biology book

Table 16 and 17 and figure 9 show that there were the highest level of expressing knowledge and there were no attention toward planning and reviewing components. In pictures were the highest level were to method knowledge component and no place for planning, evaluating and reviewing.

At last base on the second and third method (Shannon entropy) the importance rate of each component of the metacognition components is measured in order to identify the rate of attention to metacognition components in biology book in high school.

Table 18: The informative aspect of metacognitive components of high school biology book

Component	Expressing knowledge	method knowledge	Conditional knowledge	Planning	Evaluating	Monitoring	Reviewing
Ej	0.632	0.423	0.969	0	0	0.887	0.00001

Table 19: Importance coefficient of metacognitive components of high school biology book

Component	Expressing knowledge	method knowledge	Conditional knowledge	Planning	Evaluating	Monitoring	Reviewing
Importance rate	0.21	0.14	0.33	0	0	0.30	0

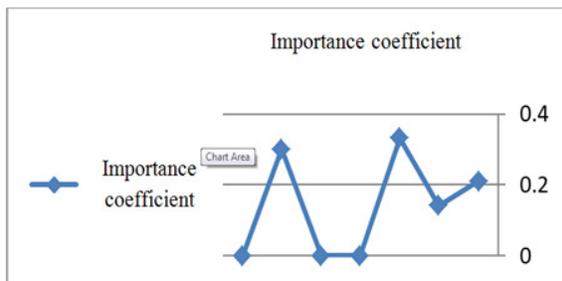


Fig. 10: Importance coefficient of metacognitive components of biology book in high school

Table 18 and 19 and figure 10 show that the highest rate of importance relates to conditional knowledge for monitoring, knowledge of expression, evaluation control, planning control, review control is zero.

4. Conclusion

Based on the findings in table 18, the content of the third grade biology book of high school students according to William's technique separated the metacognitive factors from non-metacognitive ones and based on them the coefficient in the text and picture were measured. So the conflict coefficient in the text equaled .023 and 1.35 in the pictures. According to William's technique and the conflict coefficient the text of the book had passive preparation and the pictures were presented in the active way. In the following part, based on the first and second steps of Shannon entropy each metacognitive factor (expression knowledge, methodology knowledge, conditional knowledge, planning, evaluating, supervising and reviewing) were measured based on the considered norms and the frequency table for normative data were presented in tables 2 to 15 and Figs 1 to 9. Finally, according to the last step of Shannon entropy, the data and the importance coefficient of each factor were presented in tables 18 to 19 and Fig 10. The results showed that the highest importance coefficient in the book was for conditional knowledge (0.33) and the least importance

coefficient was related to reviewing, evaluating and planning with the importance coefficient of zero.

So considering the results of the present study about the text of the third grade biology book, it is suggested that students should not be limited just to the content of the book, but metacognitive concepts in the text should be considered for motivating them to analyze and think through the contents.

References

Aghazadeh,M; Vahedian,M.(1999). Metacognition theories and applications. Tehran: Noorpardazan-peyvand. P.156

Azari,k. (2004). Metacognition in teaching and learning process.Metacognition thinking. Tehran. P.198

Ahmadi,A; Irvani,Sh; Sharaphi,M.(2013). Content analysis of fifth grade primary student science book base on video problem solving

Dlavar.Theoretical and practical principles of human and social studies. Tehran: Roshd edition. P.438

Dehghanpour,A;Razavi,A.(2012). Content analysis of primary school books for the rate of attention to metacognition components. The first national conference on cognitive science in teaching and education Mashhad university.

Kazemi, Z. 2014. content Analysis of textbooks in Primary Schools in Terms of the Amount of Focus On Cognition and Meta-Cognition learning. Switzerland Research Park Journal, 103(1).434-443

Mahmoodian Fard, S (2009). Studying the place of active methods in the content of math book 1and2. Master of art thesis. Science and research university of fars.

Maleki, H. (2011). Lesson planning (performance guide). Tehran: school publication.

Martinez Michael E.2006.What is matacognition?phi delta kappan 87(9):696.

- Nancy ,J . 2006 . Strategies for Succes. Teaching Metacognition Skills to Adolescent Learners. New England Reading Association Journal.portland,42 : 33-41
- Rasooli,m;AmirAtashani.(2012). Content analysis of course books in Tehran: sociologist publication. P. 237
- Safari, Mrzoghi R. (2010).evaluating the planning of science book of guidance school from metacognitive view. The study of teaching and learning, 10: 38-20
- Schraw, G., and Dennison, R. S. 1994. Assessing metacognitive awareness. Contemporary educational psychology, 19(4), 460-475
- Sungur Semra.2007.Contribution of Motivational Beliefs and Metacognition to Students Performance Under Consequential and Nonconsequential Test Conditions.Educational Research and Evaluation 13(2): 127-142.
- Whitebread David; Coltman Penny; Pasternak Deborahpino; Sangster Claire; Grau Valeska; Bingham Sue; Almeqdad Qais; Demetriou Demetra. 2009. The Development of Two Observational Tools for Assessing Metacognition and Self-regulated Learning in Young Childeren. Metacognition and Learning, 4(1): 63-85.
- Yarmohamadian, M.H.(2013). Principles of lesson planning.Nashr publication. P.174.