

USER PREFERENCES AND BEHAVIOUR CHANGE OWING TO WASHBASIN TAPS RETROFIT: A CASE STUDY OF THE DECIVIL BUILDING OF THE UNIVERSITY OF AVEIRO



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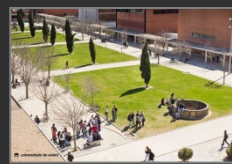
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- Sustainable resources management is essential in universities.
- The University of Aveiro already follows several sustainable solutions:
 - irrigation through stored rainwater;
 - concern on the planted species in some garden areas;
 - energy production through alternative sources (solar, geothermal);
 - local water treatment;
 - existence of a green roof;
 - building with rainwater harvesting system was recently constructed.
- However, a focus on toilet water efficiency is lacking, although *EPA (2012)* and *Meireles et al. (2014)* indicate that, in the United States and in Portugal, respectively, the main consumption of water in education facilities takes place in toilets.

Aim of the study



➤ Studied building



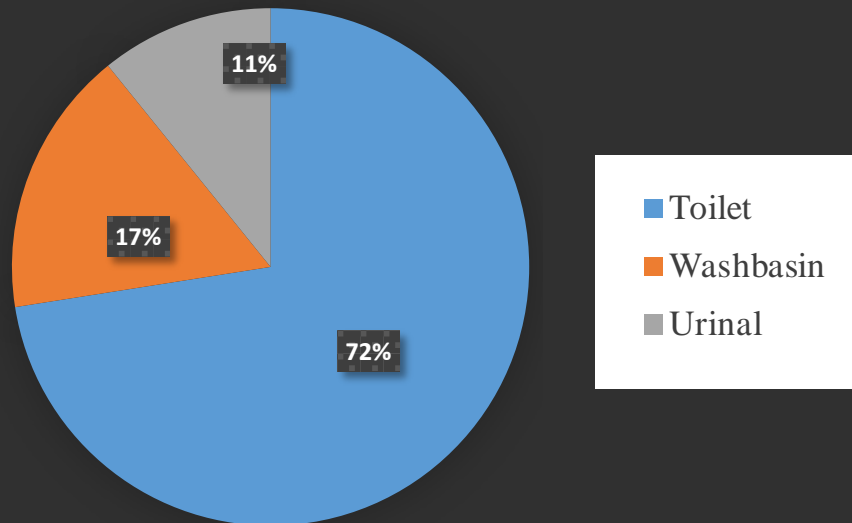
Civil Engineering Department



Aim of the study



➤ Consumption pattern in the Civil Engineering Department



Meireles et al. (2014)

Aim of the study



➤ Water efficient solutions:

- The water efficiency labelling scheme developed by ANQIP (the *Portuguese Association for Quality and Efficiency in Building Services*) was considered.
- Toilet retrofit solutions are prone to affect users behaviour.
- The objective is to study users preferences and behaviour change due to washbasin taps retrofit.





➤ Tested aerators:



Aerated flow



A ($Q = 4.7$ l/min)



C ($Q = 3.4$ l/min)



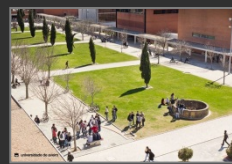
B ($Q = 3.9$ l/min)



D ($Q = 2.0$ l/min)



Spray flow



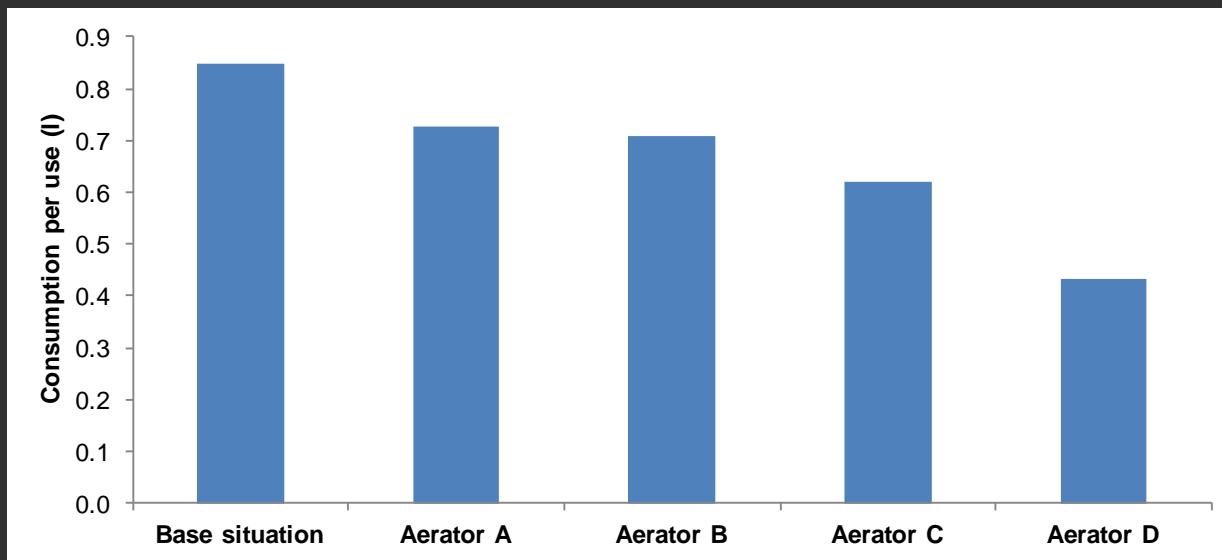
➤ Methodology:

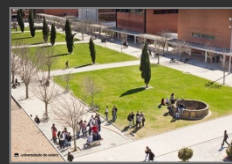
- direct questionnaires (with enquiries about water consumption behaviour and preferences)
 - during the work hours;
 - average building occupancy of 150 people;
 - in the toilets with the highest number of uses;
 - the aerators were installed with decreasing discharge;
 - the reply rate of the toilets directly monitored was of 100%, corresponding to about 50 uses per day.
- online questionnaires (focused only on preferences issues)
 - the DECivil community comprises of about 300 people;
 - the aerators were installed with increasing discharge;
 - The reply rate of the online questionnaires varied between 29% and 35% of the total DECivil building universe, representing roughly 90 responses per questionnaire.



➤ Consumption reduction:

- Samples characteristics:
 - the potential population of users in each monitoring campaign is the same;
 - was impossible to ensure the samples to be statistically equivalent at the onset;
 - there were no statistically significant differences in terms of age and gender (using the Chi-Squared test).
- Average water consumption per use:





➤ Consumption reduction:

- Discussion:
 - There is a statistically significant difference on consumption between aerators and base situation as determined by one-way ANOVA.
 - The Games-Howell post-hoc test revealed that the consumption was statistically significant lower with aerators C and D compared to the base situation.
 - Aerator D was also found to produce a statistically significant lower consumption than aerators A, B and C.
 - There were no statistically significant differences between the aerators A and B, A and C and B and C.



➤ Consumption reduction:

- Relation between discharge and consumption reduction:

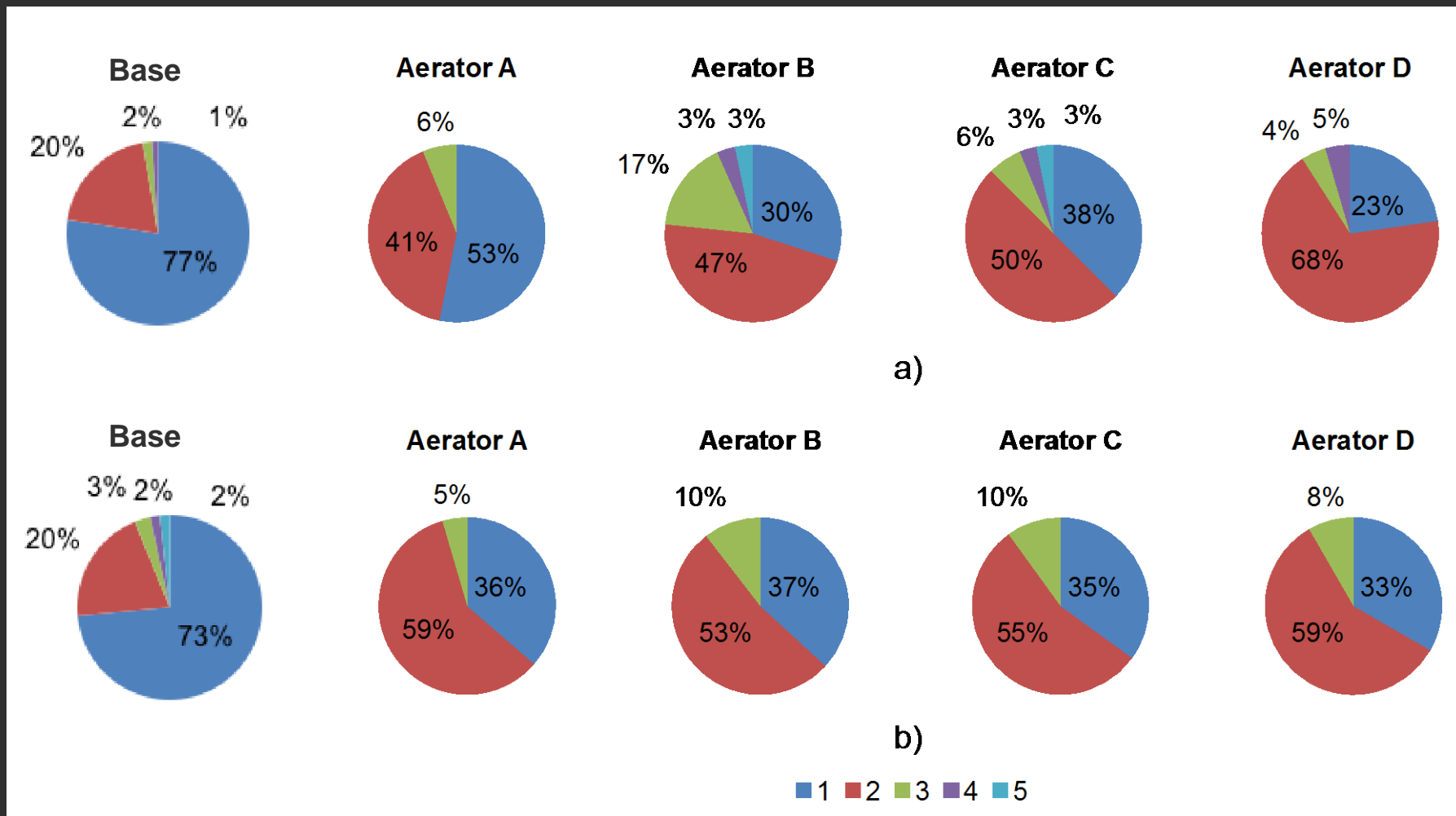
Aerator	Discharge reduction	Consumption reduction	Rel. diff. discharge and consumption reduction
A	30%	15%	51%
B	42%	17%	60%
C	49%	27%	44%
D	70%	49%	30%

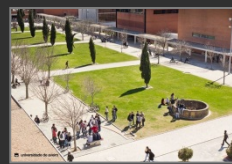
- Discussion
 - These differences resulted from behaviour change from the users, namely the number of tap pushes in each use.
 - However, the change was not uniform with the gender.

Results and discussion



➤ Number of tap pushes per use for a) male and b) female users:

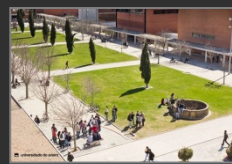




➤ Number of tap pushes per use:

- Discussion

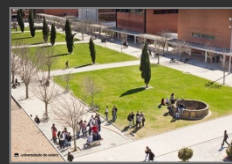
- There is a statistically significant difference on the number of tap pushes between aerators and base situation as determined by one-way ANOVA for both male users and female users.
- For female users, the Tukey HSD post-hoc test revealed that the number of tap pushes was statistically significant different only with aerators B, C and D compared to the base situation.
- For male users, the Games-Howell post-hoc test revealed that the number of tap pushes was statistically significant different only with aerators B, C and D compared to the base situation.



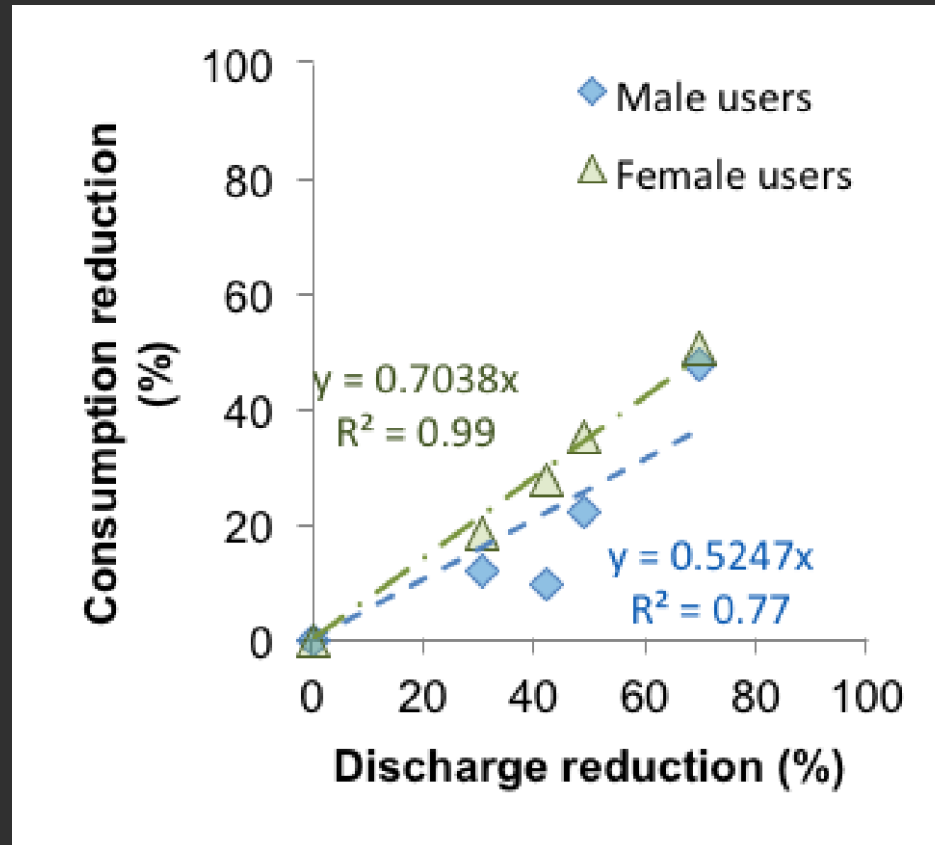
➤ Number of tap pushes per use:

● Discussion

- For the base situation and for each aerator separately there was no statistically significant difference on number of tap pushes by female and male users both using ANOVA and Mann-Whitney U tests. However, comparing the relative differences between the proportions of uses by number of tap pushes per gender for all scenarios it can be concluded that there were cases with statistically significant differences. The t-test was statistically significant from the base situation to aerator B and C and from aerator A to aerator C.
- All other cases were not statistically significant, but the maximum p-value was only 0.14. Adopting a less stringent significance level (e.g., 0.1 or 0.15, instead of 0.05) would yield that most or all cases could be regarded as statistically distinct.



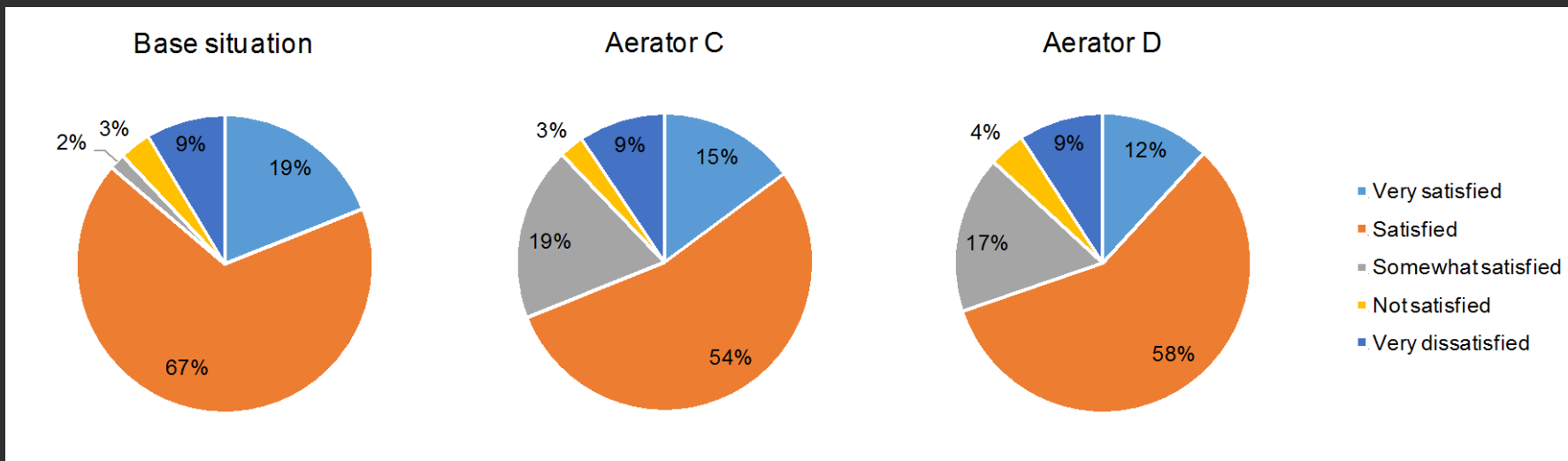
➤ Discharge reduction *versus* consumption reduction by gender:

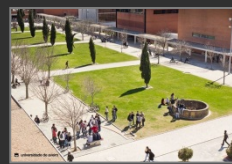




➤ Users preferences:

- Samples characteristics:
 - the potential population of users in each monitoring campaign is the same;
 - was impossible to ensure the samples to be statistically equivalent at the onset;
 - there were no statistically significant differences in terms of age, gender and professional position (using the Chi-Squared test).
- Users preferences:



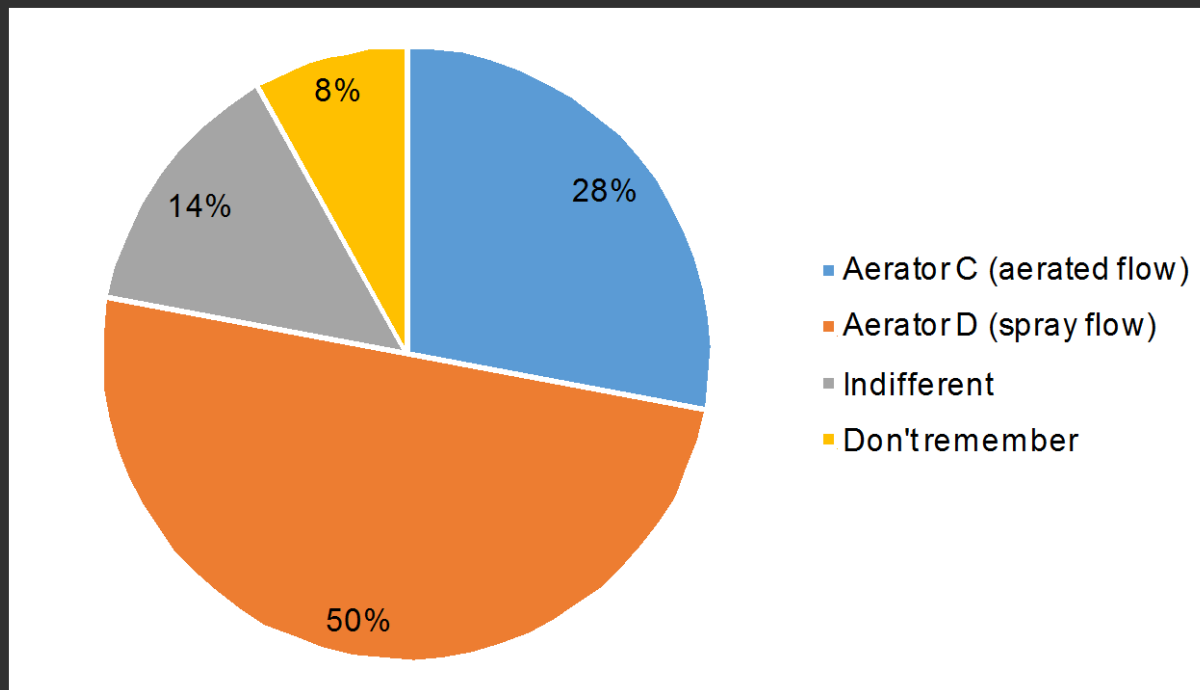


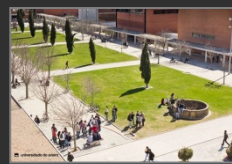
➤ Users preferences:

- Discussion:
 - Not more than 15% of the online questionnaires respondents considered to be *very satisfied* about the use of aerators C and D, as opposed to the 46 and 45% of the users in the direct questionnaire.
 - Even though, in the online questionnaires only about 12% of the users classified negatively aerators C and D.



➤ Users choice based on their preferences :





➤ Users choice based on their preferences :

● Discussion:

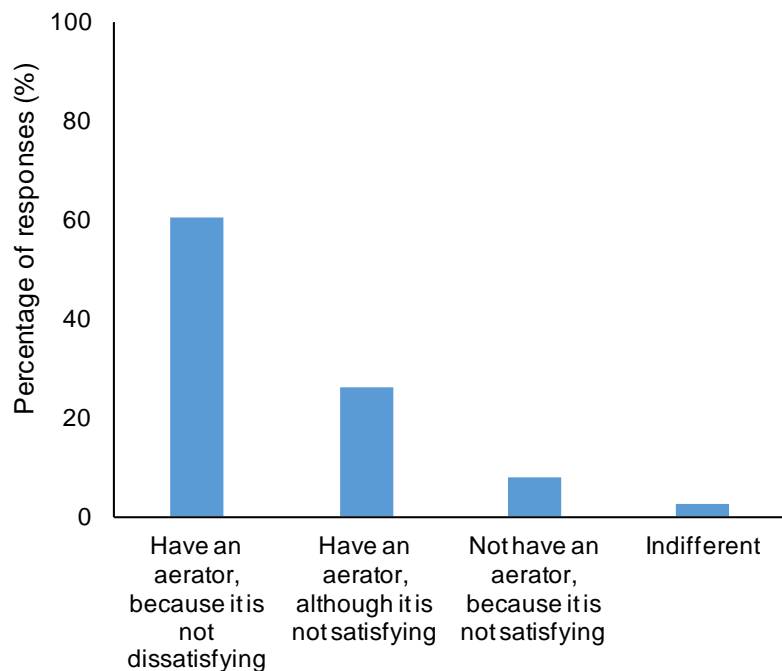
- These numbers are notable, not only because aerator D provides a smaller discharge than aerator C, showing that the type of flow is very important for the user preference, but also because the discharge of aerator D is under the limit of 3-4 l/min recommended by ANQIP for washbasin taps, in general, to be attained a minimum level of satisfaction.

Results and discussion

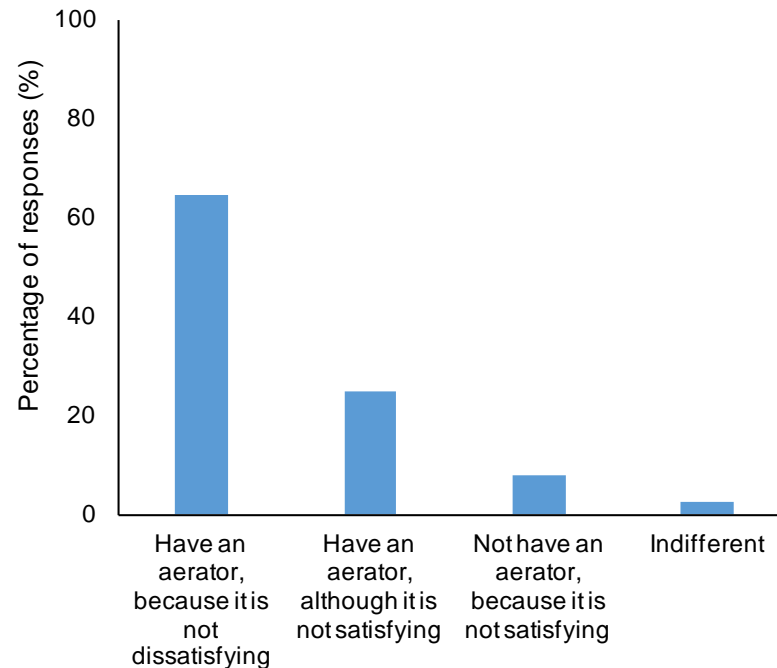


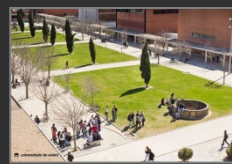
➤ Attitude to saving water:

Aerator C



Aerator D





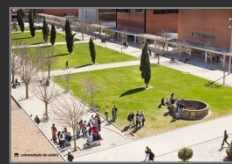
➤ Attitude to saving water:

- Discussion:
 - This finding is in agreement with the study by Adeyeye and Piroozfar (2012) where was found a positive perception in most of the studied people towards saving water and a relatively high awareness.

Conclusions



- The present study shows that there are user behaviour changes and preferences due to washbasin taps retrofit that affect water consumption in practice.
- As a consequence, the water consumption reduction potential due to the water discharge reduction of the tested aerators was never fully used because the use pattern changed to compensate for the lower discharge.
- It was also found that the behaviour change and preferences are different with gender and time.
- Lastly, an existing positive attitude on the action to save water was observed among users in general.



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