Effect on Academic Procrastination after Introducing Augmented Reality

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ABSTRACT

Students suffer academic procrastination while dealing with frequent deadlines and working under pressure. This causes to delay their coursework and may affect their academic progress, despite feeling worse. Triggering students' motivation, like introducing technologies, helps to reduce procrastination. In this context, Augmented Reality has been used before to stimulate learning in Engineering Education, and this study reveals that introducing this technology has also a visible effect in reducing academic procrastination. It was observed that this reduction was visible even after two different groups of students had worked in several tasks before introducing AR. However, it is not possible to conclude if the observed reduction is just caused by a novelty effect and cannot be maintained over time, or if it is linked to a more intrinsic attraction that students perceive for modern technologies that helps to reduce academic procrastination more consistently.

Keywords: Augmented reality, academic procrastination, learning stimulation, students' motivation.

INTRODUCTION

Doing any task usually requires complying with deadlines, but people's reactions are different with positive or negative consequences when working under pressure. These consequences may affect self-perception of efficacy and self-being, and it usually causes to postpone tasks. This tendency of usually postponing tasks is known as procrastination. Procrastinators are conscious that postponing their tasks will cause them subjective discomfort (Solomon & Rothblum, 1984), but they continue to delay their tasks despite expecting to feel worse (Steel, 2007).

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State of the literature

- Procrastination affects more frequently students than the rest of the population. Literature research reveals that at least 95% of students procrastinate at some level and 50% of them do it regularly.
- Establishing diverse motivational strategies –linked to emotional, affective, cognitive and behavioural components– reduces academic procrastination.
- One way to trigger students' motivation is novelty. In the context of Engineering Education, Augmented Reality (AR) can be used to stimulate learning.

Contribution of this paper to the literature

- This paper analyses the effect of AR over academic procrastination on engineering students. Data analysis reveals that more than 50% of students procrastinate heavily and confirms previous literature research.
- The weekday's deadline, the nature of the academic tasks (theoretical or practical), students' maturity, professional interests, or learning method do not seem to have an evident effect on heavy procrastinators.
- AR can reduce academic procrastination, even if it is not introduced during first tasks. However, it is not clear if it is just caused by a novelty effect or if it is possible to maintain this effect over time.

In fact, this behaviour is prevalent for general population; chronic procrastination affects 15-20% of adult population (Harriott & Ferrari, 1996), even though procrastinators perceive that it affects negatively to their life, and they would like to reduce it (O'Brien, 2002, as cited in Steel, 2007).

Students may suffer academic procrastination when dealing with frequent deadlines and exams, causing them to delay their coursework despite feeling worse (Steel & Klingsieck, 2016). In fact, procrastination is more common among students than in other sectors of the population. Literature research reveals that at least 95% of students procrastinate at some level and 50% of them do it regularly (Day, Mensink, & O'Sullivan, 2000; Solomon & Rothblum, 1984). Thus, academic procrastination may influence a relevant proportion of students to the point of reducing the probability of finishing their tasks successfully (Scher & Ferrari, 2000), because students' tasks are delivered after deadline, or even are abandoned, what increases their future workload (Fischer 2001). In addition, procrastination in educational environments may not just influence students' academic performance, but also students' health, and their future professional performance (Contreras et al., 2011; Quant & Sánchez, 2012; Scher & Ferrari, 2000; Semb, Glick, & Spencer, 1979; Tice & Baumeister, 1997). However, not all procrastinators behave similarly: passive procrastinators find difficulties when having to take decisions, so it makes them feeling paralyzed and not being able to deliver their tasks on time; active procrastinators prefer to work under pressure and postpone their tasks intentionally (Chu & Choi, 2005). In essence, active procrastinating students use procrastination as a positive strategy and do not suffer the same negative consequences as passive procrastinators.

Establishing diverse motivational strategies –linked to emotional, affective, cognitive and behavioural components– reduces academic procrastination (Angarita Becerra, 2012; González-Brignardello & Sánchez-Elvira-Paniagua, 2013; Howell & Watson, 2007; Kachgal, Hansen, & Nutter, 2001; Lee, 2005; Rakes & Dunn, 2010). One way to trigger students' motivation is novelty (Jones, 2009), because it produces a cascade of brain stimuli affecting cognition, such as improving perception and action, and stimulating exploratory behaviour (Schomaker & Meeter, 2015). Even if novelty is a short-term stimulus (Hanus & Fox, 2015) it can be used as a reinforcement to encourage initial interest.

In the context of Engineering Education, Augmented Reality (AR) can be used to stimulate learning (Martín-Gutiérrez, Fabiani, Benesova, Meneses, & Mora, 2014), and also to improve practical skills, spatial ability, conceptual understanding, and scientific inquiry learning (Cheng & Tsai, 2012). Real world seen through a mobile device is enriched with metadata, including multimedia contents and the possibility of visualizing abstract concepts by interacting with 3D objects, so it represents something new to students.

The idea of introducing novelty to trigger motivation, mixed with the pedagogical opportunities of the AR, drives to our research question: Can the introduction of AR in the learning process reduce academic procrastination on engineering students?

METHOD

Sample

The sample consisted of two groups of engineering students from different degrees during years 2014 and 2015 at the University of La Laguna (Santa Cruz de Tenerife, Spain).

- The first group (41 during 2014 and 37 during 2015 second year students) were enrolled in the Chemical Engineering degree. The subject analysed was Fundamentals of Electrical Engineering (FEE).

- The second group (93 during 2014 and 116 during 2015 third year students) were enrolled in the Electronic Engineering degree. The subject analysed was Continuation of Electrical Engineering (CEI).

Both groups of students have different interests, backgrounds and perceptions: FEE students did not have a previous contact with electrical engineering and, in addition, they do not perceive this subject as relevant for their career. By contrast, CEI students had studied electrical engineering before, and they perceive that this subject is essential for their careers. Teaching methods are also different: FEE is Problem-Based Learning (PBL) oriented, meanwhile CEI is traditionally taught with lectures, although both courses were taught by the same teacher.

Description of students' tasks

The activities performed by both groups of students were aimed at acquiring new knowledge, and maintained the same organization: students were exposed to new knowledge for two or three weeks through lectures –CEI students–, or through autonomous learning by using online videos or written contents –FEE students–; after ending this period, they had to answer an online questionnaire at their own pace. The questionnaire permitted unlimited attempts, but each one was limited to 60 minutes. The grading of each activity was based on the highest score, but students did not have access to the right answers before deadline. The period of days permitted to answer the questionnaire was also limited, and it varied from around one week –FEE students– to 12-15 days –CEI students–. To minimize the impact of the closing weekday effect (Levy & Ramim, 2012), deadlines to answer the questionnaires –time and weekday– were set randomly.

The last activity for each group included AR contents. These AR contents were embedded in a theoretical textbook that required the use of students' mobile devices to visualize videos and 3D objects (Martín-Gutiérrez et al., 2014). After becoming familiar with the concepts, students had to answer an online questionnaire with the same structure and organization like in previous activities.

Data acquisition and visualizing

Each questionnaire was configured and shared with students by using an e-learning platform (Moodle). The progress of each student was measured by registering the time when each questionnaire was started, the time when each attempt was sent, and the corresponding score. Remaining time to deadline after sending each attempt was also calculated, and its accumulated frequency was plotted to visualize the data. In addition, the median was calculated and plotted to compare students' behaviour. To avoid a masking effect of lazy students over procrastinators, the data of students who did not complete their questionnaires, or those having no score, was removed.

RESULTS AND DISCUSSION

Results obtained correspond to 14 tasks delivered during 2014 and 2015. Most of these tasks (12) are theoretical questionnaires (T), but two of them are numerical problems (P). It also seems that the score obtained for each attempt is not linked with the level of students' academic procrastination: after comparing time to deadline for each attempt (TD) against its corresponding score (S) there is no evidence of significant correlation in any task (**Table 1**).

Table 1: Description of the tasks performed by students.

Tasks are in chronological order. Tasks P01 and P02 are numerical problems. The rest of tasks are linked to theoretical contents. AR refers to tasks linked to theoretical contents using augmented reality.

Subject	Task	Year	Correlation TD vs S	Samples	Closing Day
FEE	T01	2014	0.3192	31	Oct 8th - Wednesday
FEE	T01	2015	-0.1206	38	Oct 7th - Wednesday
FEE	T02	2015	0.1252	37	Oct 22th - Thursday
FEE	T03	2015	0.2262	46	Nov 2nd - Monday
FEE	T04	2015	0.1841	48	Nov 25th - Wednesday
FEE	P01	2015	0.1770	47	Oct 30th -Friday
FEE	P02	2015	0.1482	36	Nov 8th - Sunday
FEE	T05(AR)	2015	0.2882	50	Dec 15th - Tuesday
CEI	T01	2014	0.1081	133	Nov 6th - Thursday
CEI	T02	2014	0.0820	164	Nov 23th - Sunday
CEI	T01	2015	-0.2823	123	Nov 7th - Saturday
CEI	T02	2015	-0.2645	118	Nov 23th - Monday
CEI	T03	2015	-0.1612	144	Dec 7th - Monday
CEI	T04(AR)	2015	-0.0691	181	Dec 20th - Sunday

Plotting Time to Deadline (TD) vs Score (S) for all tasks performed in each subject shows that the score obtained for each attempt is not linked with the level of students' academic procrastination (**Figure 1**). It also seems that most of the students' effort is concentrated during the last few days to deadline regardless the duration of the activity. Individual tasks show the same behaviour regardless of the students' group (**Figure 2**).
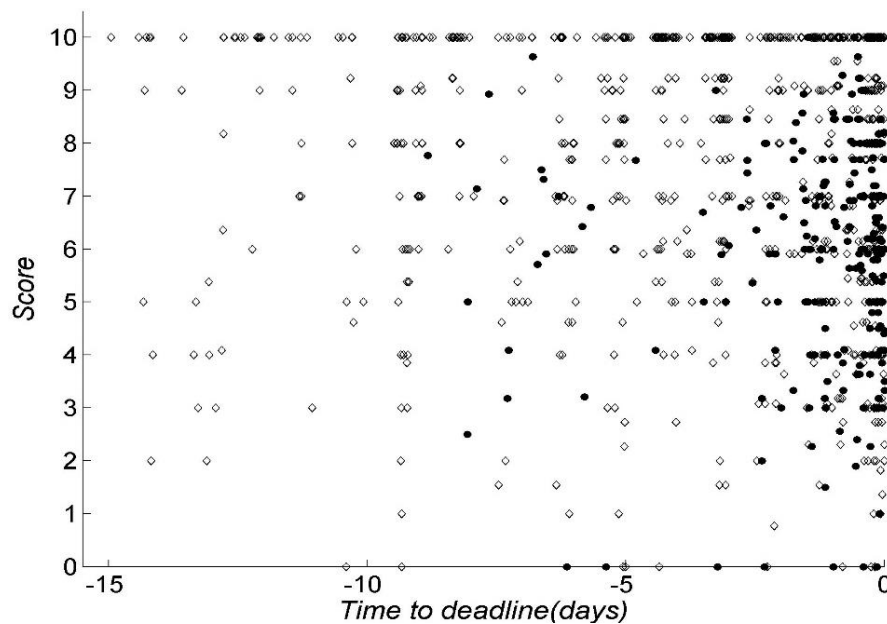

Figure 1. Time to Deadline vs Score for FEE (dots) and CEI (diamonds). Raw data

Analysis of tasks not including AR

The behaviour of students enrolled in both subjects (FEE and CEI) during 2014 and 2015 for tasks not including AR shows a high level of procrastination (**Fig. 2**): regardless the students' group, their work is concentrated during last two days.
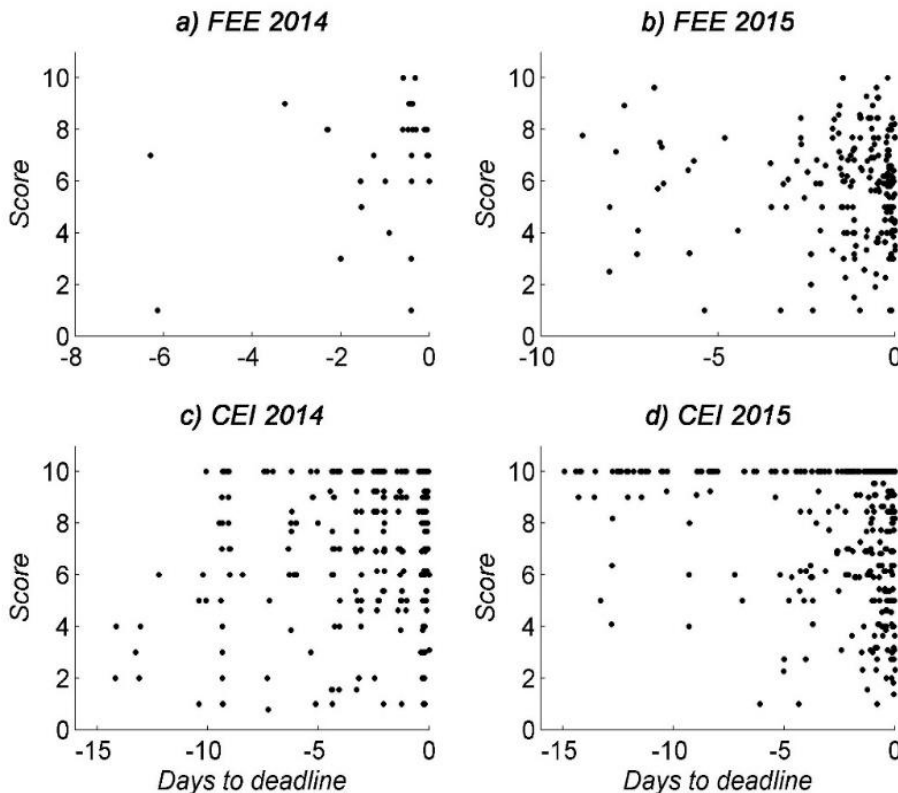

Figure 2. Time until Deadline vs. Score for tasks without AR contents

Plots of individual tasks show the same behavior (**Fig.3**), and have the typical hockey-stick shape (Weilbaker, Popkov, Colletti, & Tillman, 2009) and denote two distinct groups of students: non procrastinators, and those who delay their work until the closest days to deadline.

The median was computed and plotted in boxplots for groups FEE and CEI without including AR tasks (**Figure 4**). The median approximately matches the inflection point in every cumulative frequency diagram for each task (compare **Figure 3** and **Figure 4**), and reveals that 50% of students' attempts are delivered during last 2 days before deadline, regardless the weekday effect. Only first activities on each group (T01 on FEE and CEI) and first problem (P01) show a lower procrastination rate, probably caused by a novelty effect.
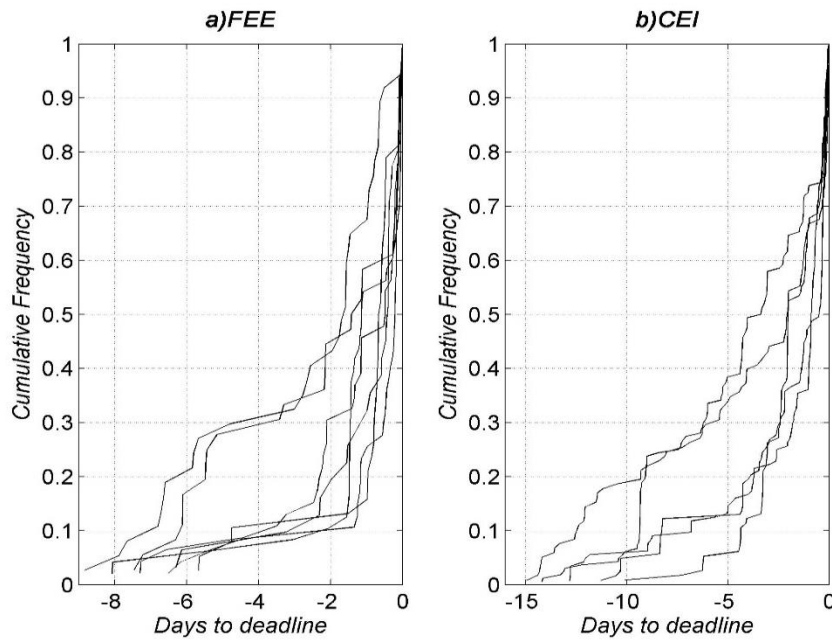
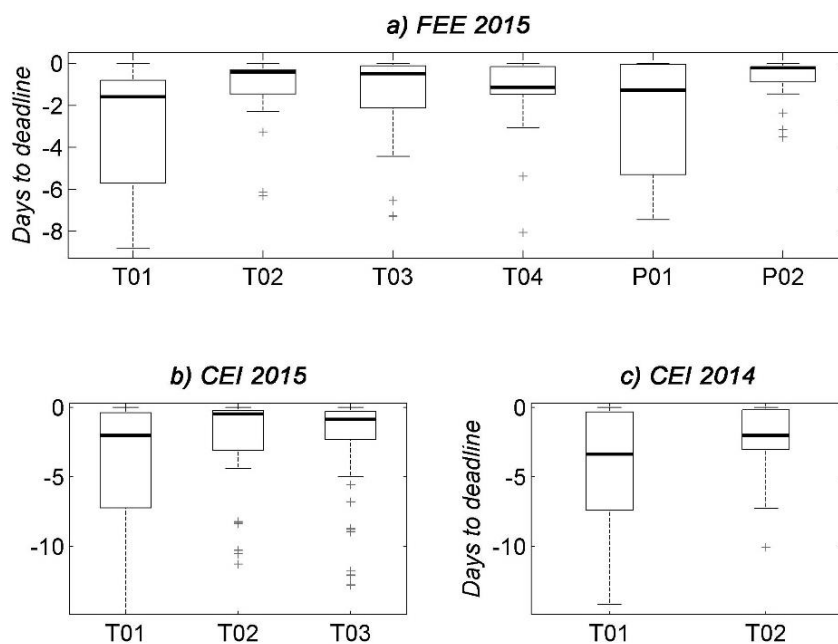**Figure 3.** Cumulative frequency diagram of all activities not including AR during 2014 and 2015.

Figure 4. Boxplots comparing all tasks excluding AR.

Comparative analysis when including AR tasks

Given that AR tasks are theoretical activities, this analysis excluded problems (see **Table 1**) to remove cross effects of students' behaviour linked to the nature of the task. Otherwise, comparison with non-AR activities would not be valid. Even though plots of each

theoretical task do not demonstrate any influence of AR in the score for each attempt, the work of students seems to be more homogeneous (**Figure 5g**).
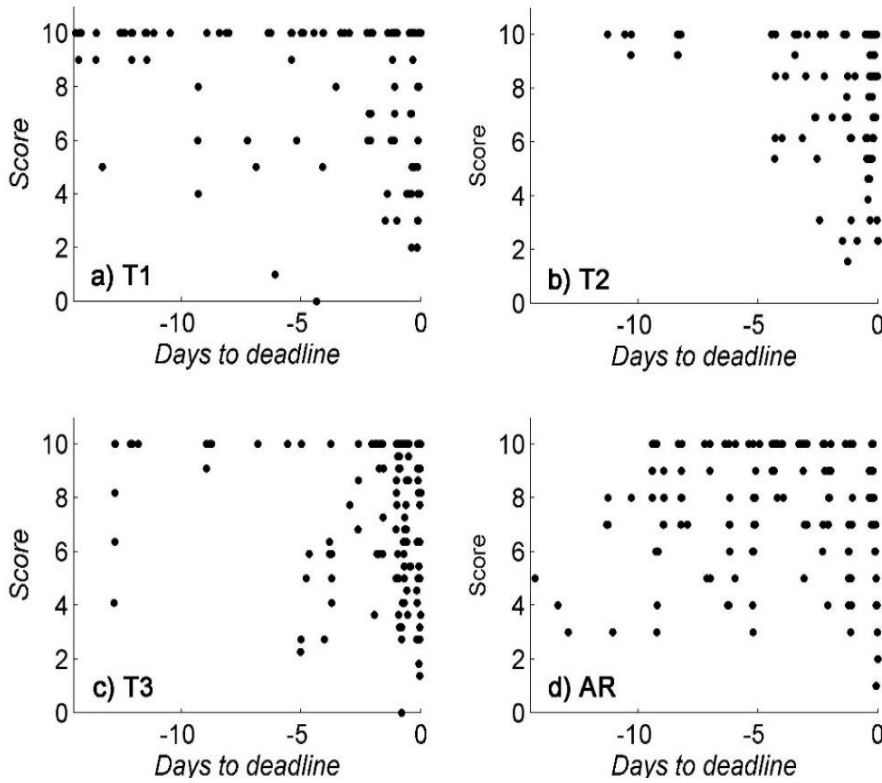

Figure 5. Time until Deadline vs. Score for theoretical tasks for CEI during 2015.

Plots of the cumulative frequency and the median eases the visualizing of any variations between attempts. Figures 6 and 7 emphasize the difference of students' behaviour when comparing AR tasks against other theoretical tasks (**Figure 6**). When doing this comparison for CEI during 2015 the median has clearly displaced to 4.4 days before deadline for the AR task, meanwhile median of the remaining theoretical tasks is located between 2.21 and 0.49 days before deadline (**Table 2**). In addition, in the case of AR tasks, the median does not mark an inflection point, and the cumulated frequency diagram shows a constant slope, which is closer to a normal distribution (**Figure 6**)

Table 2: Time median values for theoretical tasks in FEE and CEI during 2015.

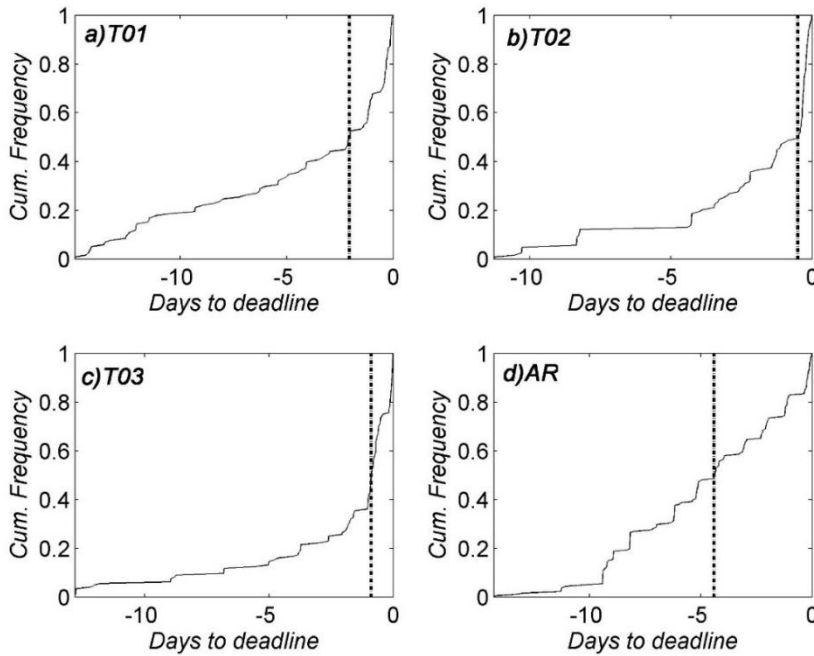| FEE tasks	Median Days until deadline	CEI tasks	Median Days until deadline
T01	0.64	T01	0.49
T02	1.59	T02	2.21
T03	0.49	T03	0.88
T04	1.14	T04(AR)	4.40
T05(AR)	4.99		

Figure 6. Cumulative frequency diagram and medians for CEI theoretical tasks during 2015.

Even though the number of students enrolled in FEE is smaller than in CEI, its cumulative frequency diagrams show a similar result. Once again, the median of the AR tasks has been clearly displaced to the left when compared against the remaining theoretical tasks for FEE (**Fig. 7**). In this case, the median of the AR task is 4.99 days meanwhile the median of the other tasks is between 1.59 and 0.49 days (**Table 2**).
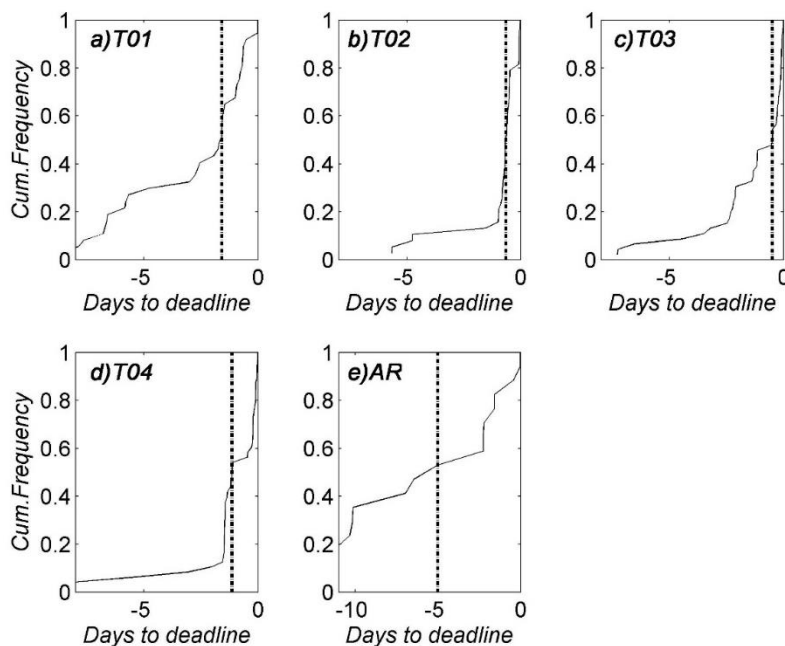

Figure 7. Cumulative frequency diagram and medians for FEE theoretical tasks during 2015.

CONCLUSION

The main goal of this paper was analysing the effect of AR over academic procrastination on engineering students. Data analysis reveals that more than 50% of students procrastinate heavily and regularly, which is aligned with literature on academic procrastination (Day, Mensink, & O'Sullivan, 2000; Solomon & Rothblum, 1984). Although there was not a visible effect over students' performance, these procrastinating students do not complete their tasks until deadline is almost upon them. Besides, even if task's deadlines were set randomly, a visible weekday effect on procrastination was not found. In addition, the nature of the tasks (theoretical or problems), students' maturity (2nd or 3rd year students), professional interests (electronics engineering or chemical engineering students), or learning method (problem based or lecture based), did not have a relevant effect over procrastination, excepting a possible novelty effect for first tasks. That means that academic procrastination has roughly the same impact on different groups of students.

When AR was introduced, it was observed that students' behaviour was closer to be statistically normal, and academic procrastination was visible reduced even after the students worked on several tasks before, and despite which students' group was analysed. However, it is not possible to conclude if this reduction of academic procrastination is just a novelty effect of AR, or it has more to do with the attractiveness to students of using modern technologies like mobile devices. The causes of the observed reduction of students' academic procrastination after introducing AR, and if it is possible to maintain this effect over time, have to be further investigated.

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