STUDENT QUESTIONING IN HIGHER EDUCATION: A GENDER PERSPECTIVE

Mariana Martinho, Research Centre for Didactics and Technology in Teacher Education, Department of Education, University of Aveiro, Aveiro, Portugal, marianamartinho@ua.pt

Patrícia Albergaria Almeida, Research Centre for Didactics and Technology in Teacher Education, Department of Education, University of Aveiro, Aveiro, Portugal, patriciaalmeida@ua.pt

José Teixeira-Dias, Department of Chemistry, University of Aveiro, Aveiro, Portugal, teixeiradias@ua.pt

ABSTRACT: This study refers to a comprehensive research project aimed at contributing to a better understanding of student questioning in the teaching, learning and assessment processes in higher education (HE). Several authors hold that the development of the students' questioning attitude has the potential to enhance the quality of teaching and, accordingly, the quality of learning.

Having in mind that the gender of the student is depicted as a determinant factor in students' academic performance, conceptual understanding and success in HE (Dayioglu & Turut-Asik, 2007), this study intends to investigate and characterize feminine and masculine student questioning profiles in HE, both in traditional classes and in online environments. The research is being conducted with first year chemistry students at the University of Aveiro in Portugal, and follows a mixed methodology (qualitative and quantitative). Data is being collected through observation, interviews, focus groups, one inquiry and an online forum. Preliminary findings suggest that: a) only a small number of oral questions were formulated either by male or female students during lectures; b) even a smaller number of students' questions were written in the pieces of paper provided in class and collected after the end of each class; c) males pose more questions in class than girls; d) by the end of the semester students pose more questions online than during the beginning or middle of the semester, but those questions are mainly referring to the evaluation procedures rather than chemistry content; e) students pose more questions in laboratory classes, than in lectures.

Student questioning drawback in HE

The admission to HE is usually accompanied by an expansion on the size of the class, a growing physical distance between the students and the instructor and a dominant delivery of content by a didactic one-way lectures, which are perceived by students as impersonal and intimidating (DeBourgh, 2007). Such a learning environment can lead students to believe they are passive recipients of the instructor's lecture rather than active participants in a student–instructor interaction (Mayer et al., 2009). DeBourgh (2007) notices that when facing such a different setting from what they were used to, students tend to interact less with teachers, as they "feel reluctant to

express an unpopular opinion and fear to be identified as uninformed or unprepared" (p. 78).

Along with their passive resistance to communicate, students experience a considerable drawback, as they tend to raise fewer questions. As observed by Neer (1990), this avoidance of verbal participation in classroom represents a limitation for the academic achievement of students.

This drawback in HE has been worrying researchers on science education to such an extent that they currently stress the need for new emphasis on teaching and learning in particular on this level of education. Several authors (Pedrosa de Jesus, Teixeira-Dias & Watts, 2003; Biggs & Tang, 2007; Cuccio-Schirripa & Steiner, 2000) highlight the key-skills and competencies every student should develop, among which is underlined the capacity for lifelong learning, which comprises the questioning skill (Teixeira-Dias, Pedrosa de Jesus, Souza, Almeida & Moreira, 2009).

It is known that the ability to raise questions that involve higher order thinking enhances an active learning (Chin & Osborne, 2008; Scholl, 2010). Therefore, a teaching practice oriented for the development of the questioning skill favors a student-centered learning, enhancing other higher cognitive level capacities, such as those of critical thinking and problem solving (Teixeira-Dias et al., 2009; Hofstein, Navon, Kipnis & Mamlok-Naaman, 2005).

Students questioning competency is claimed by numerous researchers (Almeida, Teixeira-Dias & Martinho, 2010; Pedrosa de Jesus et al., 2003; Zoller, 1987) as the most significant indicator of students most critical and highest order thinking.

Regarding learning approaches, Almeida (2007) verified that students who consistently pose low cognitive level questions tend to adopt more superficial learning

approaches, while those who adopt deeper learning approaches have the capacity to formulate questions of higher cognitive level.

Several studies (Pedrosa de Jesus, Almeida, Teixeira-Dias & Watts, 2007; Chin & Osborne, 2008; Hofstein et al., 2005) have revealed that fostering a true questioning spirit of students can result in an improvement on the quality of teaching and, accordingly, on the quality of learning. For this reason, the Boyer Comission's report (Boyer Commission on Education Undergraduates in the Research University, 1998) highlights the importance of promoting the questioning skill from the first year of university studies.

Online questioning

In light of the numerous advantageous features of network technology (independence of time, place, device and platform, vast storage capacity, high processing speed, multimedia facilities, instant data retrieval and management, customizable design, ease of updating and upgrading, anonymity), there has been a growing number of projects focused on the design and development of web-based student question-generation learning systems (Yu, 2011, p. 485), many of which in HE.

Results provided by Barak and Rafaeli (2004) sustain that web-based activities, which require students to generate questions, can serve as both learning and assessment enhancers in HE by promoting active learning, constructive criticism and knowledge sharing.

On his turn, Wilson (2004) highlights that when students were asked to write exam questions and evaluate other students' responses they improved their ability to communicate, critical thinking skills, ability to integrate facts, and motivation to do additional readings.

Similarly, Yu, Liu and Chan (2005) remarked the importance of fostering students questioning through multimedia tools available online and noticed that by enabling students to compose questions, and criticize and adapt other students questions, they perceived their learning as more motivating and cognitively-enhanced.

Questioning according to gender

The gender of the student is depicted as a factor in determining student academic performance, conceptual understanding and success in HE (Lorenzo, Crouch & Mazur, 2006; Dayioglu & Turut-Asik, 2007; Harvey, Drew & Smith, 2006). Considering the widespread consensus supporting the great importance of students' questions in the process of knowledge construction, a deeper insight into the clarification of existing gender differences in student questioning patterns must be gained, in order to overcome found gender fragilities and, ultimately, add to the enhancement of learning and teaching, in particular in HE.

Few studies have focused on gender differences on students questioning and even fewer have concentrated on HE. Despite the longstanding recognition of the existence of gender differences in verbal communication (Wood, 2009; Tannen, 1990), the few existing studies are not consensual. On one hand Pearson, West and Turner (1995) stated that it is not clear which gender raises more questions. On the other hand, Jones, Howe and Rua (2000) observed that boys are less frightened than girls to pose questions.

In an attempt to identify the existing barriers to a balanced participation of both genders, either in class or online, Blum (1999) undertook an investigation to compare the questioning patters of boys and girls, both in class and online. With this study Blum

concluded that girls ask more questions than boys in class, while boys ask more and answer more questions than girls in online environments.

Despite the fact that educational institutions have the capacity to produce or reinforce gender bias and stereotypes, they can also resist to those biases and raise other values and attitudes, such as that related to students understanding of the meaning of feminine and masculine (Vianna & Ridenti, 1998).

According to Johnston (2010), universities should pay a special attention to the first year experience, which justifies our decision to focus on this first year. The same author recommends that Universities need to offer students a first year wherein their learning experiences assure the development of the necessary skills, such as that of questioning, to empower them for lifelong learning.

Regarding gender differences in communication patters and considering the great importance of students questions in the process of knowledge construction, it is important to investigate and characterize students questioning profiles according to their gender and to the learning environment in which they are immerse (such as classes or online environments).

Research questions

The research questions emerged upon this resumed critical literature review are as follows:

(1) What are the differences between feminine and masculine students' questioning profiles in first year university chemistry classes?

(2) Which strategies and teaching practices can promote students questioning, attending to their gender, in order to optimize chemistry learning in university teaching?

The previous bear four secondary research questions:

i) How are the feminine and the masculine understandings of the role of questioning in the teaching, learning and assessment processes affecting their questioning profiles?

ii) What influence do different learning environments (such as traditional classes and online interactions) have on feminine and masculine students' questioning profiles?

iii) How does the implementation of strategies to foster students' questioning reflects on the learning approaches of feminine and masculine students?

iv) To what extent are the students (feminine and masculine) classification results influenced by their questioning profiles?

Methodology

Concerning the methodology to be followed, this study will encompasses both qualitative and quantitative methods, thus it consists in a mixed methods research. Besides observations, semi-structured interviews and focus groups, an inventory is also applied, which is a technique commonly associated to quantitative studies. On one hand, the focus groups, the records of the online interactions, the researcher's diary and the interviews made to students and to teachers will be qualitatively analyzed. On the other hand, the observation grids, the inventories and the classification grids will be statistically analyzed.

Methods and techniques

Several techniques were, and still are, being applied, such as inquiries, observations and document analysis. The corresponding developed instruments are semi-structured interview scripts, focus groups scripts, observation grids for classes,

observation grids for online interactions, audio and video records and the researchers' diary.

It has also been applied one inventory, which has already been developed and translated and validated to the Portuguese context (Approaches and Study Skills Inventory for Students - ASSIST; Valadas, Gonçalves & Faísca, 2010) to identify the students learning approaches.

Detailed description of the study's activities

The present investigation is being developed throughout three stages, as described hereinafter.

1st stage (March – September 2011):

The first stage of this investigation consisted in a critical literature review to understand what has already been studied regarding female and male students questioning. At the same time, data collection instruments were prepared. Besides observation grids, interview scripts and focus groups scripts, were also conceived learning, teaching and assessment strategies to be applied in the academic year 2011/12.

Under the premise that student question generation activities in big classes are better supported in a timely, flexible and logistically feasible manner, if they are mediated by online technologies (Yu, 2009), besides conceiving strategies to be applied in class, strategies mediated by online technologies were also conceived, namely two forums on Moodle. On these two forums where students were supposed to either write their doubts so that the teacher or other students could respond to, and on the other forum students should formulate questions which could help them understanding a science phenomena presented and explain the reasons for formulating each particular question.

2nd stage (September 2011 – January 2013):

During the academic year 2011/12, the instruments previously conceived are being applied in first year university chemistry classes. During the first semester a pilot-study was conducted, followed by the main study, which is being carried through the second semester.

Students who attend these chemistry classes are undergraduates of science and technologies degrees, such as Physics, Physical Engineering, Materials Engineering, Environmental Engineering, Meteorology and Oceanography, Biology or Geology, among many others.

The pilot study, carried out during the first semester, served as a testing study of the previously conceived techniques, instruments and learning, teaching and assessment strategies. The necessary changes and improvements were made before the main study.

During the pilot study data was collected through a non-participant observation, associated to audio taped classes (and following transcription). Furthermore, records of the online interactions were made and an inventory was applied.

Classes were audio taped and will be later transcribed in order to characterize feminine and masculine students' questioning habits (number, cognitive level and function of questions) in traditional classes. On its turn, records of online interactions will be analyzed in order to characterize both genders' questioning habits in online environments.

Through the application of the ASSIST inventory (Valadas et al., 2010) we expect to identify feminine and masculine students' learning approaches.

Still during the first semester's we kept sessions of debates and shared reflections with the class's chemistry teacher, aimed at discussing/analyzing the questioning observed in class and online and interpreting the consequences of the promoted

activities on the learning processes, considering gender equity. Furthermore, we had the opportunity to strengthen and expand the trust relation established with the chemistry teacher and took the chance to further encourage the collaboration spirit with the researcher.

Following data treatment and analysis, and having in mind the teachers' perspective, the necessary improvements were made before the main study carried through the second semester of 2011/12.

During the main study besides class observation, analysis of online interactions, application of inventories, sessions of debates and shared reflections with the class's chemistry teacher and implementation of learning, teaching and assessment strategies, interviews were already made to students and focus groups will be conducted before the end of the semester.

This last method was considered particularly because it stimulates interaction, discussion, self and metacognition among participants. A major advantage of this qualitative methodology is that due to the "dynamic nature of the process" (Greenbaum, 2000, p. 13) it "encourages the participants to think conceptually about the topic that is being discussed and to visualize ideas that are not well developed" (Greenbaum, 2000, p. 35). Moreover, through the focus groups we will investigate and characterize feminine and masculine students' questioning profiles, in a more intimate environment, constituted by a limited number of people and identify feminine and masculine students' understanding of the role of questioning in the learning, teaching and assessment processes.

At the end of the second stage we will proceed with the treatment and analysis of the data collected during the main study.

3rd stage (January 2013 – December 2014):

This period will be dedicated to an integrated analysis of the results retrieved during the pilot and the main studies, and to the writing and presentation of the PhD thesis.

Throughout the three stages of the project, a deeper critical scientific backup will be made through the further readings and review of specific literature.

Preliminary findings

Although the global results are not yet available for discussion, there are some findings that have already emerged, such as: a) only a small number of oral questions were formulated either by male or female students during lectures; b) even a smaller number of students' questions were written in the pieces of paper provided to students in class and collected after the end of each class, c) males pose more questions in class than girls, d) by the end of the semester students pose more questions online than during the beginning or middle of the semester, but those questions are mainly referring to the evaluation procedures rather than chemistry content, e) both male and female students pose more questions in laboratory classes than in lectures, and f) a significant number of the questions formulated in class evolved into an interaction episode between the student (feminine and masculine) and the teacher.

Acknowledgements

We acknowledge the financial support of the Foundation for Science and Technology, Portugal (FCT; SFRH / BD / 74511 / 2010) and of the Research Centre for Didactics and Technology in Teacher Education (CIDTFF), University of Aveiro, Portugal.

References

Almeida, P. (2007). As questões dos alunos e os estilos de aprendizagem – um estudo com um público de Ciências no ensino universitário [Students' questions and learning styles: a study with a public of Science in higher education]. Unpublished PhD thesis. Aveiro, University of Aveiro.

Almeida, P., Teixeira-Dias, J. J. & Martinho, M. (2010). Teaching and Learning Chemistry: a new approach at the University of Aveiro, in Portugal. In N. Popov, C. Wolhuter, B. Leutwyler, M. Mihova & J. Ogunleye (Eds.), *Comparative Education, Teacher Training, Education Policy, School Leadership and Social Inclusion* (pp. 357-362). Sofia, Bureau for Educational Services.

Barak, M. & Rafaeli, S. (2004). On-line question-posing and peer-assessment as means for web-based knowledge sharing in learning. *International Journal of Human-Computer Studies*, 61(1), 84–103.

Biggs, J. & Tang, C. (2007). *Teaching for quality learning at university* (5th ed.). The Society for research into Higher Education and Open University Press, Maidenhead, UK.

Blum, K. (1999). Gender Differences in Asynchronous Learning in Higher Education: Learning Styles, Participation Barriers and Communication Patters. JALN, 3(1).

Boyer Commission on Education Undergraduates in the Research University (1998). *Reinventing undergraduate education: a blueprint for America's Research Universities*. Url: http://naples.cc.sunysb.edu/pres/boyer.nsf/673918d46fbf653e852565ec0056ff3e/d955b61ffddd590a852565ec005717ae/$FILE/boyer.pdf (accessed in 20th May 2012).

Chin, C. & Osborne, J. (2008). Students questions: a potential resource for teaching and learning science. *Studies in Science Education*, 44(1), 1-39.

Cuccio-Schirripa, S. & Steiner, H. (2000). Enhancement and analysis of science question level for middle students. *Journal of Research in Science Teaching*, 37(2), 210-224.

Dayioglu, M. & Turut-Asik, S. (2007). Gender differences in academic performance in a large public university in Turkey. *Higher Education*, 53, 255-277.

DeBourgh, G. A. (2007). Use of classroom "clickers" to promote acquisition of advanced reasoning skills. *Nurse Education in Practice*, 8(2), 76-87.

Greenbaum, T. L. (2000). *Moderating Focus Group: A practical guide for group facilitation*. Thousand Oaks: Sage publications.

Harvey, L., Drew, S. & Smith, M. (2006). The First-year Experience: A Review of Literature for the Higher Education Academy. Url: http://www.heacademy.ac.uk/research/Harvey_ Drew_Smith.pdf (accessed in 20th May 2012).

Hofstein, A., Navon, O., Kipnis, M. & Mamlok-Naaman, R. (2005). Developing students ability to ask more and better questions resulting from inquiry-type chemistry laboratories. *Journal of Research in Science Teaching*, 42(7), 791-806.

Johnston, B. (2010). *The First Year at University: Teaching Students in Transition*. The Society of Research into Higher Education and Open University Press, Maidenhead, UK.

Jones, M. G., Howe, A. & Rua, M. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education*, 84, 180-192.

Lorenzo, M., Crouch, C. & Mazur, E. (2006). Reducing the gender gap in the physics classroom. *American Journal of Physics*, 74 (2), 118-122.

Mayer, R. E., Stull, A., DeLeeuw, K., Almeroth, K., Bimber, B., Chun, D., Bulger, M., Campbell, J., Knight, A. & Zhang, H. (2009). Clickers in college classrooms: Fostering learning with questioning methods in large lecture classes. *Contemporary Educational Psychology*, 34(1), 51-57.

Neer, M. R. (1990). *Instructor communication behavior as a factor influencing the class participation of classroom communication apprehensives.* Paper presented at the Annual

Meeting of the Speech Communication Association, Chicago.

Pearson, J., West, R. & Turner, L. (1995). *Gender and Communication* (3rd ed.). Dubuque, Brown & Benchmark Publishers.

Pedrosa de Jesus, H., Teixeira-Dias, J. J. C. & Watts, M. (2003). Questions of Chemistry. *International Journal of Science Education, 25*(8), 1015-1034.

Pedrosa de Jesus, H., Almeida, P., Teixeira-Dias, J. J. & Watts, M. (2007). Where learners' questions meet modes of teaching. *Research in Education, 78*, 1-20.

Scholl, R. (2010). The Question Quadrant: A stimulus for a negotiated curriculum. *Primary & Middle Years Educator*, 8(2), 3-16.

Tannen, D. (1990). You just don't understand: Women and men in conversation. New York: Ballantine.

Teixeira-Dias, J., Pedrosa de Jesus, H., Souza, F., Almeida, P. & Moreira, A. (2009). Questões de estudantes universitários no primeiro ano: Como promover a aprendizagem activa em Química. In Huet, I., Costa, N., Tavares, J. & Baptista, A. (Eds.), *Docência no ensino superior – partilha de boas práticas* (pp. 61-78). Universidade de Aveiro.

Valadas, S., Gonçalves, F. & Faísca, L. (2010). Approaches to studying in higher education Portuguese students: a Portuguese version of the approaches and study skills inventory for students. *Higher Education,* 59, 259-275.

Vianna, C. & Ridenti, S. (1998). Relações de género e escola: das diferenças ao preconceito. In Summus Editorial Ltda.

Wilson, E. V. (2004). ExamNet asynchronous learning network: augmenting face-to-face courses with student-developed exam questions. *Computers & Education*, 42(1), 87–107.

Wood, J. T. (2009). *Gendered lives: Communication, gender, and culture* (8th ed.). Belmont, Wadsworth.

Yu, F., Liu, Y. & Chan, T. (2005). A web-based learning system for question-posing and peer assessment. *Innovations in Education and Teaching International*, 42(4), pp. 337–348.

Yu, F. (2009). Scaffolding student-generated questions: Design and development of a customizable online learning system. *Computers in Human Behavior, 25*, 1129-1138.

Yu, F. (2011). Multiple Peer-Assessment Modes to Augment Online Student Question-Generation Processes. *Computers & Education*, 56 (2), 484-494.

Zoller, U. (1987). The fostering of question - asking capability: A meaningful aspect of problem-solving in chemistry. *Journal of Chemical Education*, 64, 510-512.