Increasing adult students' learning opportunities with flexible learning pathways

Evidence from a technology and industrial management graduate course

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***Abstract*—Higher education institutions play an important role in promoting equity and access conditions to adult students. Such role includes the ethical commitment to facilitate learning processes, removing barriers to adult students' entry and persistence in higher education. This paper describes the implementation of flexible learning pathways in a technology and industrial management graduate course targeted at adult students. Findings confirm that adult students welcome flexible learning pathways and choose the pathways that better suit their needs. Despite academic background differences success rates are adequate and similar for different learning pathways, showing that adult students are capable of bridging the gaps in their academic development. Findings also show that doubts related to the impact of some learning pathways on students' academic integration are unfounded. Considering the positive results it is concluded that flexible learning pathways, together with flexible entry requirements, promote equity and access conditions to adult students.**

Keywords—higher education; adult students; equity; flexible learning; learning pathways

I. INTRODUCTION

The large increase of adult students enrolled in higher education institutions [1] shows that many adults aspire to higher academic qualifications and proves the importance of flexible entry requirements to the promotion of lifelong learning. But adult students commencing their studies in Higher Education Institutions (HEIs) often find that the teaching and learning process poses unsurpassable barriers. Traditional teaching and learning processes are adapted for traditional students, not necessarily for adults that need to reconcile their academic development with professional and family responsibilities, and enroll in HEIs after having interrupted their studies for a long period of time.

During the interruption of their studies adults acquire skills related to non-academic activities, however, as mentioned in [2] and [3], these skills aren't necessarily meaningful for the academic areas of knowledge taught in first cycle studies, especially for mathematics (physics and chemistry) modules included in the curricula of first year technology and management courses. Consequently, adult students need to bridge wider gaps than traditional students and yet, due to professional and family responsibilities, they not only have less time available to learn, they often face scheduling conflicts that limit their access to the support they require. To promote equity and provide adult students with actual learning opportunities, HEIs need to go beyond flexible entry requirements, and implement changes to the traditional teaching and learning process that fit adult students' needs.

According to [4] students' learning opportunities are improved if instead of specifying a rigid learning model, with rigid course contents, time of delivery, method of delivery and support delivery; students are allowed to choose with respect to each of these key dimensions and custom learning pathways are made available. Such a learning experience is known as flexible learning and is discussed in [5] and in [4]. The flexibility to choose among different learning pathways is important for adult students in many ways; it represents the opportunity to select what, when, where, how and with whom to study. This enables individually negotiated learning activities addressing adults' specific needs, and allows a better management of conflicts due to professional and family responsibilities. Moving from rigid to flexible learning is difficult to put into practice. According to [4] difficulties arise from costs and from conflicts for the professor, student, student's employer and HEI while attempting to offer increased flexibility on several dimensions. Some of the dimensions described previously are questioned by both professors and students, notably, course content flexibility,

hence, before a HEI decides to implement flexible learning it is wise to confirm that conflicts can be managed and that students learning opportunities are actually improved.

This paper describes the implementation of flexible learning in a graduate technology and industrial management course targeted at adult students. Not all dimensions of learning were made flexible; course contents, time of delivery and pace remained rigid, but different methods of course delivery and different types of support were presented "in the shape" of flexible learning pathways.

A simple metric for the interest of flexible learning pathways is the number of students that use each pathway, so, one objective of this paper is to report on the actual use of different learning pathways. However, students' preference for a specific learning pathway isn't on its own sufficient to judge the value of the pathway. Poor pathway design can deceive students and end up hindering academic performance and integration, hence, another objective of the paper is to report on the effect of different learning pathways on students' academic performance and integration.

But students' academic performance and integration also depends on students' antecedents, for example, different studies state that students' academic background (e.g., secondary education Grade Point Average, GPA) is the best predictor of academic performance [6, 7]; age too is frequently associated with students' academic integration [6, 8]. To consider the effect of students' antecedents on academic performance and integration, students' socio-demographic data is gathered for different learning pathways. If, controlling for students' antecedents, academic performance and integration are adequate regardless of the learning pathway, flexible learning pathways contribute to increase students learning opportunities. In this case, despite the difficulties associated with its implementation, it is concluded that flexible learning should be used together with flexible entry requirements to promote equity and access conditions to adult students.

II. MATERIALS AND METHODS

A. Flexible learning pathways

Flexible learning pathways were implemented in a Technology and Industrial Management (T&IM) graduate course—"Licenciatura" with 180 ECTS—of a medium sized (6000 students) Portuguese public HEI. The T&IM course targets blue-collar workers with full time jobs that commute two to three days per week to attend evening lessons. Until 2014 a blended-learning methodology was in place with expository teaching and problem solving lessons split evenly between face-to-face and e-learning lessons (the Moodle platform was used). Additionally, face-to-face laboratory lessons (2 hours per week) were also mandatory. References [9] and [10] discuss in more detail characteristics of the T&IM course.

In 2014-2015, in addition to the above, flexible learning pathways were implemented due to the availability of:

i. An extended online version of expository lessons including digital contents (e.g., videos) to catch up on face-to-face lessons.

ii. Laboratory lessons (4 hours) on Saturday mornings, every two weeks.

Figure 1 presents the different learning pathways considered in 2014-2015. Bold lines in Figure 1 describe the T&IM course traditional learning pathway, dashed lines represent the added learning pathways. From the product of the 2 alternatives for each one of the two stages—(i) expository lesson and (ii) laboratory lesson—, 4 pathways were available to students at the start of each week.

The circumstances that led to the decision to implement extended online lessons and Saturday laboratory lessons and a discussion of advantages/ disadvantages of this decision are presented next.

Extended online lessons: Adult students with full time jobs sometimes miss lessons due to their professional and family responsibilities. To allow students to catch up on missed lessons, digital contents (e.g., videos) were available online for each face-to-face expository teaching and problem solving lesson. The extended online pathway was designed to augment, not to replace face-to-face expository lessons completely, but, because attendance to face-to-face expository lessons was not mandatory, the possibility that simultaneous delivery of online contents and face-to-face lessons could "deceive" students was considered. In fact, and according to [11] and [12], students lacking learner control (with trouble managing time spent studying, pace, depth and coverage of content) often believe they can use online contents to replace face-to-face lessons completely, but end up missing the contact with faculty and peers and often fail to achieve their study objectives. To detect and prevent these problems, close monitoring of the pedagogic experiment became mandatory.

Saturday laboratory lessons: A barrier to adult students' participation and persistence in first cycle studies is lesson scheduling conflicts. Letting students attend mandatory laboratory lessons on different dates (Saturdays or weekdays) minimizes scheduling conflicts. The financial burden and the time spent commuting to attend laboratory lessons is also reduced with Saturday lessons every two weeks instead of weekly lessons. However, since on Saturdays most academic services are closed and the number of professors and students in the HEI campus is small, students taking Saturday lessons get a different—perhaps lessened—academic experience, which could impair their academic integration. This too suggested the need for a close monitoring of the pedagogic experiment.

B. The sample

At the start of 2014-2015 the T&IM course had 51 students enrolled. Ninety eight percent of these students had a full time job. Students' ages ranged from 18 to 48 and the majority (78%) were men. More than half (56%) of the students benefited from lifelong learning legislation to apply and enroll in the T&IM course. Another important contingent were students enrolled in daytime courses that asked to be transferred; in 2014-2015 this group represented 15% of the enrolled students. The remaining students (29%) enrolled after 12 years of continued education in regular secondary schools or equivalent technological education institutes.

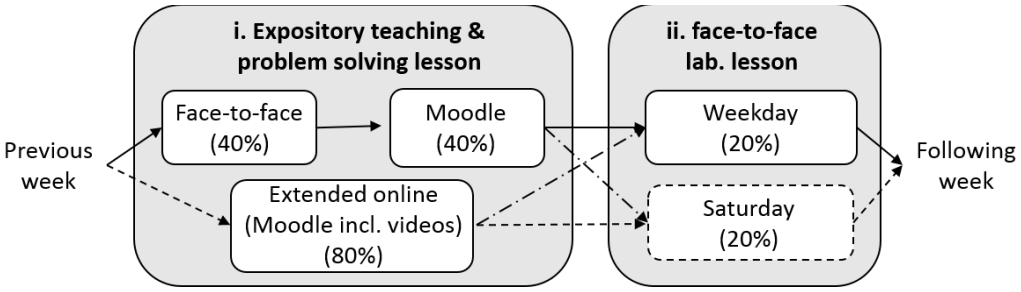

Fig. 1. Learning pathways available at the beginning of each week. The bold lines represent the traditional learning pathway. Dashed lines represent learning pathways introduced in 2014-2015. Weekly course credit percentages are presented (inside parenthesis) for different lessons. Considering the two stages (i) expository lesson, (ii) laboratory lesson, with 2 alternatives each, a total of 4 different learning pathways are available.

Out of the 51 initial students eleven (22%) did not attend lessons and did not take any of the first trimester tests or exams. Reasons presented by these 11 students to decline the opportunity to complete the first trimester modules were: prolonged illness (3), academic credit transfer acceptance (2), professional reasons (5). One student could not be contacted. Out of the 40 students that were assessed 4 reported professional difficulties and attended less than half of the laboratory lessons, the mandatory minimum attendance. The study sample considered 36 students, 70% of the initial T&IM student population.

C. Data gathering

Data was gathered at the start, during and at the end of the first trimester of 2014-2015. At the start of the trimester students' socio-demographic data were collected. During the trimester a log of lesson attendance was kept and, at the end of the trimester, data on students' academic performance and integration were collected. A brief description of the data gathering methods is presented next.

Socio-demographic data: Students' socio-demographic data including age, sex and academic background were obtained from the HEI information system. Because enrolled students came from different groups (adult students, transfers from other graduate courses, secondary education), and since the rules for ranking students varied between groups, the position of each student in their group rank order was used as a measure of student's academic background. Three tiers associated with group rank order were considered.

Lesson attendance data: During the trimester a log of lesson attendance was kept for every lesson and for every student.

Academic performance data: To assess academic performance first trimester GPA data (measured on a 20-points rating scale) were gathered from the HEI information system. Students' success was linked to GPA greater or equal to 10.

Academic integration: Students' academic integration was assessed at the end of the trimester using the QVA-r psychometric scale [13]. The QVA-r scale considers five factors of academic integration:

- *Personal*, related to students' perception of well-being.

- *Interpersonal*, related to students relationships with friends and colleagues within the HEI context, but also related to the development of relationships with significant others.

- *Career*, related to students' vocational projects and also satisfaction with the course.

- *Study*, related to study skills and daily study routines (e.g., time management, media used).

- *Institutional*, related to students' generic opinion about the HEI and about the academic services offered.

The QVA-r instrument was originally developed to assess academic integration in Portuguese HEIs but has also been used in Brazilian HEIs. The use of the QVA-r scale is reported, for example, in [14] and in [15].

D. Statistical analysis

Using the log of lesson attendance the number of students present in different types of lessons (expository, laboratory) was obtained and statistics for lesson attendance were determined. The log of lesson attendance was also used to determine each students' preferred (most used) learning pathway and to populate each one of the 4 learning pathways represented in Figure 1.

Considering students' academic performance and integration, students' antecedents and students' preferred learning pathways, the following hypothesis were tested:

- H_0^{Perf}: Students' academic performance is the same, regardless of the learning pathway.

- H_0^{Integ}: Students' academic integration is the same, regardless of the learning pathway.

- $H_0^{Socio-dem}$: Students' socio-demographic characteristics are the same, regardless of the learning pathway.

Due to the small sample size, for continuous and ordinal variables such as age, GPA or QVA-r factors measured using the Likert scale, non-parametric Mann-Whitney tests were used to test differences between two (i=1,2) independent learning pathways. The tests considered hypothesis $H_0 : F(x_1) = F(x_2)$, that variable distributions $F(x_1)$ and $F(x_2)$ were identical, against the hypothesis $H_1 : F(x_1) \neq F(x_2)$, that the variable distributions were not identical. For every test performed the

Mann-Whitney U statistic and the corresponding exact two-tailed *p*-value were determined.

For categorical variables such as gender, contingency tables were used to compare observed and expected variable counts considering two learning pathways. Fisher's exact tests were used to test if the counts were identical. Two-tailed *p*-values of the Fisher's exact tests were determined for every hypothesis tested.

Version 20.0 of the IBM SPSS software [16] was used in the statistical analysis.

III. RESULTS

A. Lesson attendance and preferred learning pathways

From the log of lesson attendance it was concluded that different students chose different weekly learning pathways. Table I presents attendance statistics for different types of lessons: face-to-face expository teaching and problem solving (Expos), laboratory on weekdays (LabWk) and laboratory on Saturdays (LabSat).

TABLE I. NUMBER OF STUDENTS AND ATTENDANCE STATISTICS PER LESSON TYPE

Lesson	**N. of**	**Attendance statistic** [%]					
type	**Stdt**(N)	Mean	Min.	P_{25}	P_{50}	P_{75}	Max.
Expos	36	83	0	73	91	100	100
LabWk	22	82	50	70	90	98	100
LabSat	14	88	60	80	100	100	100

Table I shows that students attended most of the face-to-face expository and problem solving lessons. The 25th percentile attendance for this type of lesson was 73%, which means that 75% of the students attended more than 73% of these lessons. On average expository and problem solving lessons' attendance was 83%, the attendance median was 91%.

The large attendance percentages in face-to-face expository lessons means that very few students relied exclusively on the extended online lessons. Large attendance was also registered for laboratory lessons. On average, attendance was 82% and 88% (90% and 100% medians) for weekday and Saturday laboratory lessons, respectively. During the trimester 61% (22/36) of the students preferred weekday laboratories, the remaining 39% (14/36) preferred Saturday laboratories.

Because very few students relied solely on the extended online lessons, it was decided to focus on the analysis of the availability of laboratory lessons on weekdays or on Saturdays mornings. Out of the four pathways described in Figure 1 only the following two independent pathways were considered:

- *Weekday pathway*, comprised of a face-to-face expository lesson plus (regular) Moodle support, plus a (2 hours) laboratory lesson on a weekday.

- *Saturday pathway*, similar to the above but with a (4 hours) laboratory lesson on a Saturday, every two weeks.

In the following subsections the hypothesis introduced in Section II.D are tested considering these independent pathways.

B. Academic performance

Median GPA measured on a 20-point rating scale and results from the Mann-Whitney tests are presented in Table II for the studied pathways. The sample median is 12.2. No statistically significant differences in GPA were found between pathways ($p > 0.10$).

Observed counts of students with GPA above 10 and results of Fisher exact tests are also presented in Table II. Sample success rate (GPA≥10) exceeded 80% (29 out of the 36 students successfully completed the trimester). Considering the 0.10 significance level, Fisher's exact tests showed no difference in success between pathways ($p > 0.10$).

From these results it can be concluded that hypothesis H_0^{Perf} is accepted and students' performance is similar, and adequate, regardless of the learning pathway.

TABLE II. COUNTS, MEDIANS, FISHER'S EXACT TEST RESULTS AND MANN-WHITNEY TEST RESULTS FOR THE WEEKDAY AND SATURDAY PATHWAYS. SAMPLE COUNTS AND MEDIANS, AND THE NUMBER OF STUDENTS (N) PER PATHWAY ARE ALSO PRESENTED. ALL P-VALUES ARE TWO-TAILED; (*) P<.10, (**) P<.05.

			Pathway	
		Sample	**Weekday**	**Saturday**
Academic performance		(N=36)	(N=22)	(N=14)
Grade Point	Median	12.2	13.3	11.5
Average, GPA	Mann-Whitney U	—	126	
(0-20)	p-value	—	.377	
GPA≥10	Yes count	29	19	10
(Yes/No)	No count	7	3	4
Fisher's exact test p-value		—	.394	
QVA-r factor (1-5)		(N=34)	(N=20)	(N=14)
Personal	Median	3.73	3.65	3.85
	Mann-Whitney U	—	119	
	p-value	—	.472	
Interpersonal	Median	3.65	3.73	3.58
	Mann-Whitney U	—	124	
	p-value	—	.585	
Career	Median	3.92	3.85	4.00
	Mann-Whitney U	—	118	
	p-value	—	.440	
Study	Median	3.23	3.23	3.08
	Mann-Whitney U	—	118	
	p-value	—	.440	
Institutional	Median	3.62	3.56	4.00
	Mann-Whitney U	—	102	
	p-value	—	.182	
Socio-demographic characteristic				
Age	(18-48)	(N=34)	(N=22)	(N=12)
	Median	28	28	38
	Mann-Whitney U	—	91.0	
	p-value	—	**.076 ***	
Enrolment	(1-3)	(N=31)	(N=22)	(N=12)
rank position	Median	1	1	2
	Mann-Whitney U	—	57.0	
	p-value	—	**.003 ****	

C. Academic integration

QVA-r factors' medians and results from the Mann-Whitney tests are presented in Table II for the studied pathways. Factors' sample medians vary between 3.23 and 3.92 on a 5-point Likert-type rating scale. All QVA-r factors have medians above 3 with factors "Career", "Personal" and "Interpersonal" having the highest sample medians. Results show that no statistically significant differences were found between pathways ($p > 0.10$ for all QVA-r factors).

From these results it can be concluded that hypothesis H_0^{Integ} is accepted: Students' academic integration is similar, and adequate, regardless of attending weekday or Saturday laboratory lessons.

D. Socio-demographic characteristics

Observed and expected counts of female and male students and Fisher's exact tests were made (results not presented). No statistically significant difference in the counts of female and male students was found for the studied pathways ($p > 0.10$).

Age and enrolment rank position medians and results from the Mann-Whitney tests are presented in Table II. These results show that for age or enrolment rank position statistically significant differences were found between students attending weekday or Saturday pathways. Differences in age are statistically significant at the 0.10 level (p=0.076) and differences in enrolment rank position are significant at the 0.05 level (p=0.003).

From these results it can be concluded that hypothesis $H_0^{Socio-dem}$ is rejected: Students attending Saturday laboratory lessons are older (median is 38 whereas for the weekday laboratory is 28) and enroll with a lower rank position (median is 2 whereas for the weekday pathway is 1).

IV. Discussion

One of the initial objectives of this study was to know if students used different learning pathways. Results (Table I) show that, overall, the traditional pathway including the face-to-face expository lesson and the weekday laboratory lesson was the most used. However, pathways including Saturday laboratory lessons were preferred by almost 40% (14/36) of the students. Because students choose the pathways that better suit their needs, the fact that different pathways were used confirms that flexible learning addresses adult students' needs.

With the availability of digital contents (e.g., videos) for each expository lesson a reduction in traditional face-to-face lessons attendance was expected. Among faculty, face-to-face lessons attendance reduction is a sensitive subject [5], and flexible learning literature presents warnings against the negative impact on students' academic integration of the simultaneous delivery of online contents and face-to-face lessons. The most common argument is that students, especially commencing students, depend on the support given by faculty during face-to-face lessons. In [11] and [12] it is argued that the availability of online contents can be deceiving; especially for students lacking learner control, who trust on their ability to use the online contents to catch up or even replace face-to-face lessons completely, but end up missing the contact with faculty and peers.

Contradicting these findings, data gathered in this study doesn't show a reduction in face-to-face lessons attendance. Face-to-face expository lessons attendance was very high and very few students relied exclusively on the extended expository lesson pathway. These results are similar to those presented by [17] who also concluded that the delivery of online contents doesn't imply a reduction in face-to-face lesson attendance. According to [17], attendance depends on students' commitment to learn, regardless of the simultaneous delivery of online contents. Results presented in [18] show that students aren't deceived by online contents; quite the opposite, students that use digital media become more concerned not to miss anything that is provided, either face-to-face or online.

The fact that the majority of the T&IM students are adults with full time jobs is fundamental to explain the results from this study. For these students [19], academic development is perceived as instrumental for career development and this instrumentality is a powerful source of commitment to learn. In spite of the difficulties related to lower self-confidence (especially with mathematics [20]) and in spite of scheduling conflicts, the perceived instrumentality of higher education studies provides adult students the commitment needed to persist and to seek all the support available, either face-to-face or online. It is therefore reasonable to conclude that adult students use online contents to augment face-to-face lessons and to catch up on missed lessons, not to replace these lessons completely.

Another objective of this paper was to determine if academic students' performance varied with the learning pathway. Results show that students' success rate is high (exceeding 70%) regardless of the learning pathway, and hypothesis H_0^{Perf} is accepted. But rejection of hypothesis $H_0^{Socio-dem}$ confirms that students' antecedents aren't independent of the learning pathway chosen. Students attending Saturday laboratory lessons enroll with a lower rank position and have lower skills in mathematics (a mathematics exam is used to rank applicants to technology graduate courses). Combining the fact that at the start of the trimester students skills are different and at the end of the trimester students' academic performance is similar and adequate, it can be concluded that the adopted teaching and learning process helped students overcome the gaps in their academic development process.

Assessing the link between students' chosen learning pathway and students' academic integration was yet another objective of this paper. Results show that hypothesis H_0^{Integ} is accepted and academic integration does not vary with the learning pathway. It also shows that academic integration is adequate (QVA-r factors above 3.00) for the Saturday pathway, dismissing doubts related to the negative impact of having lessons on Saturdays.

V. Conclusion

Flexible learning pathways were successfully implemented in a technology and industrial management graduate course targeted at adult students. Results show that students choose the learning pathways that better suit their needs, and that success rates are similar and adequate (exceeding 70%) regardless of the

learning pathway. Because different pathways were chosen by students with different characteristics—notably, with different academic backgrounds—; similar and adequate success rates are evidence that gaps in students' academic development process were successfully bridged. Moreover, results also show that doubts related to the negative impact of Saturday laboratory lessons and of extending the contents provided online were unfounded.

In spite of the results supporting the use of flexible learning pathways, this methodology was ineffective for the students that attended less than 50% of the laboratory lessons and for the 20% that failed. For these students dimensions of flexible learning not included in the present study (e.g., time, pace and course content flexibility) could provide the extra support needed. Important insights into the effect of flexible learning pathways could be obtained with more detailed characterization of students, namely, their prevailing motivation patterns and their online learning skills. These topics deserve further research and could improve the efficacy of the adopted teaching and learning process; however, results presented are already evidence that flexible learning pathways increase students' learning opportunities and support the implementation of flexible learning together with flexible entry requirements to promote equity and access conditions to adult students.

REFERENCES

[1] OECD, OECD statistic extracts database, 2015. Website. Available at: http://stats.oecd.org/Index.aspx?DatasetCode=RENRLAGE (accessed on June 2015).

[2] P. Jarvis, "Meaningful and meaningless experience: Towards an analysis of learning from life," Adult Education Quarterly, vol. 37, pp. 164–172, 1987.

[3] C. Kenner, J. Weinerman, "Adult learning theory: Applications to non-traditional college students," Journal of College Reading and Learning, vol. 41, pp. 87–96, 2011.

[4] B. Collis, J. Vingerhoets, J. Moonen, "Flexibility as a key construct in European training: Experiences from the Telescopia Project," British Journal of Educational Technology, vol. 28, pp. 199–217, 1997.

[5] D. Kirkpatrick, "Becoming flexible: Contested territory," Studies in Continuing Education, vol. 19, pp. 160–173, 1997.

[6] J. Bean, B. Metzner, "A conceptual model of nontraditional undergraduate student attrition," Review of educational research, vol. 55, pp. 485–540, 1985.

[7] K. Cross, Adults as learners, Jossey-Bass, San Francisco, 1981.

[8] J. Lynch, C. Bishop-Clark, "The influence of age in college classrooms: Some new evidence," Community College Review, vol. 22, pp. 3–12, 1994.

[9] R. Duarte, A. Ramos-Pires, H. Gonçalves, "Identifying art-risk students in higher education," Total Quality Management & Business Excellence, vol. 25, pp.944–952, 2014.

[10] R. Lourenço, E. Ferreira, R. Duarte, H. Gonçalves, J. Duarte, "IPS' technology and industrial management graduate course: A curriculum follow-up analysis," in: J. Morgado, M. Alves, I. Viana, C. Ferreira, F. Seabra, N. Hattum-Janssen, J. Pacheco (Eds.), European Conference on Curriculum Studies, Future Directions: Uncertainty and Possibility, University of Minho, 2013, pp. 263–269.

[11] T. Bell, A. Cockburn, B. McKenzie, J. Vargo, "Flexible delivery damaging to learning? Lessons from the Canterbury Digital Lectures Project. University of Cantebury," 2001. Paper available at http://ir.canterbury.ac.nz/bitstream/10092/517/1/42637_edmedia.pdf (accessed on June 2015).

[12] E. Dobozy, "'Plan your study around your life, not the other way around': How are semi-engaged students coping with flexible access", in: Proceedings of EDU-COM Conference, 2008.

[13] L. Almeida, P. Soares, "Questionário de Vivências Acadêmicas (QVAr): Avaliação do ajustamento dos estudantes universitários," Avaliação Psicológica, vol. 2, pp. 81–93, 2002.

[14] L. Almeida, A.P. Soares, M. Guisande, J. Paisana, "Rendimento académico no ensino superior: Estudo com alunos do 1º ano," Revista Galego-Portuguesa de Psicoloxia e Educación, vol. 14, pp. 207–220, 2007.

[15] E. Igue, I. Bariani, P. Milanesi, "Vivência acadêmica e expectativas de universitários ingressantes e concluintes," Psico-USF, vol. 13, pp. 155–164, 2008.

[16] J. Arbuckle, IBM SPSS (version 20.0) [Computer Program], SPSS, Chicago, 2011.

[17] S. Jones, J. Richardson, "Designing an IT-augmented student-centred learning environment," in: Proceedings of HERDSA Conference, Perth, Australia, 2002, pp. 376– 383.

[18] K. McShane, M. Peat, A. Masters, "Playing it safe? Students' study preferences in a flexible chemistry module," Australian Journal of Education in Chemistry, vol. 67, pp. 24–30, 2007.

[19] A. Pires, "Aprendizagem ao Longo da Vida, Ensino Superior e novos públicos: uma perspectiva internacional," in: Aprendizagem ao Longo da Vida e Políticas Educativas Europeias: Tensões e ambiguidades nos discursos e nas práticas de Estados, Instituições e Indivíduos. UIED, Colecção Educação e Desenvolvimento, FCT / Universidade Nova de Lisboa, 2010, pp. 107–137.

[20] M. Jameson, B. Fusco, "Math anxiety, math self-concept, and math self-efficacy in adult learners compared to traditional undergraduate students," Adult Education Quarterly, vol. 64, pp. 306–322, 2014.