

# Learner Autonomy in Mechanical Engineering Students: taking it further

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**Abstract:** *Lifelong learning is crucial in engineering where new fields are constantly emerging. That is why, in engineering, the education that succeeds will be the one that facilitates lifelong learning and self-directed learning. Learning in a self-directed way requires learner autonomy, which is the ability to take charge of one's own learning, and the will to act and choose independently. The purpose of this research is to check how the use of mixed methods can contribute to the understanding of how the perceptions of some Portuguese engineering students regarding learner autonomy influence the way they engage in curricular activities and perceive the teacher's role. Results allow insights and conclusions to be drawn, that are only possible with the use of mixed methodologies, with qualitative data being indispensable to understand results provided by quantitative data.*

## Introduction

For a knowledge based society, lifelong learning is of a paramount importance and it is seen as an essential element of the European Higher Education Area (Prague Communiqué, 2001, 2), as “lifelong learning strategies are necessary to face the challenges of competitiveness and the use of new technologies and to improve social cohesion, equal opportunities and the quality of life”. The Berlin Communiqué (2003, 6) emphasizes “the important contribution of higher education in making lifelong learning a reality” and in the Dublin descriptors (Joint Quality Initiative Group, 2004) is stated that the qualifications that signify completion of the higher education first cycle “are awarded to students who have the learning skills to undertake further studies with some autonomy”.

In some scientific areas, such as engineering, lifelong learning is crucial because new fields are constantly emerging (Chen and Lord, 2013). That is why, in engineering, the education that succeeds will be the one that facilitates lifelong learning (Dutta, Patil and Porter, 2012) and self-directed learning (Barry and Rees, 2006). Learning in a self-directed way requires learner autonomy, which is the ability to take charge of one's own learning (Holec, 1979), and the will to act and choose independently (Little, 1991; Dam et al., 1990). Nevertheless, although the exercise of learner autonomy is an individual choice, it will always depend on the opportunity to do so. So, it is up to the teacher to be the facilitator who provides the conditions for the exercise and the development of autonomy, “adopting appropriate teaching methodologies” (Littlewood, 1996, 3), and providing a learning environment that encourages and allows learner autonomy, because “students hardly become autonomous learners without encouragement of the teacher”.

Thus, learner autonomy should be understood as influenced by the learner characteristics and the teaching-learning transaction, which is why we have adopted the personal responsibility orientation (PRO) model of self-direction in learning as operationalized by Stockdale and Brockett (2011). Their operationalization is based on the conceptualization of self-direction by Brockett and Hiemstra (1991) because it provides a “definitional foundation for understanding and recognizing differences and similarities in self-directed learning as a teaching and learning transaction external to the individual and learner self-direction as a personal orientation internal to the individual” (Stockdale and Brockett, 2011, 162).

Brockett and Hiemstra (1991, 24) define the teaching-learning transaction component as a “process in which a learner assumes primary responsibility for planning, implementing, and evaluating the learning process”. In this process, the focus is the external factors and characteristics of the teaching-learning transaction, in which teachers play a facilitating role. As for the learner characteristics component, Brockett and Hiemstra (1991, 29) define it as “characteristics of an individual that predisposes one towards taking primary responsibility for personal learning endeavours” and by doing so being motivated to learn.

This orientation for the students’ personal responsibility in learning may be seen as a shift in the roles of students and teachers in formal education, resulting in a ‘movement’ in which these roles are questioned and that “is generally referred to as learner autonomy” (Crabbe, 1999, 3). The focus of this movement is on the ability of the students to be responsible for their own learning, more specifically on the issue of decision making in the learning process.

To Boud (1988), any practice of teaching and learning, whether or not identified with autonomy, can be assessed by the extent to which it promotes aspects of autonomous learning. At one end of the spectrum are the extremely educational presentations in which students are relatively passive and have few opportunities to practice the necessary skills to exercise autonomy in learning. At the other end of the spectrum are the approaches in which all decisions are made by the students and teachers only get involved by request. The readiness for students to benefit from a particular approach varies, due to their previous learning experiences and also due to the reasons that lead them to learn.

The conceptions that students have about teaching and learning affect their approaches to learning. The approach to learning is, according to Ramsden (2003), one of the most influential concepts that emerged from research on teaching and learning in higher education in the last decades of the XX century. It describes the student-learning relation, showing that a learning event has elements of the situation as perceived by the student and the student's own elements, but is not merely its sum. Changing student’s approach to learning is not changing the student, but changing the experiences, perceptions and conceptions that the student has. The approaches to learning are characterised by the intentions and processes used by the students (Marton e Säljö, 1997; Entwistle, 1997; Biggs, 1999; Ramsden, 2003). The result of the learning diverges because the intention in the face of the task and the process that leads to its execution also diverges, no longer being solely a question of differences in previous knowledge or in the cognitive skills of students.

So this means that when researching learner autonomy, considering students perceptions and conceptions, it coexists an objective and a subjective dimension. That is why it is not possible to resort to an exclusively quantitative or exclusively qualitative research, expecting that it might be advantages in choosing to use a mixed methodology in which quantitative and qualitative techniques are integrated in a sequential procedure, as according to Coutinho (2011, 32) “what should determine the methodologic option of the researcher is not the preference for one or the other methodology, for one or another paradigm, but the problem to be analysed”.

That is why, recognizing the importance of what students do and why they do it, and that learner autonomy is of paramount importance for effective learning and lifelong learning, the purpose of this research is to check how the use of mixed methods can contribute to the understanding of how the perceptions of some Portuguese engineering students regarding learner autonomy influence the way they engage in curricular activities and perceive the teacher’s role. The following specific objectives were formulated, knowing that because it is a work in progress only partial results are available at this time.

- 1) Measure learner autonomy and quantify it in terms of its components and dimensions.
- 2) Identify students’ conceptions about learner autonomy and its importance for learning.

- 3) Identify students' conceptions about the relation between learner autonomy, academic achievement and workload.
- 4) Identify students' conceptions about the influence of teachers and the curriculum in learner autonomy.
- 5) Compare quantitative and qualitative data, highlighting the contribution of mixed methods to this research.

Bearing in mind that what is intended is to measure learner autonomy but also to identify conceptions regarding it and what it is influenced by, it seems adequate to combine quantitative data that allow "objective comparisons to be made, and the measurements of quantitative research permit overall descriptions of situations or phenomena in a systematic and comparable way" (Punch, 1998, 243) and qualitative data that "are the best way we have of getting the insider's perspective, the 'actor's definition of the situation', the meaning people attach to things and events" (Punch, 1998, p.243). It is considered that it is this joint use of different types of data that will allow, not only a global vision, but also a deeper comprehension of singularities e specificities of students' perspective.

The resort to several methods and types of data is explained by Creswell (2003, 15), to whom it was by "recognizing that all methods have limitations, [that] researchers felt that biases inherent in any single method could neutralize or cancel the biases of other methods".

Several authors (Tashakkori & Teddlie, 1998; Minayo & Sanches, 1993), highlight the purposes of the use of mixed methods, pointing out that despite the difference between them there is no contradiction. Once the complementary between these two approaches is accepted, and their integrated use respect each one specificities, it is possible to identify how both can be incorporated in the research (Serapioni, 2000).

## Method

The participants were 371 Portuguese students (9.7% female and 90.3% male) of a mechanical engineering studies course in a polytechnic institute, being a convenience sample. All participants collaborated voluntarily with this research.

The age of the participants ranged from 18 to 54 years old ( $M=23.61$ ;  $SD=6.54$ ); 290 students (78.2%) attended classes during the day, while 81 (21.8%) attended evening classes because they had a job during the day. Students attending classes during the day were younger ( $M=21.18$ ;  $SD=3.074$ ; between 18 and 41 years old) than those attending at night ( $M=32.31$ ;  $SD=8,085$ ; between 21 and 54 years old). Of the 371 students that participated in this research, 37.2% were first year students, 31.8% were in the second year, and 31.0% were in the third and final year.

Students were approached during classes (with the permission and cooperation of their teachers) in 2014 and asked to answer to a paper-and-pen questionnaire (PRO-SDLS). The purpose of the study was explained to participants by the researcher; they were also informed that the data collection was completely anonymous, voluntary and confidential, and that returning the completed questionnaires would be interpreted as informed consent. Students not wishing to participate in the study were told that it would be enough to return a blank questionnaire.

For the measurement of learner autonomy, the Portuguese adapted version (Duarte, 2014) of the Personal Responsibility Orientation to Self-direction in Learning Scale (PRO-SDLS) (Stockdale and Brockett, 2011) was used. The PRO-SDLS is a five-point Likert scale ranging from 'totally disagree' {1} to 'totally agree' {5}. Although the original version has 25 items, the Portuguese validated version (Duarte, 2014) has only 12 items, but the same structure, with the two main components, the teaching-learning transaction (TLT) and learner characteristics (LC). The TLT component has two dimensions, control (items 4, 19 and 23 of the original

scale) and initiative (items 10, 15 and 17 of the original scale), and the LC component has also two dimensions, motivation (items 3, 11 and 20 in the original scale) and self-efficacy (items 21, 22 and 24 in the original scale). Learner autonomy (LA) was obtained by the sum of all items of the scale, after negative items were reversed. The maximum score in the adapted version of the PRO-SDLS was 60 points (Duarte, 2014). The learner autonomy dimensions measured by the adapted PRO-SDLS refer to the perception of self-directed learning that participants in this research had of their most recent learning experiences in higher education.

A socio-demographic and academic questionnaire was used to characterise the participants, which included items as age, nationality, gender, studies course, curricular year and overall grade.

Based on learner autonomy and academic achievement (overall grade), eight participants were select to be interviewed. They all agreed to continue to participate in the study. A semi-structured interview was used. Regarding learner autonomy, participants were questioned about: (i) their own learner autonomy; (ii) what it is; (iii) what is its importance; (iv) what is the teachers' role in fostering it; (v) what is the importance of the studies programme on its development; (vi) the way it is valued by teachers; and (vii) its relation with academic achievement and workload.

At this time, data is still being collected and content analysis will be done, and the information will grouped into the following categories, related with learner autonomy: conceptions and importance for learning, teachers' influence, and curriculum influence.

## Results and discussion

Table 1 includes descriptive statistics of the adapted PRO-SDLS, namely the mean value of learner autonomy, the standard error of the mean and standard deviation, noting that, on average, students score higher on motivation and self-efficacy (LC component) than on initiative and control (TLT component). This means that the learner autonomy of the participants in this research is more influenced by the individual characteristics that predisposes one towards taking primary responsibility for personal learning endeavours and by doing so being motivated to learn. With less influence in the learner autonomy of these students, are the external factors and characteristics of the teaching-learning transaction, in which teachers play a facilitating role.

**Table 1: PRO-SDLS descriptive statistics**

PRO-SDLS	N	M	Standard deviation	Mean standard error
Control	371	9.89	1.831	0.950
Initiative	371	9.05	2.016	0.105
Motivation	371	11.06	2.069	0.107
Self-efficacy	371	10.96	2.067	0.107
TLT component	371	18.94	3.051	0.158
LC component	371	22.02	3.404	0.177
Learner autonomy	371	40.96	5.330	0.277

The participants' selection for the interviews was made considering the academic achievement and learner autonomy. Nine participants were selected: four participants had

low scores in learner autonomy, and variable academic achievement; other four participants had high scores in learner autonomy, and variable academic achievement.

**Table 2: Participants' selection criteria**

ID	Gender	Age	Curricular year	Overall grade	Learner autonomy	TLT component	LC component
A	Male	20	1	11,60	25	10	15
B	Male	19	2	10,74	27	12	15
C	Male	19	1	13,20	30	10	20
D	Male	20	2	14,50	31	18	13
E	Male	21	3	13,70	53	25	28
F	Male	22	3	11,94	50	23	27
G	Male	22	2	14,15	50	23	27
H	Male	19	1	11,00	52	23	29

Regarding learner autonomy, participants answered that:

1. To be an autonomous learner is...

Making decisions about when to study and organizing what to do; making choices. Not being lazy. Looking for more information about a topic that interested me, even though it is not assessed. *(participant A)*

Wanting to learn more, having that incentive to study, without the need for teacher's intervention all the time. *(participant B)*

Looking for answers alone, when I do not understanding something. Not giving up. *(participant C)*

To have lots of will power, being able to insist and not being lazy. *(participant D)*

Being able to study alone, but also to get help from colleagues when needed. Being a quick learner, with good comprehension abilities. *(participant E)*

Being able to gather information even when it is difficult. *(participant F)*

Being able to study alone when I can't attend classes and still be successful, to get the required learning resources, to do self-assessment and to be perseverant. *(participant G)*

Organize information after classes and verify if all is comprehended. *(participant H)*

2. Learner autonomy is important because...

In the future there will be no one to tell us what to do. We will need to learn to do it ourselves. *(participant A)*

Students learn more, but I do not like to do it. I prefer having someone telling me what to do. *(participant B)*

We need to able to figure things out for ourselves. *(participant C)*

It is important for students to solve problems using their own reasoning, to find their own way to the solution. *(participant D)*

It is important being able to do things alone. *(participant E)*

We have to search for information and by doing that we can develop other abilities, like learning to read better in English. *(participant F)*

It improves learning by making students actively participate in their own learning.

Learning only happens when we are doing something, when we are trying and not only listening to the teacher. *(participant G)*

To learn is necessary an individual effort, and to try to find answers alone first (*participant H*)

3. Benefits of learner autonomy on academic achievement and workload are...

I am more autonomous when I am motivated, and so I tend to study more and spend more time because I am interested. My academic achievement is better when I study more time. (*participant A*)

I guess learner autonomy improves learning because autonomous learners tend to want to know more and get to the bottom of things. I am not like that. (*participant B*)

A more autonomous student will learn in less time. (*participant C*)

Being more autonomous sometimes improves academic achievement. Depends on the assessment. Sometimes you know more and the grade is lower. (*participant D*)

It is not so much learner autonomy, but the fact of studying in a regular way, or for exams. I learn more when studying in a regular way. (*participant E*)

Being more autonomous in learning means a better academic achievement, and it will be important after graduating. Regarding the time spent, I spent more time studying subjects I liked better. (*participant F*)

Good grades and a smaller workload, because it is a great help being able to select good learning resources and self-assess. (*participant G*)

When I learn in a more autonomous way, my academic achievement is better, and assessment becomes easier because there is another connection with the subjects. I also spend less time when I am more autonomous. (*participant H*)

4. Teachers are important in fostering learner autonomy because...

When a teacher asks the student to do something, instead of just doing it. (*participant A*)

They give students incentive and hints on how to look for more information. (*participant B*)

They don't give students the answers. They tell them they have to look for themselves. It is very hard at the time, but it will have benefits in the future (*participant C*)

They can incentive students to solve problems on their own, but they also can help students to get there when they are struggling. (*participant D*)

They try to get students to do things on their own, even if many students do not understand it. (*participant E*)

They do not feed spoon students with information. They make students find out things for themselves. (*participant F*)

Greater autonomy means a greater involvement of the teacher, because students need teacher's feedback to be able to do autonomous work. (*participant G*)

They can give students extra coursework, so they can try to learn on their own. (*participant H*)

5. Teachers' position regarding the value of learner autonomy is...

It is not possible for teachers to value learner autonomy. They have too many students. (*participant A*)

Teacher value learner autonomy because they give students incentive and hints on how to look for more information (*participant B*)

I think they value it, because they demand it from students. (*participant C*)

Some teachers value learner autonomy because they incentive students to do the activities on their own. Others not so much. (*participant D*)

Teacher value learner autonomy because they tell students they have to be able to do things on their own. (*participant E*)

I do not think that learner autonomy is valued by teachers, not because they do not want to, but because they have too many students in the classroom. (*participant F*)

Assessment is done mostly by final exams, so learner autonomy can't be assessed by teachers. (*participant G*)

When students show teachers exercises and problems they solved at home, this is valued. (*participant H*)

6. Studies programmes are important for learner autonomy because...

The existence of project courses promotes learner autonomy. Other courses could also do that if there were more practical classes. Being in this course improved my learner autonomy because it changed the way I think. (*participant A*)

Project courses makes us do more autonomous work. (*participant B*)

Project courses make me more capable of figuring alone what to do. (*participant C*)

Not all classes are mandatory, and so students can learn in a more autonomous way (*participant D*)

Project courses and coursework in other courses are important in learner autonomy development. The fact that I skip a lot of classes also made me a more autonomous learner. (*participant E*)

Some courses demand that students have learner autonomy. The possibility to skip a lot of classes forces students to learn in a more autonomous way. (*participant F*)

If there were more project courses, learner autonomy of students would be better. (*participant G*)

Higher education in general is very demanding and students have to develop some degree of learner autonomy. (*participant H*)

The interviews of these eight participants reveal that the conceptions about learner autonomy are that an autonomous learner is someone who is able to make decisions and choices, to organize and search for information, who wants to learn more and is perseverant and not lazy. Regarding these conceptions there is no visible difference between more autonomous (participants E, F, G, H) and less autonomous learners (participants A, B, C, D).

On the importance of learner autonomy, all eight participants recognize it as important for learning and for the development of the capability of being able to do certain things on their own. Some mention the need to be autonomous in the future, as engineers.

Regarding the benefits of learner autonomy on academic achievement and workload, the general view of the eight participants is that learner autonomy improves academic achievement. On the subject of time, opinions vary from those who feel greater learner autonomy means more interest and motivation for certain subjects, and so more time dedicated to it, to those to whom being more autonomous means being more effective and spending less time.

They all agree that teachers are important in fostering learner autonomy, by not giving the students the answers, and making them try to figure out things for themselves. On the matter of teachers valuing learner autonomy, some interviews point out to yes, on the grounds that if teachers foster learner autonomy it is because they value it. Other interviews point out to teachers not having conditions to do so, because of the excessive number of students in the classroom.

As for the Mechanical Engineering course, these participants found project courses to be an effective way of promoting learner autonomy. Some participants skip a lot of classes (because they can) and saw in this something that makes them more autonomous learners.

## Conclusions

The purpose of this research is to check how the use of mixed methods can contribute to the understanding of how the perceptions of some Portuguese engineering students regarding learner autonomy influence the way they engage in curricular activities and perceive the

teacher's role. To do so, learner autonomy was measured and eight participants were selected to be interviewed, four with low learner autonomy and four with high learner autonomy.

What the interviews showed is that in spite of being more or less autonomous learners, the eight students have very similar views about what it is learner autonomy and its importance and relation with academic achievement and workload, the role of teachers in fostering learner autonomy and of the studies programme.

Some less autonomous students stated that they did not like to learn in an autonomous way and that they had difficulties in doing so. Also, only less autonomous students mention they were too lazy to be autonomous learners.

Although they all recognize the importance of teachers for learning, many of them skip a lot of classes. On their opinion, this made them more autonomous learners, and they view the possibility of doing so as a benefit, thought recognizing that their learning would have been better if they attended more classes.

On the development of learner autonomy in higher education, the importance of project courses is highlighted, and this is independent of the teacher. On other courses, it depends on the teachers and not on the courses.

Quantitative data shows that the participants of this research could improve their learner autonomy, on average, if they improve initiative and control, which are related to the teaching-learning transaction. On the other hand, interviews show that students relate the development of learner autonomy with specific courses and certain teachers, even in more traditional courses, and that the development of learner autonomy is not a widespread practice in the studies programme, even though examples of good practices exist and are valued by the students.

These insights and conclusions are only possible with the use of mixed methodologies, with qualitative data being indispensable to understand results provided by quantitative data.

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