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Prospective Science Teachers' Perception Related to Formative Assessment Approaches in Turkey

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Abstract

In this study, it was aimed to investigate the perceptions and competences of prospective science teachers about formative assessment approaches. Qualitative case study methodology was used in the study. Research group consisted of 17 senior students of science education. As a data collection tool, a semi-structured "Formative Assessment Perception Interview Form" was used which was developed by the researcher. The data were collected by conducting a total of ten in-depth interviews, 8 with focus groups and another 2 as face -to-face. Collected data were subjected to content analysis. Study findings revealed that perceptions and competences of prospective science teachers on formative assessment approaches are very low and not sufficient. In particular, it was found out in this study that prospective science teachers are familiar with the definition and function of formative assessment approaches (12%) at a low extent albeit; however, they are seriously deficient about for what purpose (7% competence) they will use and choose them, how to prepare such approaches (3% competence), how to interpret and score effects of the results for the learning-teaching process (2% competence). Science teacher training curricula need to be revised in a way to give prospective teachers a training and preparation in practical, long-term and real learning-teaching environments for formative assessment approaches.

Keywords: formative assessment approaches, science education, science teacher training, Turkey

1. Introduction

Theories that dominated learning in the 20th century seem to be associationist and behaviourist learning, and they were replaced by social constructivism in the 21st century (Shepart, 2000). The perspective, concepts and approaches to learning, teaching, and assessment seem to change as well as how learning takes place and views and theories related to learning change (Abell & Siegel, 2011 ¸Shepart, 2000). Measurement and assessment is also an important element of this change, leading to radical reforms in science education and science curricula. Therefore, measurement and assessment is of vital importance in secondary and tertiary science education and classes, for reporting on student learning and knowledge affecting students 'development on the basis of the curriculum as well as providing support to students' science learning (Lyon, 2013).

In Turkey, various innovations have been made both in science education and in structural and science curricula in order to be able to keep up with current developments and to keep up with the times. The school system in Turkey consists of three levels, 4 + 4 + 4. The first level is primary education, the second level is secondary level-I and the third level is secondary level-II. Particularly in 2004, science curricula based on constructivist learning theories and student centered science-technology course curricula was adopted along with other learning theories. Then in 2013, science training curricula based on inquiry-based learning approach were developed. Thus, there have been significant changes in the measurement and assessment of science curricula. In science curricula, although classical measurement and assessment approaches are excluded, the main emphasis is on formative assessment approaches. Science teacher training program in Turkey consists of 8 semesters and lasts for 4 years. In general, the courses are divided into three parts: field and field training courses, pedagogical courses and general knowledge courses. Those who graduate from this curriculum, work as science teachers in secondary education level 1. In science teacher training program, measurement and assessment is offered as a pedagogical course in the third year. Among the knowledge and skills to be acquired by undergraduate students related to this course are the development and effective application of tools for multidimensional identification of students (observation, interview, portfolio, research papers, research projects, peer assessment, self-assessment, attitude scales etc (HEC, 2007). In parallel with this, it is seen that in the secondary-I science curricula, a measurement and assessment approach is adopted to provide continuous feedback to monitor students' improvement in the process, to guide them, to fix and eliminate learning difficulties and to support meaningful and permanent learning (MoNE, 2013). This

gives priority to the evaluation of the learning process as much as the product. Besides classical measurement and assessment approaches, formative assessment approaches also need to be used effectively in science education. Thus, it can be said that in science curricula, assessment-centered learning environments are adopted. In assessment-centered learning environments (Abell & Siegel, 2011), teachers apply formative assessment approaches to support learning, to help students become aware of and improve their thinking, and to provide information about education. In Turkey, as understood from the science teacher training curriculum and secondary-I science curricula, when a prospective science teacher graduates from the faculty of education, they must have sufficient knowledge and skills on formative assessment approaches and be fully equipped to graduate.

Science education promotes our knowledge or understanding of the need to organize and use effective and efficient measurement and assessment in science classes. However, there are very few studies that examine science teachers' measurement-assessment competences, knowledge, perceptions, etc (Lyon, 2013). In addition, many teachers do not feel sufficient about measuring and assessing, and need help to implement and make decisions based on measurement and assessment techniques in multiple and different types (Mertler & Campbell, 2005). Thus, prospective science teachers' use of effective measurement and assessment approaches or activities in science education has a vital importance for the development and progress of science education (Lyon, 2013). Teacher training programs make a great effort to help teacher candidates acquire the knowledge and skills needed to be successful in their future careers (Yılmaz-Tüzün, 2008). Teacher candidates must graduate with the necessary and well-developed professional knowledge and skills. The more sufficient knowledge they leave with about measurement and assessment, the more confident they will be able to apply different types of measurement and assessment techniques after graduation (Yılmaz-Tüzün, 2008). In this research, it was aimed to examine the perceptions and competences of prospective science teachers towards formative assessment approaches. For this purpose; investigation was carried out on conceptions and competences of prospective science teachers related to formative assessment approaches such as performance assessment, portfolio, diagnostic branched tree, structured grid, word association tests, concept maps, interview and observation. Based on each of these identified formative assessment approaches, answer was sought for the following research questions:

1. What is the level of perceptions and competences of prospective science teachers for the definition/function of formative assessment approaches?
2. What is the level of perceptions and competences of prospective science teachers for the purposes of formative assessment approaches?
3. What is the level of perceptions and competences of prospective science teachers for the preparation of formative assessment approaches?
4. What is the level of perceptions and competences of prospective science teachers for the interpretation/scoring of results from formative assessment approaches?

2. Method

2.1 Research Design

This study was conducted as a case study, one of the qualitative research methods. Case studies are about in-depth description and analysis of a limited system or situation (Meriam, 2009; McMillan & Schumacher, 2010).

2.2 Participants

The research was conducted with 17 (11 female and 6 male) senior grade science teacher candidates, selected by convenient sampling method, in 2014-2015 academic year.

2.3 Data Collection Tool and Development and Implementation Process

In this study, the "Formative Assessment Perception Interview Form" developed by the author was collected using semi-structured interview form. Before the interview form was developed, relevant literature and documents were reviewed. As a result of the related researches, interview questions about the study were prepared. The questions were presented to two experts who were experts in the field for their opinion. A draft interview form was prepared according to their opinions. The draft interview form was pilot interviewed with three prospective science teachers. Following examination of the interviews, the shortcomings found in the form were resolved and the form was finalized. The semi-structured interview form is composed of two parts: the first part briefly presents the purpose of the research and demographic data about the participants. The second part included the interview questions. The interview questions consist of 9 open-ended questions and probes under them.

By using the semi-structured interview form, in-depth interviews were held; face-to-face interviews with 2 senior grade prospective science teachers and 8 focus group interviews were conducted with 15 other participants. In total, 10 interviews were made with 17 prospective science teachers. The interviews were held at the author's office separately for

each individual and group at the pre-scheduled time and date. The interviews lasted approximately 45 minutes to 1 hour and were recorded.

2.4 Data Analysis

Content analysis, which is a kind of qualitative data analysis, was conducted on the data obtained from the interviews. In the first content analysis, the data obtained from the interviews were transcribed. Then, the transcriptions were read and analyzed in detail. In the analysis of the data, first of all, the data obtained from the first 3 interviews were analyzed and main categories and codes were created. Then the same process was applied to the remaining interviews and obtained categories and codes were added to the initial list. As a result of the content analysis of all the interviews, 4 basic categories and their sub codes were formed as the description/function of, purpose of, preparation of and interpreting/scoring of results of the formative assessment approach. The first content analysis was completed by calculating the frequency and percentages of the categories and codes.

The interview data were reviewed and analyzed by the author a second time in order to ensure the consistency and reliability of the analysis data. The second content analysis was performed approximately 5 months after the initial content analysis. The first content analysis and the second content analysis were calculated for the percentage of matches. Agreement percentage was calculated by using the agreement percentage formula ($P= N_a \times 100/N_a + N_d$) (Coll, 1986, p.512; Robson, 1893, p.222, cited by Türnüklü, 2000; Bakeman & Gottman, 1997, p.60, cited by Türnüklü, 2000). Agreement percentage of 80% indicates that the results of qualitative data analysis are reliable (Keeves & Sowden, 1994, p.1469, cited by Türnüklü, 2000). In this study, the first and second content analysis agreement rate was 82.07% and the content analysis was found to be reliable. The results of the content analysis are presented in tables from 1 through 8.

After the interview data content analysis, rubrics for each formative assessment approach were drawn up based on the literature to determine the competence levels of prospective science teachers in relation with the defined formative assessment approaches. The content analysis results obtained from the participants were compared with developed rubrics. As a result, competences of prospective science teachers related to formative assessment approach were referred with three codes ***S**trong **C**ompetence* (**SC**), ***W**eak **C**ompetence* (**WC**) and ***In**competence* (IC) and displayed in graphics (see figure through 1 to 9).

3. Results

In this section, findings are given about **p**rospective **s**cience **t**eachers' (PST) perceptions and competences related to **f**ormative **a**ssessment **a**pproaches (FAA).

3.1 Perceptions and Competences of PSTs related to Performance Assessment (PA)

The first category consists of definition and function (DF) of PA with six affiliated codes such as DF1 to DF6. It was seen that PST placed the most focus on DF1 and DF2 at 33.33%. The second category includes **P**urpose (**P**) of PA and 13 codes are located under this category as P1to P13. PSTs were found to have the most emphasis on P1 code at 17.24%. The third category consists of **Pr**eparation (**Pr**) of PA and under this category are 7 codes as Pr to Pr7. PSTs were found to have the most emphasis on Pr1 code AT 33.33%. The fourth category, as shown in Table 1, is about **I**nterpreting and **S**coring (**IS**) results of PA, and under this category there are 11 codes as IS1 to IS11. Prospective science teachers were found to have the most emphasis on IS1 and IS2 codes at 16.66%.

Table 1. Perceptions of PSTs related to PA

Codes	DF of PA	f	%
DF1	Through performance assignments, assessment of learners as a whole during the process.	4	33,33
DF2	Yielding a product through the project.	4	33,33
DF3	An approach that evaluates the practices / activities of the learners in the process.	2	16,66
DF4	The effort exerted by the learner for one semester.	1	8,33
DF6	I do not know	1	8,33
Subtotal		12	100
	P of PA		
P1	Ensuring learners to acquire the skill doing of research and inquiry.	5	17,24
P2	Ensuring learners to access knowledge.	4	13,80
P3	Ensuring learners to be responsible for their learning.	3	10,35
P4	Ensuring learners to acquire the skill of self-assessment.	2	6,90
P5	Identifying and increasing interest and curiosity of learners.	2	6,90
P6	Ensuring learners to develop scientific process skills.	2	6,90
P7	Identifying and developing learners' psycho-motor skills.	2	6,90
P8	Ensuring development of learners' responsibility consciousness.	2	6,90
P9	Ensuring development of learners' cognitive development.	1	3,50
P10	Ensuring increase of student self-confidence.	1	3,50
P11	Ensuring learners' socialization.	1	3,50
P12	Ensuring identification and development of students' affective skills.	1	3,50
P13	I do not know.	3	10,35
Subtotal		29	100
	Pr of PA	f	%
Pr1	Different performance tasks / assignments to prepare learners for research are prepared and assigned to them.	6	33,33
Pr2	A form is prepared that includes the work done during the process.	2	11,11
Pr3	A problem about daily life is given to students as a task.	2	11,11
Pr4	In performance tasks, assessment criteria are determined.	2	11,11
Pr5	Students are aware of the assessment criteria.	2	11,11
Pr6	Student developments are monitored.	1	5,55
Pr7	I do not know.	3	16,66
Subtotal		18	100
	IS results of PA		
IS1	Results are interpreted and scored according to some predetermined criteria.	4	16,66
IS2	Weekly interviews / short meetings are held to interpret and score the results.	4	16,66
IS3	Results are interpreted and scored according to the resulting product.	3	12,5
IS4	Results are interpreted and scored according to the general trend during the process.	2	8,33
IS5	Results are interpreted and scored according to the student effort in the process.	2	8,33
IS6	The process is observed and the results are interpreted and scored.	1	4,17
IS7	Results are interpreted and scored by making regular checks.	1	4,17
IS8	Results are interpreted and scored according to students' diaries.	1	4,17
IS9	Self-assessments are made and the results are interpreted and scored.	1	4,17
IS10	Peer evaluation is done and the results are interpreted and scored.	1	4,17
IS11	I do not know how to interpret and score the results.	4	16,66
Subtotal		24	100

In parallel with Table 1, competence of prospective science teachers for performance assessment are given below in Figure 1. As seen in Figure 1, according to the perception of prospective science teachers, they have 80% of weak competence and 20% of incompetence for DF, which is the first category of performance assessment. As for P, which is the second category under performance assessment, they have 70% weak competence and 30% incompetence. Thirdly, it is seen that participants have 70% weak competence and 30% incompetence for Pr of performance assessment. Lastly in IS, the last category of PA, it was found out that the participants have 60% weak competence and 40% incompetence.

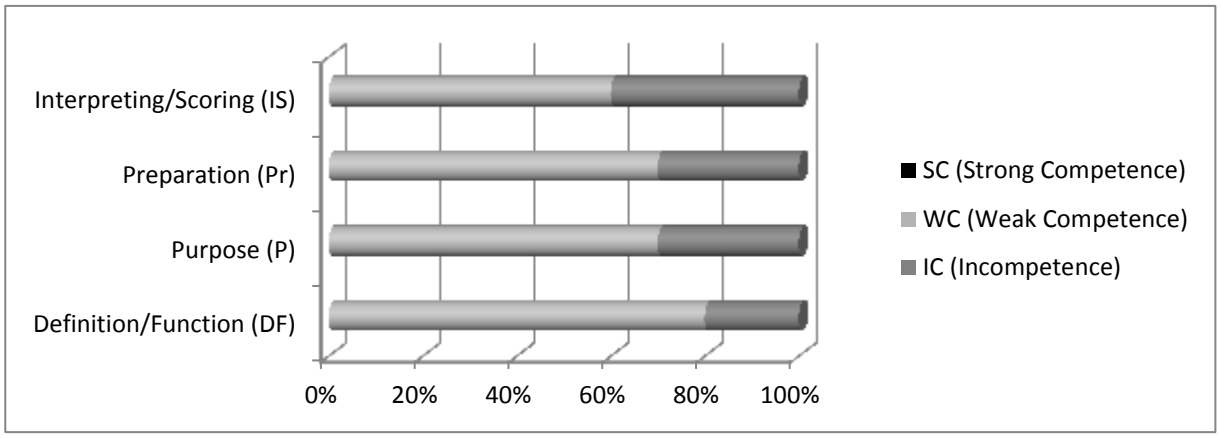

Figure 1. Competence levels of PSTs for PA

3.2 Perceptions and Competences of PSTs Related to Portfolio (Po)

First category is about DF of **Po**rtfolio (**Po**) with five codes under such as DF toDF5. It was seen that PSTs placed the most focus on DF1 with 69,23%. The second category includes P of Po and 18 codes are located under this category as P1 to P18. Prospective science teachers were found to have the most emphasis on P1 code with 16%. The third category consists of Pr of Po and under this category are 7 codes as Pr1 toPr7. Prospective science teachers were found to have the most emphasis on Pr1 code with 34,78%. The fourth category, as shown in Table 1, is about IS results of Po, and under this category there are 12 codes as IS1 to IS12. Prospective science teachers were found to have the most emphasis on IS12 with 23,53%, followed by IS1 with 17,65%.

In parallel to Table 2, competences of prospective science teachers for portfolio are given Figure 2. As seen in the Figure 2, according to the perceptions of science teachers, they have 90% of weak competence and 10% of incompetence for DF, which is the first category of portfolio. As for P, which is the second category under portfolio, they have 70% weak competence and 30% incompetence. Thirdly, it is seen that participants have 70% weak competence and 30% incompetence for Pr of portfolio. Lastly in IS, the last category of Po, it was found out that the participants have 30% weak competence and 70% incompetence.

Table 2. Perceptions of PSTs related to Po

Codes	DF of Po	f	%
DF1	A file which includes all assignments, projects, etc. given to the learners during the education and instruction period.	9	69,23
DF2	It is a collection of performance tasks.	1	7,70
DF3	It is an assessment approach that involves the assessment of the product generated.	1	7,70
DF4	It is an annual assignment given to learners.	1	7,70
DF5	An assessment approach without process evaluation.	1	7,70
Subtotal		13	100
	P of Po		
P1	Ensuring to better recognize learners relating to information, skills, attitudes, and so on.	4	16,00
P2	Following learner's development through the process.	3	12,00
P3	Identifying learners' information about a topic.	2	8,00
P4	Ensuring learners to identify missing aspects of their knowledge about a topic.	1	4,00
P5	Ensuring study in cooperative groups.	1	4,00
P6	Determining learners' interest and attitude towards lesson.	1	4,00
P7	Providing learning experiences or experiences.	1	4,00
P8	Increasing the success of learners.	1	4,00
P9	Ensuring learners to build self-consciousness.	1	4,00
P10	Ensuring learners to be responsible for their learning.	1	4,00
P11	Ensuring learners to become active.	1	4,00
P12	Ensuring learners to gain self-assessment awareness.	1	4,00
P13	Ensuring learners to improve their scientific process skills.	1	4,00
P14	Determining the level of learners or their readiness.	1	4,00
P15	Determining and eliminating the misconceptions of learners.	1	4,00
P16	Ensuring learners to acquire research skills.	1	4,00
P17	Development of cognitive, affective and psychomotor skills of the learners.	1	4,00
P18	I do not know.	2	8,00
Subtotal		25	100
	Pr of Po		
Pr1	The portfolio should include homework, assignments, projects and activities that learners have prepared.	8	34,78
Pr2	Learners need to create a portfolio.	6	26,09
Pr3	The portfolio should include information about learners and their families.	2	8,70
Pr4	The portfolio should include directions for specific tasks.	1	4,35
Pr5	In preparing the portfolio, it is necessary to carry out certain planning which shows gradual progress.	1	4,35
Pr6	As the laboratory report is prepared, a portfolio must be prepared.	1	4,35
Pr7	I do not know.	4	17,4
Subtotal		23	100
	IS results of Po		
IS1	Results are interpreted and scored according to the products, studies, assignments, and activities, etc. attached to the file.	3	17,65
IS2	Results are interpreted and scored by looking at what the learners have done in the process.	1	5,88
IS3	Results are interpreted and scored according to some predetermined criteria.	1	5,88
IS4	Results are interpreted and scored according to the success of the learner in the general trend.	1	5,88
IS5	Some stages are determined and the results are interpreted and scored accordingly.	1	5,88
IS6	Results are interpreted and scored according to the learners' expressions, verbally and in writing.	1	5,88
IS7	Results are interpreted and scored by observing the progress in the process.	1	5,88
IS8	A certain scoring system is determined and the results are interpreted and scored accordingly.	1	5,88
IS9	Results are interpreted and scored according to learners' diaries.	1	5,88
IS10	Self-evaluation is performed and the results are interpreted and scored accordingly.	1	5,88
IS11	Peer evaluation is performed and the results are interpreted and scored accordingly.	1	5,88
IS12	I do not know	4	23,53
Subtotal		17	100

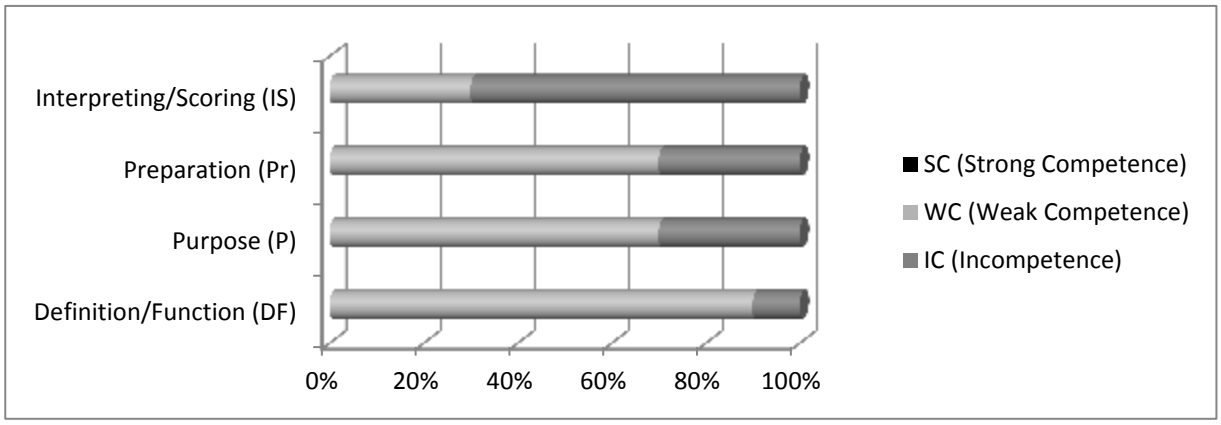

Figure 2. Competence levels of PSTs for Po

3.3 Perceptions and Competences of PSTs related to Concept Maps (CM)

The first category consists of DF of concept map with four affiliated codes such as DF1 to DF4. It was seen that PSTs placed the most focus on DF1 at 36,84%. The second category includes P of CM, 10 codes are located under this category as P1 to P10. Prospective science teachers were found to have the most emphasis on P1 code at 23,08%. The third category consists of Pr of CM and under this category are 9 codes as Pr1 to Pr9. Prospective science teachers were found to have the most emphasis on Pr1 code at 25%. The fourth category, as shown in Table 3, is about IS of results of CM, and under this category there are 6 codes as IS1 to IS6. Prospective science teachers were found to have the most emphasis on IS6 code at 33,33%, followed by IS1 at 22,22%.

In parallel with Table 3, competences of prospective science teachers for concept maps are given in Figure 3. As the figure displays, according to the prospective science teachers, they have 80 % of strong competence and 20% of weak competence for DF, which is the first category of CM. As for P, which is the second category under CM, they have 30 % strong competence, 50% weak competence, and 20% incompetence. Thirdly, participants have 30% strong competence and 50% weak competence and 20% incompetence for Pr of concept maps. Lastly in IS, the last category of CM, it was found out that the participants have 40% weak competence and 60% incompetence.

Table 3. Perceptions of PSTs related to CM

Codes	DF of CM	f	%
DF1	It is a course material used at the end or before the subject.	7	36,84
DF2	It is an approach that gives concepts related to the subject and clarifies the connection between them.	6	31,58
DF3	It is an approach that provides the main summary, idea or essentials of a topic.	4	21,05
DF4	It is an approach in which the concepts are written on the board and the (conceptual) network among them is drawn.	2	10,53
Subtotal		19	100
	P of CM		
P1	To present the relationship between concepts.	6	23,08
P2	To provide narration and summary of the topic.	5	19,23
P3	To provide conceptual learning.	4	15,39
P4	To identify and eliminate misconceptions.	3	11,54
P5	To measure the knowledge of learners.	3	11,54
P6	To measure and determine whether the learner listens to the lecture.	1	3,85
P7	To determine whether learners come prepared for the lesson.	1	3,85
P8	To determine and measure the attentiveness and attention of the learner.	1	3,85
P9	To eliminate lack of knowledge of learners.	1	3,85
P10	To establish the relationship between the previous knowledge and the new knowledge to be learned.	1	3,85
Subtotal		26	100
	Pr of CM		
Pr1	It is prepared as an approach in which a concept is given a sub-concepts are identified and the relationship between them is elicited.	7	25,00
Pr2	Relationships between the arrows and the concepts are provided.	4	14,29
Pr3	It is an approach in which concepts and the boxes are provided for learners and the map is prepared.	3	10,71
Pr4	The relationship on the arrows must be determined.	3	10,71
Pr5	It is an approach in which concepts on the subject are asked of learners in the end of the course.	2	7,14
Pr6	It is an approach prepared in a way to create the network/connection among concepts (to create the conceptual network).	2	7,14
Pr7	It is an approach in which learners are asked to create the concept map before providing them the concept and boxes.	2	7,14
Pr8	It is prepared by writing the concepts in empty boxes.	1	3,57
Pr9	I do not know.	4	14,29
Subtotal		28	100
	IS results of CM		
IS1	Results are interpreted and scored by giving right points to correct conceptions and wrong points to incorrect conceptions.	4	22,22
IS2	Results are interpreted and scored according to accurate determination and account of the relation between concepts.	3	16,67
IS3	Results are interpreted and scored by identifying a certain score in each box.	2	11,11
IS4	Results are interpreted and scored according to correct determination of the relationship on the arrows.	2	11,11
IS5	Results are interpreted and scored by right determination of the arrow direction.	1	5,56
IS6	I do not know.	6	33,33
Subtotal		18	100

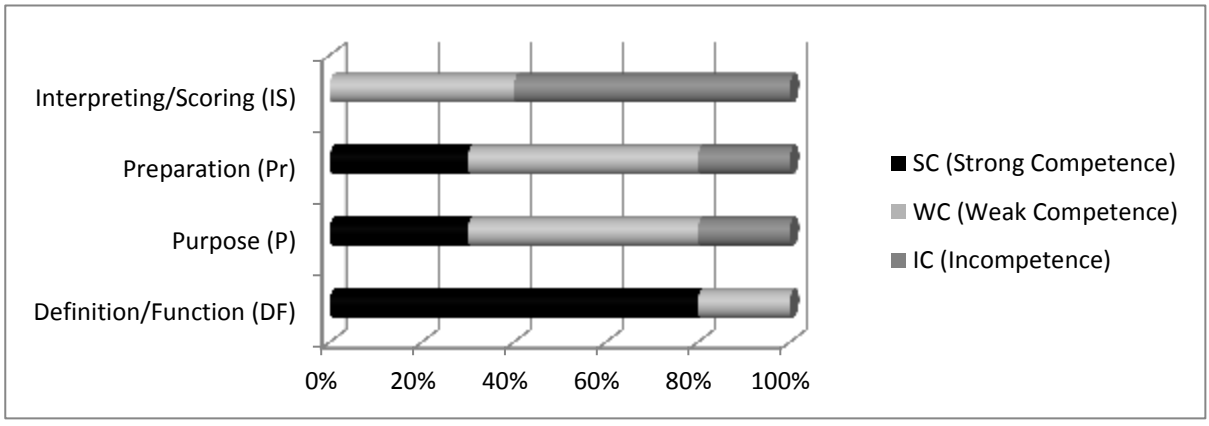

Figure 3. Competence levels of PSTs for concept maps

3.4 Perceptions and Competences of PSTs related to Diagnostic Branched Tree (DBT)

The first category consists of DF of DBT with 2 codes under it as DF1 and DF2. PSTs placed the most focus on DF1 at 60%. The second category includes P of DBT and 7 codes are located under this category as P1 to P7. Prospective

science teachers were found to have the most emphasis on P1 and P7 at 31,25%. The third category consists of Pr of DBT and under this category are 6 codes as Pr1 to Pr6. Prospective science teachers were found to have the most emphasis on Pr1 and Pr6 at 28,57%. The fourth category is about IS results of DBT, and under this category there are 3 codes, IS1, IS2, and IS3. Prospective science teachers were found to have the most emphasis on IS3 at 42,86%, followed by IS1 and IS2 at 28,57%, respectively.

Table 4. Perceptions of PSTs related to DBT

Codes	DF of DBT	f	%
DF1	It is an approach in which true or false statements follow the questions and exits are involved in the end.	6	60,00
DF2	I do not know.	4	40,00
Subtotal		10	100
	P of DBT		
P1	It is about identifying correcting learners' misconceptions.	5	31,25
P2	It is about providing the conceptual learning.	2	12,5
P3	It ensures finding of the right answer by reasoning and questioning of students.	1	6,25
P4	It determines whether the student has the master of the subject.	1	6,25
P5	It provides the the relationship between concepts.	1	6,25
P6	It develops students' ability to make decisions.	1	6,25
P7	I do not know.	5	31,25
Subtotal		16	100
	Pr of DBT		
Pr1	It is the questionnaire in which true-false statements are followed with arrows and exits are involved in the end.	4	28,57
Pr2	It is the questionnaire in which a problem is involved in every step followed by subsequent questions with yes or no statement.	2	14,29
Pr3	It is the questionnaire in which the next stage is achieved according to the right or wrong path selected.	2	14,29
Pr4	It is the questionnaire in which both true and false conceptions are involved at every.	1	7,14
Pr5	It is a questionnaire in which each arrow leads to a box.	1	7,14
Pr6	I do not know.	4	28,57
Subtotal		14	100
	IS results of DBT		
IS1	Results are interpreted and scored according to the exit point/departure point.	4	28,57
IS2	Results are interpreted and scored according to the number of right or wrong answers for each question.	4	28,57
IS3	I do not know.	6	42,86
Subtotal		14	100

In parallel with Table 4, competences of prospective science teachers for DBTs are given in Figure 4. As displayed in Figure 4, according to the prospective science teachers, they have 60% of weak competence and 40% of incompetence for DF, which is the first category of DBT. As for P, which is the second category under DBT, they have 50% weak competence, 50% incompetence. Thirdly, participants have 60% weak competence and 40% incompetence for Pr of DBT. Lastly in IS, the last category of DBT, it was found out that the participants have 50 % weak competence and 50% incompetence.

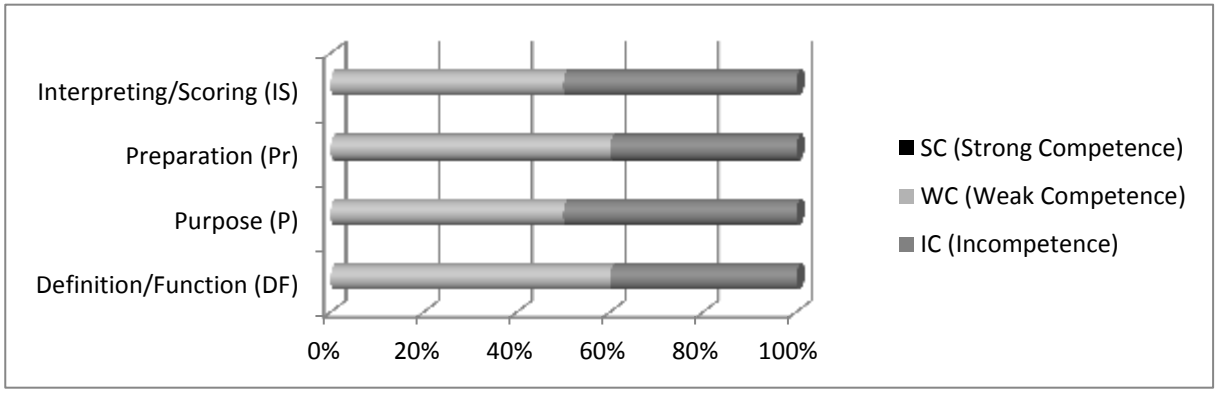

Figure 4. Competence levels of PSTs for DBT

3.5 Perceptions and Competences of PSTs related to Structured Grid (SD)

The first category consists of DF of SG with 6 codes under it as DF1 to DF6. PSTs placed the most focus on DF6 and DF1 at 46,15% and 23,08%, respectively. The second category includes P of SG and 6 codes are located under this category as P1 toP6. Prospective science teachers were found to have the most emphasis on P6 at 58,33%, followed by P1, P2, P3, P4, and P5, respectively. The third category consists of Pr of SG and under this category are 9 codes as Pr1 to Pr9. Prospective science teachers were found to have the most emphasis on Pr9 at 35%, followed by Pr1 at 20%. The

fourth category is about IS results of SG, and under this category there are 3 codes, IS1, IS2, and IS3. Prospective science teachers were found to have the most emphasis on IS3 at 53,85%, followed by IS1 at 23,08%.

Table 5. Perceptions of PSTs related to SG

Codes	DF of SG	f	%
DF1	It is the questionnaire in which there are boxes/words/concepts/images in tables on top and questions in the bottom.	3	23,08
DF2	It is the questionnaire in which there are gaps in the table to be filled in.	1	7,69
DF3	It is the questionnaire in which there are questions on top and answers in the bottom.	1	7,69
DF4	It is the questionnaire with more than one answer.	1	7,69
DF5	It is the questionnaire in which there are boxes.	1	7,69
DF6	I do not know	6	46,15
Subtotal		13	100
	P of SG		
P1	It helps the student find the right answer by questioning.	1	8,33
P2	It measures the knowledge level of students.	1	8,33
P3	It provides the conceptual learning.	1	8,33
P4	It builds up the relationship between concepts.	1	8,33
P5	It ensures classification of concepts.	1	8,33
P6	I do not know	7	58,33
Subtotal		12	100
	Pr of SG		
Pr1	It is the questionnaire in which answers (concepts, words, pictures, etc.) are first placed into boxes/tables, and then questions are asked.	4	20,00
Pr2	It is the questionnaire in which the number of boxes is given by the number of questions asked.	2	10,00
Pr3	It is the questionnaire which asks more than one question.	2	10,00
Pr4	It is the questionnaire with a number of options, unlike the multiple-choice questionnaire, and decreased luck factor.	1	5,00
Pr5	It is the questionnaire with boxes more than the number of questions.	1	5,00
Pr6	It is the questionnaire in which the student determines the appropriate response to each question according to boxes.	1	5,00
Pr7	It is the questionnaire in which some of the boxes are the wrong answers to the other questions.	1	5,00
Pr8	It is the questionnaire in which tables and spaces are provided for students to fill.	1	5,00
Pr9	I do not know	7	35,00
Subtotal		20	100
	IS results of SG		
IS1	Results are interpreted and scored by the number of boxes filled in correctly.	3	23,08
IS2	Results are interpreted and scored by giving full points to those answering the questions correctly.	1	7,69
IS3	I do not know	7	53,85
Subtotal		13	100

In parallel with Table 5, competences of prospective science teachers for SGs are given in Figure 5. As seen in Figure 5, according to the prospective science teachers, they have 30% of weak competence 70% of incompetence for DF, which is the first category of SG. As for P, which is the second category under structured grid, they have 30% weak competence and 70% incompetence. Thirdly, participants have 40% weak competence and 60% incompetence for Pr of SG. Lastly in IS, the last category of SG, it was found out that the participants have 30% weak competence and 70% incompetence.

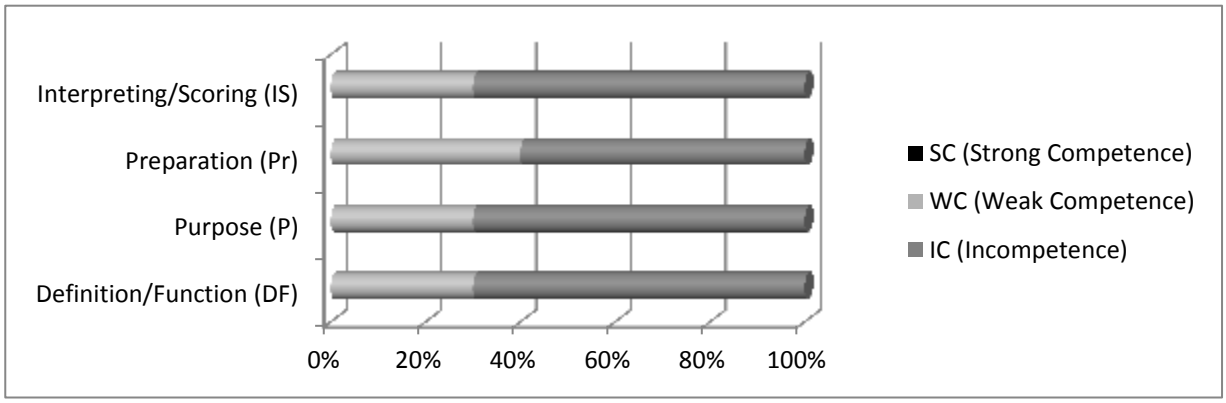

Figure 5. Competence levels of PSTs for SG

3.6 Perceptions and Competences of PSTs related to Word Association Tests (WATs)

The first category consists of DF of WAT with 4 codes under it from DF1 to DF4. PSTs placed the most focus on DF4 and DF1 at 46,47% and 40 %, respectively. The second category includes P of WAT and 4 codes are located under this category as P1 to P4. Prospective science teachers were found to have the most emphasis on P4 at 72,73%, followed by P1, P2, and P3, respectively at 9,09%. The third category consists of Pr of WAT and under this category are 3 codes as Pr1 to Pr3. Prospective science teachers were found to have the most emphasis on Pr3 at 70%, followed by Pr1 at 20%. The fourth category is about IS results of WAT and under this category there are 2 codes as IS1 and IS2. Prospective science teachers were found to have the most emphasis on IS2 at 80%, followed by IS1 at 20 %.

Table 6. Perceptions of PSTs related to WAT

Codes	DF of WAT	f	%
DF1	It is the questionnaire which is the same as pairing tests.	6	40
DF2	It is the questionnaire by which associations in students' minds are investigated for a given word or concept.	1	6,67
DF3	It is the questionnaire used to check preliminary information.	1	6,67
DF4	I do not know.	7	46,47
Subtotal		15	100
	P of WAT		
P1	It provides the conceptual learning.	1	9,09
P2	It measures the level of knowledge.	1	9,09
P3	It identifies and fixes misconceptions.	1	9,09
P4	I do not know.	8	72,73
Subtotal		11	100
	Pr of WAT		
Pr1	It is the questionnaire with concepts on one side and corresponding complements on the other side.	2	20
Pr2	It is the questionnaire which investigates associations in students' minds for a given word or concept.	1	10
Pr3	I do not know.	7	70
Subtotal		10	100
	IS results of WAT		
IS1	Results are interpreted and scored according to every correct match.	2	20
IS2	I do not know	8	80
Subtotal		10	100

In parallel with Table 6, competences of prospective science teachers for WATs are given in Figure 6. As seen in Figure 6, according to the prospective science teachers, they have 10% of strong competence and 90 % of incompetence for DF, which is the first category of WATs. As for P, which is the second category under WAT, they have 10% strong competence and 90% incompetence. Thirdly, participants have 10% weak proficiency and 90% incompetence for Pr of WAT. Lastly in IS, the last category of WAT, it was found out that all of the participants have 100% incompetence.

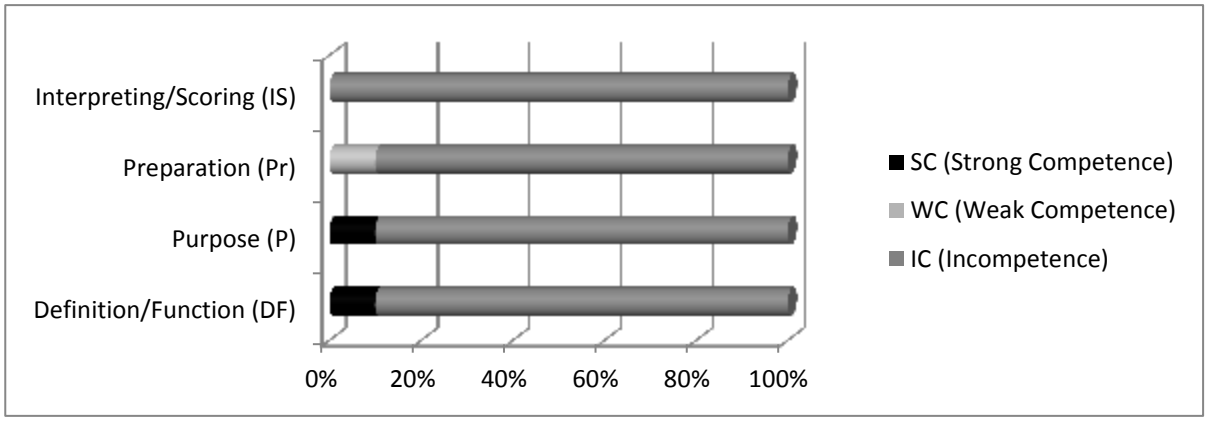

Figure 6. Competence levels of PSTs for WATs

3.7 Perceptions and Competences of PSTs Related to Interview (I)

The first category consists of DF of I with 10 codes under it as DF1 to DF10. PSTs placed the most focus on DF4 and DF10 with 30%. The second category includes P of I and 4 codes are located under this category as P1 to P4. Prospective science teachers were found to have the most emphasis on P4 with 37,5%, followed by P1 and P2, respectively at 25%. The third category consists of Pr of I and under this category are 3 codes as Pr1 to Pr3. Prospective science teachers were found to have the most emphasis on Pr3 with 50%, followed by Pr1 at 41,67%. The fourth category

is about IS results of I and under this category there are 6 codes from IS1 to IS6. Prospective science teachers were found to have the most emphasis on IS2 with 46,67 %, followed by IS1 with 20 %.

Table 7. Perceptions of PSTs related to I

Codes	DF of I	f	%
DF1	It is a kind of oral examination.	6	30,00
DF2	Is an approach that we use to measure the knowledge of students.	1	5,00
DF3	It is an approach used in business negotiations.	1	5,00
DF4	Is an approach that we use to get to know the students.	1	5,00
DF5	It is an approach to measure the students' ability to express themselves.	1	5,00
DF6	It is the process by which students and teachers mutually express their respective opinions.	1	5,00
DF7	It is not a measurement and evaluation tool.	1	5,00
DF8	It is an approach based on face to face conversation with non-active students.	1	5,00
DF9	It is a data collection tool.	1	5,00
DF10	I do not know.	6	30,00
Subtotal		20	100
	P of I		
P1	To measure the student's knowledge	4	25,00
P2	To measure speech and self-expression skills.	4	25,00
P3	To measure readiness of students.	2	12,50
P4	I do not know.	6	37,50
Subtotal		16	100
	Pr of I		
Pr1	It is an approach in which certain questions are prepared and implemented.	5	41,67
Pr2	It is prepared in order to talk with students and take notes about a certain subject.	1	8,33
Pr3	I do not know.	6	50,00
Subtotal		12	100
	IS results of I		
IS1	Interpretation and scoring is done according to the correct responses of students.	3	20,00
IS2	As in written exams, results are interpreted and scored according to the prepared answer key.	2	13,33
IS3	Student responses are recorded and then examined in detail for scoring and interpretation.	1	6,67
IS4	Short notes are taken and then scoring and interpretation is done by examining these notes.	1	6,67
IS5	Results are scored and interpreted based on pre-determined criteria.	1	6,67
IS6	I do not know.	7	46,67
Subtotal		15	100

In parallel with Table 7, competences of PSTs for interview are given in Figure 7. As seen in Figure 7, according to the prospective science teachers, they have 20% of strong competence, 60% of weak competence and 20% of incompetence for DF, which is the first category of interview. As for P, which is the second category under interview, they have 20% strong competence, 30% weak competence and 50 % incompetence. Thirdly, participants have 60% weak competence and 40% incompetence for Pr of I. Lastly in IS, the last category of I, it was found out that participants have 30% of weak competence and 70% of incompetence.

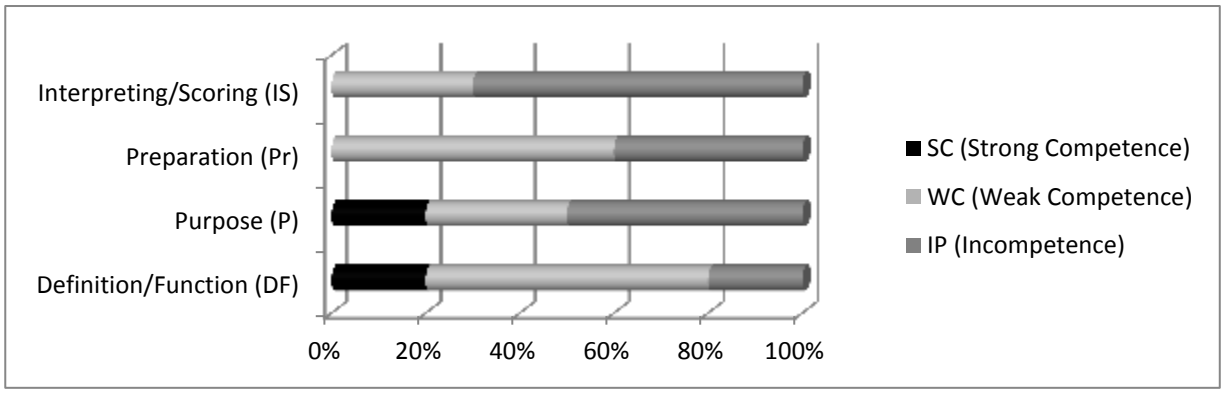

Figure 7. Competence levels of PSTs for I

3.8 Perceptions and Competences of PSTs Related to Observation (O)

The first category consists of DF of O with 8 codes under it as DF1 to DF8. PSTs placed the most focus on DF8 with 33,33 %, followed by DF1 at 20 %. The second category includes P of O and 7 codes are located under this category as P1 to P7. Prospective science teachers were found to have the most emphasis on P7 with 42,86 %, followed by P1 at 21,43 %. The third category consists of Pr of O and under this category are 6 codes as Pr1 to Pr6. Prospective science

teachers were found to have the most emphasis on Pr6 with 61,54%, followed by Pr1, Pr2, Pr3, Pr4, and Pr5, respectively at 7,69%. The fourth category is about IS results of O and under this category there are 3 codes from IS1 to IS3. Prospective science teachers were found to have the most emphasis on IS3 with 81,82%, followed by IS1 and IS2 with 9,09%.

Table 8. Perceptions of PSTs related to O

Codes	DF of O	f	%
DF1	It is a research and investigation.	3	20,00
DF2	It is an information acquisition process about students by monitoring them.	2	13,33
DF3	Results of observation carried out while students are involved in experiments.	1	6,67
DF4	Students' observing and reporting what they understand at the end of the course.	1	6,67
DF5	It is the approach that allows generating observation forms containing specific criteria and evaluating students.	1	6,67
DF6	It is the process of gathering information on a given topic or task assigned to students.	1	6,67
DF7	It an approach used to determine readiness of students.	1	6,67
DF8	I do not know.	5	33,33
Subtotal		15	100
	P of O		
P1	It is about recognizing students.	3	21,43
P2	It is about measuring the attention of students.	1	7,14
P3	It is about observing the participation of students in the course.	1	7,14
P4	It is about ensuring the monitoring of student progress in the process.	1	7,14
P5	It is about determining and observing social relations of students.	1	7,14
P6	It is about observing the students that are passive and introvert in the course in different environments.	1	7,14
P7	I do not know.	6	42,86
Subtotal		14	100
	Pr of O		
Pr1	It is prepared by taking students' observations in writing during an experiment or event (trips and observation).	1	7,69
Pr2	It is prepared by taking written notes on students' performance in the classroom.	1	7,69
Pr3	Students should not be made aware observed.	1	7,69
Pr4	Based on the questions prepared by the teacher, an observation is prepared and made.	1	7,69
Pr5	It is prepared as a form containing certain criteria.	1	7,69
Pr6	I do not know.	8	61,54
Subtotal		13	100
	IS results of O		
IS1	Results are scored and interpreted on pre-determined criteria.	1	9,09
IS2	Students are observed in the classroom, and they are scored and interpreted accordingly by giving plus or minus points.	1	9,09
IS3	I do not know.	9	81,82
Subtotal		11	100

In parallel with Table 8, competences of prospective science teachers for Observation (O) are given in Figure 8. As seen in Figure 8, according to the prospective science teachers, they have 10% of strong competence, 30% of weak competence and 60% of incompetence for DF, which is the first category of observation. As for P, which is the second category under observation, they have 10% strong competence, 30 % weak competence and 60% incompetence. Thirdly, participants have 30% weak competence and 70% incompetence for Pr of O. Lastly in IS, the last category of O, it was found out that participants have 20% of weak competence and 80% of incompetence.

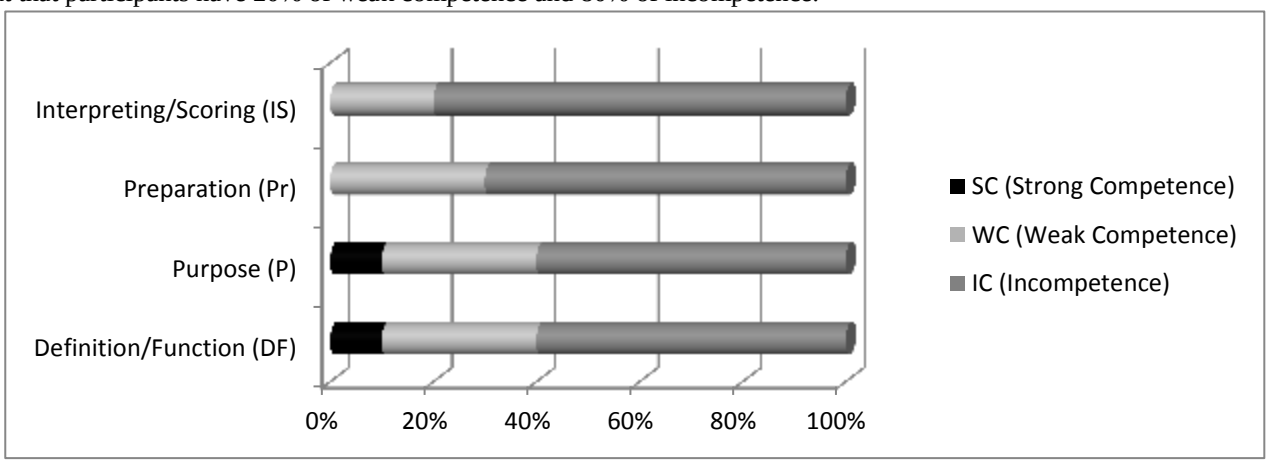

Figure 8. Competence levels of PSTs for O

4. Conclusions and Discussions

In this study, prospective science teachers' perceptions and thus competences related to formative assessment approaches were investigated. It was found out that PSTs do not have a far-fetching perception and interpretation for each of the mentioned formative assessment approaches (see Table 1 through Table 8) and they have inadequate levels of competence as well (see Figure 1 through Figure 8). In conclusion, PSTs' qualifications for all of those formative assessment approaches are given below in Figure 9. As can be seen from Figure 9, although PSTs have knowledge, though little, about function and definition of the formative assessment approaches in this study (12% competence), they seriously lack knowledge related to the purpose of such approaches (7% competence), how to prepare them as an assessment tool (3 % competence) and interpretation and scoring of the results obtained (2%). In this study, the results seem to be supported by Şaşmaz-Ören, Ormancı & Evrekli (2014), suggesting that prospective science teachers have moderate levels of self-sufficiency related to alternative assessment approaches. Besides, the results of this study is similar to Sağlam-Arslan, Devecioğlu-Kaymakçı & Arslan (2009) and Şener-Çoruhlu, Er-Nas & Çepni (2009), which carried out research on science-technology teachers, found out that teachers cannot use this kind of approach effectively and among other problems teachers do not have sufficient knowledge and skills about this type of assessment and evaluation approaches.

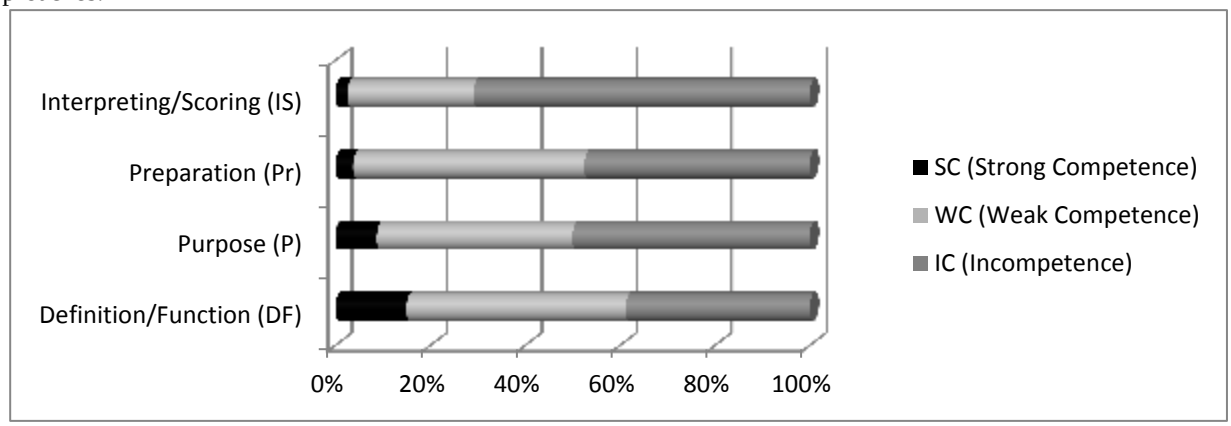

Figure 9. Competence levels of PSTs for FAA

It is understood from this study that prospective science teachers will face difficulties in using formative assessment approaches in the future once they become in-service teachers. Furthermore, the study suggests that prospective science teachers do get adequate levels of education on purposes to use formative assessment approaches for, how to prepare them or interpret the results. This shows that education faculties have serious shortcomings in assessment and measurement. Moreover, in teacher training programs, more emphasis should be made to PSTs' literacy of assessment and pre-service teachers should be trained accordingly. Thus, prospective teachers will be able to both choose and apply the assessment approaches that are appropriate to support student learning (Siegel & Wissehr, 2011). In addition, it is recommended that education faculties offer more practical assessment and measurement activities and elective courses rather theoretical courses in the context of science education (Şaşmaz-Ören, Ormancı & Evrekli, 2014). It is thought that qualifications and development of PSTs can be promoted if they are prepared for the real school and classroom environment and climate, and if they apply these formative assessment approaches in the long term. In this way, prospective teachers will have increased levels of knowledge on assessment and formative assessment approach in particular, and their self-confidence and self-sufficiency will develop accordingly (Şaşmaz-Ören, Ormancı & Evrekli, 2014; Yılmaz-Tüzün, 2008). Lastly, contribution will be made to solving the problem if this type of formative assessment approach is used frequently and effectively in science education from the first school to tertiary education and students get accustomed to that approach.

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