University Students' Perceptions of Their Science Classrooms*

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Abstract: The purpose of this study was to investigate the dimensions of the university students' perceptions of their science classes and whether or not the students' perceptions differ significantly as regards to the gender and grade level in six main categories namely; (1) pedagogical strategies, (2) faculty interest in teaching, (3) students interest and perceived competence in science, (4) passive learning, (5) grades as feedback, and (6) laboratory experiences. There were a total of 507 students from two big universities in Turkey, including pre-service middle school science and chemistry teachers, was randomly selected for the study. The study group consisted of 232 males and 275 female students in age ranging between 18 and 23. Questionnaire of Perceptions of Science Classes (QPSC), consisting of a 55-positive and negative Likert scale items, was administered to all students. The statistical results of the QPSC scores indicated that the undergraduates' perceptions of their science classes were significantly differ favoring female students in the grades of third year, and students' perceptions of their science classes showed a significant positive change from first to third years of the universities. Also, there was a significant difference favoring the female students on the factor of

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students' interest and perceived competence in science in the grades of second and final year. In the grade of third year, female students were significantly better than male students on the factors of faculty interest in teaching, grades as feedback, and laboratory experiences, while male students were better than female students on only the factor of passive learning in the grade of the first year.

Introduction

Today, there are many natioanal documents representing how science education programs can be developed, re-organized and implemented in classrooms for the effective or good teaching of science. These documents also indicate what and how science should be taught in schools. The two most well-known documents are the *Benchmarks for Scientific Literacy* developed by the American Association for the Advancement for Science (AAS, 1993) and the *National Science Education Standards* (NSES) developed by the National Research Council (NRC, 1996). The purpose of these kinds of documents is to guide or inform teachers about the reform efforts in science curriculum development and teacher practice toward good rather than poor teaching of science. For example, the *National Science Education Standards* (NSES) envision change throughout the system. The NSES standards in different strands encompass the changes in emphases shown in Figures 1 and 2.

Good teaching of science means "teaching science" organized by teachers who have strong subject matter and pedagogical knowledge that consists of knowledge of students' learning difficulties and conceptions, curriculum, assessment, and instructional strategies. For example, having strong knowledge about the curriculum will enable science teachers to understand goals and objectives for students in the subject(s) that they are teaching, as well as the articulation of those guidelines across topics addressed during the school year (National Research Council (NRC) 1996).

LESS EMPHASIS ON	MORE EMPHASIS ON
Treating all students alike and responding to the group as a whole	Understanding and responding to individual student's interests,strengths,experiences,and needs
Rigidly following curriculum	Selecting and adapting curriculum
Focusing on student acquisition of information	Focusing on student understanding and use of scientific knowledge, ideas,and inquiry processes
Presenting scientific knowledge through lecture, text,and demonstration	Guiding students in active and extended scientific inquiry
Asking for recitation of acquired knowledge	Providing opportunities for scientific discussion and debate among students
Testing students for factual information at the end of the unit or chapter	Continuously assessing student understanding
Maintaining responsibility and authority	Sharing responsibility for learning with students
Supporting competition	Supporting a classroom community with cooperation,shared responsibility, and respect
Working alone	Working with other teachers to enhance the science program

Figure 1. Teaching standards of the NSES encompass the changes in emphases above (NRC, p. 62)

LESS EMPHASIS ON	MORE EMPHASIS ON
Transmission of teaching knowledge and skills by lectures	Inquiry into teaching and learning
Learning science by lecture and reading	Learning science through investigation and inquiry
Separation of science and teaching knowledge	Integration of science and teaching knowledge
Separation of theory and practice	Integration of theory and practice in school settings
Individual learning	Collegial and collaborative learning
Fragmented, one-shot sessions	Long-term coherent plans
Courses and workshops	A variety of professional development activities
Reliance on external expertise	Mix of internal and external expertise
Staff developers as educators	Staff developers as facilitators, consultants,and planners
Teacher as technician	Teacher as intellectual, reflective practitioner
Teacher as consumer of knowledge about teaching	Teacher as producer of knowledge about teaching
Teacher as follower	Teacher as leader
Teacher as an individual based in a classroom	Teacher as a member of a collegial professional community
Teacher as target of change	Teacher as source and facilitator of change

Figure 2. The professional development standards of the NSES encompass the changes in emphases above (NRC, p. 72).

Teachers of science should know possible learning barriers of students together with appropriate reasons indicating why students may have these difficulties or develop alternative conceptions in science topics (Ayas & Demirbas, 1997; Wandersee et al., 1994; Magnusson et al., 1999). In addition, the National Science Education Standards document (NRC, 1996) specifically declared that effective teachers of science must be knowledgeable about the various educational purposes for assessment, and it clearly emphasized that teachers should know how to implement and interpret a variety of authentic assessment approaches in their science classrooms and laboratories in order to improve students' understanding of science. Teaching strategies and activities used by teachers in science classrooms should be the contemporary teaching approaches, emphasized in the reform documents (e.g., NRC, 1996) and the literature (e.g., Akkus et al., 2003; Alparslan et al., 2003; Osborne et al., 2004; Posner et al., 1982; Sungur et al., 2001; Yager, 2000) such as conceptual change strategies, inquiry-based learning, and problem-based learning. For example, in their teaching approaches, teachers should first focus on elaborating students' learning difficulties and then incorporating them into their teaching, and use authentic assessment approaches such as portfolio assessment and concept mapping. Of course, teachers' practical or craft knowledge in real classrooms is as important as their subject matter and pedagogical knowledge for the effective or good teaching of science.

One interesting topic between our students and university instructors has been what our students mean by poor or good teaching in university science classrooms. During these conversations about their perceptions of their university science classes, we made a list of criteria including the reasons of their perceptions toward their science classes. The factors affecting students' perceptions of their science classrooms are as follows:

- The clear goals and organizations,
- Passive learning,
- Faculty interest in teaching,
- Appropriateness between class materials, homework and tests,
- Laboratory experiences
- Grading practices that do not adequately represent students performance,
- The social relationships between students and their instructors
- Encouraging competition among students,

- An emphasis on memorization of facts the expense of conceptual understanding,
- Classroom discussions.

Purpose

The aim of this study was to investigate the dimensions of the university students' perceptions of their science classes and whether or not the students' perceptions differ significantly as regards to the gender and grade.

Research questions

- What are the dimensions the university students' perceptions of their science classes?
- How are the students' perceptions of their science classes with respect to their gender and grade levels?

Method

Participants

There were a total of 507 students from two big universities in Turkey, including pre-service middle school science and chemistry teachers, was randomly selected for the study. The study group consisted of 232 males and 275 female students in age ranging between 18 and 23. The range of students responding QPSC was given in Table 1 with respect to their gender and grade levels.

Table 1. The number of participating students based on both gender factor and grade level.

	Grade level				
Gender	**1st**	**2nd**	**3rd**	**4th**	**Total**
Male	52	55	59	66	232
Female	72	53	90	60	275
Total	124	108	149	126	507

Procedure

QPSC was administered to all students toward the end of the second semester of 2003-2004 academic year in Education Faculties in two big universities of Turkey, Gazi University and Blacksea Technical University.

Instrument

Questionnaire of Perceptions of Science Classes (QPSC) that was originally developed by Kardash and Wallace (2001) was used in this study. First, QPSC was translated and adapted into Turkish by the authors of this paper from the two universities in this study. Then, as a pilot study, we carried out conversations with 15 university students on all items of the QPSC for determining what they would understand when reading QPSC. As a result, we had the QPSC consisting of a 55 positive and negative Likert scale items with 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. Scores of 5, 4, 3, 2 and 1 respectively were assigned for positive items, and reverse scoring for negative items. QPSC composed of six main categories is given in Appendix A.

Results

The data were analyzed by the use of independent sample t-test and one-way ANOVA. In Table 2, only results found statistically significant difference are presented. For example, the statistical results of the QPSC scores undergraduates' perceptions of their science classes were significantly differ favoring female students in the grades of third year, and students' perceptions of their science classes showed a significant positive change from first to third years of the universities (see Table 2). Also, there was a significant difference favoring the female students on the factor of students' interest and perceived competence in science in the grades of second and final year (see Table 2). In the grade of third year, female students were significantly better than male students on the factors of faculty interest in teaching, grades as feedback, and laboratory experiences, while male students were better than female students on only the factor of passive learning in the grade of the first year (see Table 2). As seen in Table 3, there was statistically significant difference in only students of 3rd year favoring male students with respect to the total scores of the QPSC.

Table 2. Means, standard deviations and t-test results of the scores of the factors of QPSC based on the gender factor.

Factor	Grade	Gender		t
		Male	Female	
Passive learning	1st year	16.02 (2.52)	14.97 (2.48)	2.304*
Students interest and perceived competence in science	2nd year	27.17 (5.04)	30.40 (3.77)	2.811**
Students interest and perceived competence in science	4th year	32.01 (4.48)	33.60 (3.67)	2.138*
Faculty interest in teaching	3rd year	44.77 (6.13)	46.68 (5.40)	1.998*
Grades as feedback	3rd year	7.74 (2.66)	8.70 (2.74)	2.100*
Laboratory experiences	3rd year	11.33 (2.88)	12.44 (2.19)	2.509*

* $p < .05$, ** $p < .01$

Table 3. Means, standard deviations and t-test results of total scores of QPSC based on the gender factor.

Grade	Gender		t
	Male	Female	
1st year	176.51 (25.16)	177.93 (17.93)	.35
2nd year	190.73 (20.03)	197.43 (15.89)	1.44
3rd year	215.18 (28.81)	234.21 (35.57)	3.44**
4th year	220.83 (27.35)	220.82 (28.87)	.001

* $p < .05$

Results of ANOVA for total scores of QPSC based on the grade levels are given in Table 4. The statistical analyses indicated that there was a significant difference ($p < .001$) among the students in terms of the grade level. As shown in Table 5, the results of post-hoc comparisons indicated that there was a significant difference in mean scores of students in different grade levels regardless of their gender. For example, the results of perceptions of the first year students were statistically less than those of the second, third and fourth year students. In addition, the perceptions of third and fourth year students were found statistically better than those of the second year students.

Table 4. The results of ANOVA for total scores of QPSC based on the grade levels

Source of Variation	Sum of Squares	df	Mean Square	F	p
Between Groups	200437.30	3	66812.43	87.79	.000
Within Groups	344742.33	453	761.021		
Total	545179.64	456			

Table 5. The means, standard deviations, and percentages with Scheffe Test based on the grade level.

Grade	**N**	$\bar{X}$	**SD**	**%**	**Post-hoc results**
1st	124	177.34	21.18	64,48	2-1, 3-1, 4-1, 3-2, 4-2
2nd	108	194.08	18.24	70,57	
3rd	149	226.68	34.26	82,43	
4th	126	220.83	27.96	80,30	
Total	507	207.42	34.57	75,43	

Summary and Conclusions

The purpose of this study was to explore the dimensions of the university students' perceptions of their science classes and whether or not the students' perceptions differ significantly as regards to the gender and grade level in six main categories namely; (1) pedagogical strategies, (2) faculty interest in teaching, (3) students interest and perceived competence in science, (4) passive learning, (5) grades as feedback, and (6) laboratory experiences. For this purpose, Questionnaire of Perceptions of Science Classes (QPSC), composing of a 55-positive and negative Likert scale items, was used.

507 students from two big universities in Turkey, including pre-service middle school science and chemistry teachers participated to this study. The statistical results of the QPSC scores indicated that the undergraduates' perceptions of their science classes were significantly differ based on grade levels and their gender. For example, the perceptions of female students were statistically better than those of male students in the grades of third year. In terms of the total scores of the QPSC, students' perceptions of their science classes showed a significant positive change from first to third years of the universities. Also, there was a significant difference favoring the female students on the factor of students' interest and perceived competence in science in the grades of second and final year. In the grade of third year, female students were significantly better than male students on the factors of faculty interest in teaching, grades as feedback, and laboratory experiences, while male students were better than female students on only the factor of passive learning in the grade of the first year.

The findings of this study contribute to the literature in terms of Turkish pre-service science teachers' perceptions of their science classes. The comparison of QPSC total average grade of 207.42 of PSTs with the maximum value of 275.00 shows a success rate of 75%. This value indicates the perceptions of PSTs' science classes are reasonable. However, average score of the first year students with comparison of the maximum value of QPSC reveals 64% that is low. These values gradually increase from the first to the last year students, indicating PSTs' perceptions are directly proportional to the years that they spent in Education Faculties. One possible reason for this finding may be the structure of Turkish science teacher education programs. For example, PSTs generally take science, mathematics, general education, and language and grammar courses during the first two year of their education. Those courses and general atmosphere in Education Faculties in Turkey are very similar to the courses and learning environment in Turkish Faculties of Art and Science. However, PSTs can take science methods and school practicum courses that improve their perceptions in positive manner during the last two years of their education. Future research should focus on the reasons of those kinds of differences in university students' perceptions of their science classrooms.

Appendix A. The Perceptions of Science Class Survey

Factor 1: Pedagogical Strategies

1. Science teachers make a genuine effort to link new concepts to information that students have learned previously.
2. Science teachers try hard to make sure that students understand science.
3. Science teachers give good examples and practical applications of scientific concepts.
4. Science teachers encourage me to think for myself.
5. Science teachers promote the idea of discovering things together with students in their classes.
6. Science teachers relate the information they teach to the real world.
7. Science teachers relate information presented in their classes to other science classes.
8. Science classes emphasize the understanding of concepts as much as the acquisition of scientific facts.
9. Science teachers go out of their way to be sure that students understand the arguments or ideas presented in class.
10. Science teachers try to ensure that their students feel confident and competent in their study of science.
11. Science teachers strongly encourage students to participate in classroom discussion.
12. Science teachers emphasize which information in class is most important to learn.
13. My science teachers have been effective teachers.
14. Science classes emphasize having students formulate and test their own hypotheses.
15. Science teachers explain their ideas in a way that makes sense.
16. Science teachers talk about the impact of science on history and society.
17. Science teachers are clear and specific about what they expect students to learn.
18. I feel comfortable asking my science teachers for help and assistance with class-related issues.
19. Science classes focus more on the processes of science (e.g., how to pose questions, collect data, and assess quality of information) than on the transmission of facts.
20. Science teachers are willing to review information that students find difficult to understand.
21. Science teachers attempt to find out what students already know about a topic before presenting new or more advanced information in their classes.
22. My science teachers have involved their students in in-class research projects.

Factor 2: Faculty Interest in Teaching

1. Science teachers are more interested in their own research than in teaching students. (R)
2. Science teachers are indifferent to students' concerns about grades they receive on class assignments and tests. (R)
3. Science teachers seem to lack any motivation to teach well. (R)
4. To do well in science classes, those classes must take precedence over other aspects of students' lives. (R)

5. Science teachers are unapproachable and cold. (R)
6. It's harder to get good grades in science than it is in other classes. (R)
7. Science teachers have a hard time understanding questions students raise in class. (R)
8. Science teachers assume that students know more about science than they really do. (R)
9. Science teachers seem to feel that the responsibility for student learning rests solely with the students. (R)
10. Science teachers encourage competition for grades among students. (R)
11. Science teachers assume that students have more scientific skills than they really do. (R)
12. Science teachers are most interested in those students who are planning on science related careers. (R)
13. I am afraid my science teachers will ask me questions I cannot answer. (R)
14. Doing well in science classes depends more on natural ability than on effort. (R)

Factor 3: Student Interest and Perceived Competence in Science

1. I would not take science classes in college if they weren't required. (R)
2. I'm excited about learning more about science.
3. Science classes have increased my interest in science.
4. I don't know enough science to understand the information presented in my science classes. (R)
5. Science has nothing to do with my life. (R)
6. Science classes are dry and boring. (R)
7. I have a good understanding of basic concepts in science.
8. I feel uncomfortable in science classes. (R)

Factor 4: Passive Learning

1. I spend most of my time in science classes copying teacher notes. (R)
2. Science teachers emphasize memorization of facts. (R)
3. Science classes emphasize what students need to know, rather than what they should be able to do with the information presented. (R)
4. Science teachers rely primarily on lectures as a teaching method. (R)
5. Science teachers expect students to take the information presented in class as fact (R)

Factor 5: Grades as Feedback

1. My grades in science classes are a good indicator of the quality of my work.
2. My grades in science classes are a good indicator of how much effort I put into my science classes.
3. My grades in science classes are a good indicator of how much I learned in those classes.

Factor 6: Laboratory Experiences

1. Laboratory activities in science are lively and stimulating.
2. The laboratory activities in my science classes are boring. (R)
3. I enjoy laboratory activities in science.

(R) indicates items that were reverse scored.

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