

KNOWLEDGE ABOUT ARITHMETIC MEAN – A STUDY WITH FUTURE TEACHERS



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This poster reports on a study aiming to analyse future teachers' statistical knowledge at the beginning of their training. The arithmetic mean is the focus of this presentation.



The study (Martins, Pires & Barros, 2009)

- **goals:** (i) to identify students' statistical knowledge at the beginning of their degree, and (ii) to assess the influence of the intervention of the curricular unit *Numbers and Statistics* in the progression of this knowledge
- **participants:** 40 future teachers in the 1st year of the License Degree in Basic Education
- **nature:** a qualitative and interpretative approach ^{6,7}
- **data collection:** an initial questionnaire (IQ) applied at the study's beginning, participant observation during the classes, a final questionnaire (FQ) at the end
- **data analysis:** interpretation of the students' answers, supported by a *floating* approach and followed by a systematization, setting up classifications and categories ⁶

Mean

- importance of developing the statistical and probabilistic thinking in school education and mathematics education ^{1,2}
- evidence for conceptual errors and difficulties on practical application of the knowledge about central tendency measures ^{3,4,5,9}

Knowledge of the students about the concept of mean

Task 1 (arithmetic mean)

Say what do you mean by "arithmetic mean".

Task 2 (qualitative variable)

The graph represents the favourite hobbies mentioned by students.

Indicate (and justify) the arithmetic mean of the favourite hobbies.



Task 3 (discrete quantitative variable)

Maria asked ten friends how much money received weekly. She gathered the following data (in euros): 10, 15, 9, 7, 8, 5, 10, 6, 10, 30. Calculate the arithmetic mean of the weekly allowances.

Task 4 (continuous quantitative variable)

The table refers to the time spent by 55 students on the way home-from school. Calculate the arithmetic mean of time spent.

Time (minutes)	[0, 5[[5, 10[[10, 15[[15, 20[[20, 25[[25, 30[
N. of students	3	18	14	8	7	5

Initial questionnaire

- 1 considered mean as an equilibrium value
- 12 students considered mean-algorithm association
- 18 did not answer and 9 gave inconsistent answers

Final questionnaire

- 12 considered mean as an equilibrium value
- 20 students considered mean-algorithm association
- 1 did not answer and 7 gave inconsistent answers

a significant improvement in the performances from IQ to FQ... but the mean-algorithm association has remained as the predominant reasoning

Initial questionnaire

- no correct answers
- 17 of the students just did not answer
- some of the mistakes noted
 - calculating the mean of absolute frequencies
 - numerical manipulation of the values shown in the graph (e.g., the mean values given in x-axis)
 - indicating a variable's category (e.g., "the mean is Televisão")

Final questionnaire

- all the students answered, 28 submitting correct answers (e.g., "can not be calculated because it is a qualitative variable")
- the remaining 12 calculated the mean of absolute frequencies or indicated one of the hobbies

Initial questionnaire

- 24 correct answers: applying the mean algorithm
- some of the mistakes noted
 - confusing the mean with the mode
 - not considering the repeated values

Final questionnaire

- 38 correct answers: applying the mean algorithm
- the remaining 2 applied the mean algorithm, but not considering the repeated values

Initial questionnaire

- 3 correct answers: applying the mean algorithm
- 20 of the students just did not answer
- a great diversity of the 17 incorrect answers (see Table)

Final questionnaire

- 21 correct answers: indicating the relevant calculations (mean algorithm based on the representative of the class)
- 20 of the students just did not answer
- a great diversity of the 17 incorrect answers (see Table)

Conclusions

- there was an evolution in the understanding of the concept of arithmetic mean though some difficulties still remain in cases involving qualitative or continuous quantitative variables
- in the written ideas about mean, some students revealed an instrumental interpretation of the concept, centered on applying formulas and calculation procedures
- in general, the curricular unity allowed students to deepen, change or consolidate their statistical knowledge

Type of incorrect answers	Number of students	
	IQ	FQ
Averaging the absolute frequencies: $(3+18+14+8+7+5)/6=9,2^*$	4	4
Reference to the upper limit of the ranges that are in the central position of the table: "the mean is 15"	3	-
Indicating one of the ranges that are in the central position of the table: [10, 15[or [15, 20[-	5
Considering the ranges as if they are decimal numbers and calculating their mean: $(0,5+5,10+10,15+15,20+20,25+25,30)/6=12,75^*$	2	-
Averaging the upper or lower limits of the ranges: $(5+10+15+20+25+30)/6=17,5^*$ or $(0+5+10+15+20+25+30)/7=15^*$	2	2
Calculating the ratio of the upper limit of the last range and ...	1	-
Confusing mean and modal class: "the mean of time spent is 5 to 10 min"	-	2
Calculating the representative of the class followed by meaningless numerical manipulation	1	-
Indicating an incorrect denominator (number of classes) in the application of the mean algorithm	-	3
Other answers (e.g., building frequency table vertically)	-	1
	4	-

References:
¹Alfonso, P., Serrazina, L., & Oliveira, I. (1999). *A matemática na educação básica*. Lisboa: Departamento de Educação Básica, Ministério da Educação.
²Albuquerque, C., Veloso, E., Rocha, I., Santos, L., Serrazina, L., & Nogueira, S. (2006). *A matemática na formação inicial de professores*. Lisboa: Associação de Professores de Matemática & SEM, Sociedade Portuguesa de Ciências da Educação.
³Barros, P. (2008). *Os futuros professores do 2º ciclo e a estatística - Dificuldades sentidas e o ensino do tema*. Coleção TESES. Lisboa: Associação de Professores de Matemática.
⁴Bealero, C. (2000). *Dificuldades de los estudiantes en los conceptos estadísticos elementares. El caso de las medidas de posición central*. In C. Lourenço et al. (Orgs.), *Enseño e aprendizagem de estatística* (pp. 31-48). Lisboa: SPS, AFM, FCLM.
⁵Boaventura, M. G., & Fernandes, J. (2004). *Dificuldades de alunos do 12º ano nas medidas de tendência central: O contributo dos manuais escolares*. In Atas do Encontro de Probabilidades e Estatística na Escola (pp. 103-106). Braga: Universidade do Minho.
⁶Bogdan, R., & Biklen, S. (1994). *Investigação qualitativa em educação*. Porto: Porto Editora.
⁷Bolivar, A., Domingo, J., & Fernandez, M. (2001). *La investigación biográfica-narrativa en educación: Enfoque y metodología*. Madrid: Editorial La Muralla.
⁸Martins, C., Pires, M. V., & Barros, P. (2009). *Conhecimento estatístico: Um estudo com futuros professores*. In C. Costa et al. (Orgs.), *Números e estatística - Atas do XIX EIEEM, Vila Real: SEM, Sociedade Portuguesa de Ciências da Educação*.
⁹Mayer, S., Coble, S., Bateman, C., & Bateman, P. (2007). *Comprehension de las medidas de posición central en estudiantes mexicanos de bachillerato*. *Lábex*, 8, 187-201.