CHAPTER V
CHAPTER V
SUMMARY, DISCUSSION OF RESULTS AND CONCLUSION

5.1 Introduction

Chapter V presents a summary of the purpose, procedure, and major findings of this research study. A discussion of the implications and recommendations for future study are also presented.

Teaching and assessment go hand in hand. In the classroom, teaching cannot be truly effective if it is not linked to some form of performance assessment. Likewise, assessment is useless if it is not based on what has been, or is to be, taught. Although this may sound obvious, teachers sometimes forget the close relationship between these two. Performance-based assessment requires students to demonstrate their learning and understanding by performing an act or a series of acts. This type of assessment is appropriate to use in a project-based, problem-based, or inquiry-based science classroom because it is consistent with the way students learn—by investigating a question or problem using tools and materials (i.e., performing an act).

Educational reform in the 1980s was based on the premise that too many students knew how to repeat facts and concepts, but were unable to apply those facts and concepts to solve realistic problems that require complex thinking and reasoning skills. Assessments need to better reflect students’ competencies in applying their knowledge and cognitive skills to solve substantive, meaningful tasks. Promising advances in the study of both cognition and learning in content domains and of psychometrics also prompted individuals to think differently about how students process and reason with information and how assessments can be designed to capture meaningful aspects of student learning. There is evidence that the format of the assessment affects the type of thinking and reasoning skills that are used by students, with performance assessments being better suited to assessing high-level, complex thinking skills (e.g., Martinez & Katz, 1996). Performance assessments that affect complex cognitive skills were considered to be valuable tools for educational reform by policy makers and advocates for curriculum reform (Linn, 1993; Resnick & Resnick, 1982). They were thought of as vehicles that could help shape sound instructional practice by modeling to teachers what is important to teach and to students what is important to learn. Carefully crafted performance assessments that
measure complex thinking and reasoning skills can serve as exemplars of assessments that stimulate and enrich learning rather than just serve as indicators of learning (Black & William, 1998). Performance assessments are needed to assess the types of thinking and reasoning skills that are valued by educators, and cannot be assessed by other item formats such as multiple-choice items. The performance assessment tasks were interdisciplinary, required students to produce both short and extended written responses, and some required hands-on activities and collaboration with peers.

Performance assessments have been an integral part of educational systems in numerous countries however they have not been fully integrated in assessment systems in this country. Research has shown that the format of the assessment affects the type of thinking and reasoning skills that are used by students, with performance assessments being better suited to assessing high level, complex thinking skills. The educational benefit of using performance assessments has been demonstrated by a number of researchers. When students are given the opportunity to work on meaningful, real world tasks in instruction, students have demonstrated improved performance on performance assessments. There is ample evidence to support the use of performance assessments in both instruction and assessment to improve student learning for all students. Performance assessments can measure students’ cognitive thinking and reasoning skills and their ability to apply knowledge to solve realistic, meaningful problems. The educational benefit of using performance assessments has been demonstrated by a number of researchers (Lane et al., 2002; Niemi et al., 2007; Stecher et al., 2000). When students are given the opportunity to work on meaningful, real world tasks in instruction, students have demonstrated improved performance on performance assessments.

Performance-based assessment allows the student to construct his or her own answers as opposed to simply choosing from a list. Both student and teacher are made aware in advance of the skills and knowledge to be learned, as well as the criteria for judging performance. Furthermore, performance-based assessment relies on multiple forms of testing. The work of students is compared to set criteria and not to other students’ performances. Cognitive research (Gardner 1993) indicates that most learning that affects on meta-cognitive skills goes on within an active, rather than a passive, context and “that children construct knowledge from their actions on the environment” (Wadsworth1989, p. 156). Performance-based assessment is therefore
suitable for assessing nearly all types of learning because it allows students to
demonstrate their competency in ways compatible with their learning experience. In
project- or inquiry-based teaching, this method of assessment is particularly
applicable for assessing science-process skills, such as the ability to ask questions,
formulate hypotheses, design experiments, analyze and interpret data, use
instruments, and present findings.

While the introduction of performance assessment to education is a positive
development, there are still issues and problems facing teachers, students and policy
makers. Especially, teachers should change their roles of being slaves of the
traditional evaluation of examination-centered system to being pioneers of new
curriculum evaluation reform. Being well aware of the real meaning of curriculum
evaluation and performance assessment is crucial for teachers to improve teaching,
learning and meta-cognitive skills to promote education reform fundamentally.

5.2 TOOLS USED FOR THE STUDY

The instrument applied in the present study by three questionnaires. They are:

1. Academic achievement pre test in chemistry
2. Meta cognitive skills scale
3. Academic achievement post test in chemistry

1. Academic achievement pre test in chemistry was prepared by the researcher and
teacher and was used to measure the academic achievement of pre university students
on the subject chemistry. In this study purpose of academic achievement pre- test
was assessing learners’ mastering amount of learning objects at the first of program in
pre university chemistry (Information, concepts, principals, rules and skills). Pre-test
of chemistry was standardized by researcher.

2. Meta-cognitive skills test: This instrument was designed by O’Nils & Abedi (1996)
to measure four dimensions of meta-cognitive skills. The instrument includes 5
statements to measure planning, 5 statements to measure monitoring, 5 statements to
measure cognitive strategy and 5 statements measure awareness. Students were asked
to rate the statements on a 4-point scale. The rating was scored on Likert-type scale.
The scale ranges from 1 for “ Not at all ” to 4 “ very much ”.
3. Academic achievement post test in chemistry: was prepared by the researcher and teacher and was used to measure the academic achievement of pre university students on the subject chemistry. In this study purpose of academic achievement post-test was assessing learners’ mastering amount of learning objects at the end of program in pre university chemistry (Information, concepts, principals, rules and skills) by standardized academic achievement test for chemistry.

The results of the study are discussed in this chapter in further detail and conclusions drawn that suggest how the results contribute to the current body of knowledge on the desired assessment and education by teachers. The results are based on a quasi experimental research of the chemistry pre university students in Malayer/Iran as identified by the Academic year in 2011-2012. The sample was randomly selected from each school in Malayer. Then researcher asked students to complete the inventory of meta-cognitive skills and chemistry academic achievement test in two stages of pretest and posttest.

Data analysis was tabulated for all independent variables and dependent variables. The independent variables are: performance assessment and gender; the dependent variables are: meta-cognitive skills and academic achievement.

Coded data were analyzed with the help of SPSS software. Dependent sample t-test and two factor covariate analysis (ANCOVA) were used to compare the affect of performance assessment and gender on meta-cognitive skills and academic achievement in pre university students. Students’ responses to questionnaires from two groups (42 performance assessment group and 45 traditional assessment group) were analyzed to provide answers to the following 12 hypotheses:

5.3 HYPOTHESES OF THE STUDY

**H1:** There is a significant difference between the performance assessment group and the traditional assessment group in meta-cognitive skills.

**H2:** There is a significant difference between boys and girls in meta-cognitive skills.

**H3:** There is a significant difference between the performance assessment group and the traditional assessment group in monitoring sub scale.

**H4:** There is a significant difference between boys and girls in monitoring sub scale.
H5: There is a significant difference between the performance assessment group and the traditional assessment group in planning sub scale.

H6: There is a significant difference between boys and girls in planning sub scales.

H7: There is a significant difference between the performance assessment group and the traditional assessment group in cognitive strategy sub scale.

H8: There is a significant difference between boys and girls in cognitive strategy sub scales.

H9: There is a significant difference between the performance assessment group and the traditional assessment group in awareness sub scale.

H10: There is a significant difference between boys and girls in awareness sub scales.

H11: There is a significant difference between the performance assessment group and the traditional assessment group in academic achievement in chemistry.

H12: There is a significant difference between boys and girls in academic achievement in chemistry.

5.4 MAJOR FINDING OF THE STUDY

1- A significant influence of performance assessment was found on all dimensions of meta-cognitive skills, as we find that in the all dimensions meta-cognitive skills in traditional assessment group scored significantly lesser than students who were in performance assessment group. In other words, performance assessment had positive impact on meta-cognitive skills of students. Hence H1 is accepted.

Furthermore, these conclusions support earlier research findings related to studies by: Niemi (2007), Pellegring (2006), Tough & Reed (2006), Cunliffe (2003), Brown (2003), Printich (2002), Stecher (2000), Lane (2002), O'Neil & Brown (1998), Martinez & Katz (1996), O'Neil & Abedi (1996), who examined effect of performance assessment on meta-cognitive skills. In addition, quantitative data findings confirmed these results and also indicated the significance effect of performance assessment on meta-cognitive skills. The result of other research that cited for support and contrary of study of researcher, consist in the following:

O'Neil & Brown (1998), investigated the effect of assessment on meta-cognitive and affective processes of children in the context of a large-scale
mathematics assessment program. Mathematical items were presented in both multiple choice and open-ended formats to 8th-grade students (N=1,032) as part of the California Learning Assessment System. Meta-cognition and affect were measured following each format for boys and girls of various ethnic groups. Results indicate that open-ended question formats have differential effects. Open-ended questions induced more cognitive strategy usage, less self-checking, and greater worry than did multiple-choice questions.

2- Boys and girls students did not differ in their scoring on meta-cognitive skills, as in all the dimensions, ‘F’ value revealed non-significant. Hence H2 is rejected.

Also the interaction between assessment group and sex on meta-cognitive skills was found to be non-significant. There are some researches about effectiveness of performance assessment on meta-cognitive skills but hardly any study compared the effectiveness of performance assessment on meta-cognitive skills in boys and girls.

3- In dimension of monitoring, providing performance assessment situation had significant influence, in other words, monitoring of the students in performance assessment group scored significantly higher than students in traditional assessment group. Hence H3 is accepted.

These finding supported by previous studies have been done in other countries such as: A study was done by Haefner (2004), the results showed that performance assessment engages planning, monitoring and evaluation, through three different mechanisms of assessment feedback. These engage students in setting goals, evaluating their performance and monitoring their understandings through techniques that are internal such as performance assessment.

4- Boys and girls students did not differ in their scoring on monitoring, ‘F’ value revealed non-significant differences. Hence H4 is rejected.

Also the interaction between assessment group and sex on monitoring was found to be non-significant.

There are some researches about effectiveness of performance assessment on monitoring especially meta-cognitive skills but no study has been done to compare the effectiveness of performance assessment on monitoring in boys and girls.
5- As far as the performance assessment is considered, it was observed that in planning students got scores higher than traditional assessment group. In other words, performance assessment had positive impact on monitoring of students. Hence H5 is accepted.

Bennett & Gitomer (2008); Choi (2006); Black & William (1998), Martinez & Katz (1996), have done the studies on effectiveness format of the performance assessment on type of thinking and reasoning skills that are used by students, with performance assessments being better suited to assessing high-level, complex thinking skills. Quantitative data findings confirmed these results and also indicated the significance effect of performance assessment on planning sub scale of meta-cognitive skills.

Another study by Haefner (2004) showed the effectiveness of performance assessment on planning.

6- Boys and girls students did not differ in their scoring on planning, ‘F’ value revealed non-significant differences. Hence H6 is rejected.

Also the interaction between assessment group and sex on planning was found to be non-significant.

There are some researches about effectiveness of performance assessment on planning especially meta-cognitive skills but hardly any study compared the effectiveness of performance assessment on planning in boys and girls.

7- Performance assessment had significant influence on dimension of cognitive strategy, as we find that in dimension of cognitive strategy traditional assessment group scored significantly lesser than students who were in performance assessment group. In other words, performance assessment had positive impact on cognitive strategy of students. Hence H7 is accepted.

O'Neil & Abedi (1996), investigated the effectiveness of performance assessment on all dimensions of meta-cognitive skills such as cognitive strategy. The findings confirmed these results and significance of influence of performance assessment on cognitive strategy.

8- Boys and girls students did not differ in their scoring on cognitive strategy, ‘F’ value revealed non-significant differences. Hence H8 is rejected.
Also the interaction between assessment group and sex on cognitive strategy was found to be non-significant.

There is any research to compare the effectiveness of performance assessment on cognitive strategy in boys and girls.

9- A significant influence of performance assessment was found on dimension of awareness, as we find that in dimension of awareness in performance assessment group scored significantly higher than students who were in traditional assessment group. In other words, performance assessment had positive impact on awareness of students. Hence H9 is accepted.

Furthermore, these conclusions support earlier research findings related to studies by: Herman, Klein, Heath, & Wakai (1994), Baker & O'Neil (1994), Winfield & Woodard (1994), Miller & Legg (1993), who examined effectiveness of performance assessment on awareness.

10- Boys and girls students did not differ in their scoring on awareness, ‘F’ value revealed non-significant. Hence H10 is rejected.

Also the interaction between assessment group and sex on awareness was found to be non-significant.

There is any research to compare the effectiveness of performance assessment on awareness in boys and girls.

11- As far as the performance assessment is considered, it was observed that in chemistry academic achievement students got scores higher than traditional assessment group. In other words, performance assessment had positive impact on academic achievement of students in chemistry. Hence H11 is accepted.

significance effect of performance assessment on academic achievement. The result of some research that cited for support of study of researcher, consist in the following:

Sari & Wiyarsi (2011) examined a study to determine: (a) whether there is any difference between chemistry learning achievements of students taking the chemistry class with the implementation of Performance Assessment and ones joining the class without the implementation of Performance Assessment if the prior knowledge was statistically controlled, (b) the effectiveness of the implementation of Performance Assessment on the motivation improvement to learn chemistry of high-school (SMA) students in Yogyakarta. The results showed: (a) there were significant differences on chemistry learning achievement with and without the implementation of Performance Assessment on students of class. (b) Based on the statistical analysis of the t-test of same subjects, it showed that there was a significant increase of scores of students’ motivation to learn chemistry in classes with the implementation Performance Assessment.

Kearney & Perkins (2010) examined the relationship of performance assessment and students learning in the classroom. Research conducted in the School of Education at the University of Notre Dame, Australia where 280 undergraduate primary education students. Research has shown strong links between the implementation of authentic assessment and high quality learning.

These results are due to performance assessment features in comparison with traditional assessment. Performance-based assessment allows the student to construct his or her own answers; Performance-based assessment is an active learning experience and actually motivates students to learn more about the subject matter, they demonstrate scientific knowledge and understanding through performance. This method of assessment is coordinated to constructivism view of learning, while traditional assessment is adjusted to behaviorism view.

12- Only in chemistry academic achievement, a significant difference was observed in boys and girls scoring. In other words, in both groups, boys got scores significantly lesser than girls students. Hence H12 is accepted.

The interaction between assessment group and sex on chemistry academic achievement was found to be non-significant.
Some research about effectiveness of performance assessment on academic achievement that have been reviewed in chapter two shows that academic achievement in boys are significantly more than the girls such as:

Klein et al. (1997) revealed that gender effectiveness on science academic achievement in performance assessment group and traditional group. The results showed the differences in mean scores among gender on science performance assessments are comparable to the differences that are typically found among these groups of traditional multiple-choice tests. Quantitative of the study revealed that girls tended to have higher overall mean scores than boys on the performance measures.

Girls' higher scores mean can be due to more tendency of girls to participate in cultural activities. As seen rate of girls' participation in higher education have increased. Also more females' tendency to social activities can be due to their warm reception in academic achievement.

5.5 FURTHER FINDING OF THE RESEARCH

5.5.1 Comparison of pre test and post test of meta-cognitive skills

The present study revealed that there was significant difference between pre test and post test of meta-cognitive skills in performance assessment group.

To comparison of students' meta-cognitive skills means in traditional assessment group and performance assessment group, researcher applied dependent sample t-test. The result revealed that the mean of students' meta-cognitive skills scores was about same before and after the traditional assessment method. In meta-cognitive skills, mean of the students' posttest was about 12 scores higher than the pretests' mean in performance assessment group. It means that performance assessment had significant influence over meta cognitive skills mean, as the obtained ‘t’ value of 6.66 was found to be statistically significant (p=.000). The mean paired differences clearly revealed that the differences between meta-cognitive skills scores before the performance assessment and after that were statistically significant.

5.5.2 Comparison of pre test and post test of Monitoring sub scale

To comparison of students' monitoring means in traditional assessment group and performance assessment group, researcher applied dependent sample t-test. The result revealed that performance assessment has significant influence, as the obtained
‘t’ value of 4.89 was found to be statistically significant (p=.000) and also significant at 0.05 levels. The mean paired differences clearly revealed that the differences between monitoring scores before the performance assessment method and after that were statistically significant.

5.5.3 Comparison of pre test and post test of planning sub scale

According to results of dependent samples t-test, traditional assessment did not have significant influence over the planning mean, as the obtained ‘t’ value of 1.14 was found to be statistically non significant (p=.257). The mean paired differences clearly revealed that the differences between planning scores before the traditional assessment and after that were not statistically significant. The mean paired differences clearly revealed that the differences between planning scores before the performance assessment method and after that were statistically significant.

5.5.4 Comparison of pre test and post test of cognitive strategy sub scale

According to the results of dependent samples t-test, performance assessment had significant influence over the cognitive strategy mean, as the obtained ‘t’ value of 4.75 was found to be statistically significant (p=.000) and also significant at 0.05 levels. The mean paired differences clearly revealed that the differences between cognitive strategy scores before the performance assessment method and after that were statistically significant.

5.5.5 Comparison of pre test and post test of awareness sub scale

The results indicated that performance assessment has significant influence over the awareness mean, as the obtained ‘t’ value of 7.79 was found to be statistically significant (p=.000) and also significant at 0.05 levels. The mean paired differences clearly revealed that the differences between awareness scores before the performance assessment method and after that were statistically significant.

5.5.6 Comparison of pre test and post test of chemistry academic achievement

The results showed that performance assessment has significant influence over the chemistry academic achievement mean, as the obtained ‘t’ value of 13.14 was found to be statistically significant (p=.000) and also significant at 0.05 levels. The mean paired differences clearly revealed that the differences between chemistry
academic achievement scores before the performance assessment method and after that were statistically significant.

5.6 LIMITATIONS OF THE STUDY

It is of great importance to a researcher to identify the limitations of the study, help him defend, more firmly the finding. The following are the limitations of the present study.

1. Execution time of this research was limited, because this research was administrated in the second half of the year. If it was administrated during the academic year, different results were obtained.

2. Since this research was a quasi experimental design, the selected sample size was too limited.

3. Since this research was done only on chemistry subject, the results will not be generalized to other subject.

4. Since this research was done only on pre university grade, the results will not be generalized to other academic grades.

5. In this study, researcher used teacher-made chemistry academic achievement test, because there was not standardized test of pre university chemistry.

6. The results of this study in relation to performance assessment are worthy and do not cover the other methods of assessment.

7. The results of this study in relation to dependent variables (meta-cognitive features and chemistry academic achievement) are worthy.

8. Need to train of the selected teachers for administration was a limitation in this study.

9. Course hour's restriction of chemistry lab and low tendency of teachers for doing practical activities in laboratory were other limitations of administration in this study.

10. Another limitation of this study was restriction of course hours in a session and being time consuming of performance assessment.

11. Since the other subjects of experimental groups were assessed by traditional assessment methods, it reduced mental preparation of students to cooperate in chemistry classes.
12. Utilization of only two methods of performance assessment (paper and pencil performance test and project method) was another limitation of this study.

13. Data collection was limited to meta-cognitive skills inventory and chemistry academic achievement test.

14. Since, this study was a student project, there was a lot of financial constrains of researcher to provide some requirements to students performance assessment in laboratory.

15. Administration officials and pre university administrators did not cooperate with researcher, so implementation was delayed.

5.7 IMPLICATIONS OF THE STUDY

1- Through performance assessment, teachers of chemistry change their traditional ideas of chemistry assessment. Teachers of chemistry become aware that it is important to make chemistry teaching as realistic as possible to provide students with suitable experiences that encourage them to ultimately use chemistry in real-life situation.

2- With performance assessment, students learn to self-assess and to understand the importance of cooperative learning. They have more chance to improve their meta-cognitive skills.

3- The most important thing is that performance assessment helps low-achieving students become more confident, since they have more chance show their potential talents.

4- Students’ learning is evaluated not only by teachers, but also by students themselves and their peer students concerning both their achievements and weaknesses.

5- Performance assessment arouses students’ interest of learning chemistry.

6- Performance assessment is good for teachers to get feedback from student himself/herself, peer students, parents and teachers themselves to help monitor teaching and learning and encourages students to learn.

7- Performance assessment helps students participate in classroom activities and changes students from passive acceptance of the assessment to be the masters of learning.
8- Performance assessment adjusts students learning strategies and enhances students’ meta-cognitive skills and helps stimulate their learning effectiveness.

9- Performance assessment provides opportunities for the parents to involve in the school teaching and learning and to know their students' learning better at schools.

10- Performance-based assessment allows the student to construct his or her own answers as opposed to choosing from a group of answers. Both student and teacher are made aware of the skills and knowledge to be learned as well as the criteria for judging performance. Performance-based assessments “can be a learning experience in themselves. They can actually motivate students to learn more about the subject matter”.

11- Performance assessment provides opportunities to assess process and products of learning.

12- Performance assessment helps teachers to assess students' learning directly.

13- Teachers can use performance assessment in order to assess students' learned skills, for example experimental skills in chemistry and problem solving skills in mathematic.

14- Performance assessment helps students to be self-director in their learning process.

15- Using performance assessment is caused teaching, learning and assessment to be integrated.

5.8 SUGGESTIONS FOR FUTURE RESEARCH

1. This research study was limited to one district in Malayer (Iran). The sample size consisted of a small pool of schools. So the generalization of the findings is limited. Therefore, it is necessary to expend the data sources to include the larger populations. It would be interesting to see whether performance assessment will have same impact on meta-cognitive skills and academic achievement. So a broader size across several districts is recommended.

2. A wider adoption of other different methods of non-traditional assessment approaches is recommended.
3. Future studies should consider other cognitive features such as critical thinking and creative thinking in relation to performance assessment.

4. The impact of the other methods of performance assessment as independent variable on developing meta-cognitive features should be explored.

5. Further studies should explore the other subject beside of chemistry in relation to performance assessment and meta-cognitive features.

6. Repetition of this study in different communities will determines the generalization of the research.

7. Repetition of this research in different academic grades will show the results of performance assessment on developing meta-cognitive features in different academic grades.

8. Another approach to further the research would be to have students score their own Meta-cognitive skills test (using the scoring table offered by the developers) after the initial testing occasion which would allow students to see for themselves what areas they were strong in and what areas they needed to improve in and then have these students meta-cognitively plan out (using the Meta-cognitive skills as a guide) how to improve their weakest areas and report their efforts as they monitor, regulate, and evaluate their progress over a term.

9. For future research, further refinement of the Meta-cognitive skills inventory is recommended. It would be of interest to hear teachers’ and students’ thoughts of how the tool could be refined. One way to accomplish this would be to have teachers and students, who have used the tool, give their input on the elements of each step that can be eliminated or condensed, as well as hear their input on the sequencing of steps and the elements within each step in an effort to further streamline the tool.