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► **To cite this version:**

Clément Maisch. Conception about "measurement" and "attribute" of pre-service primary school teachers in France.. ESERA, Aug 2019, Bologna, Italy. hal-03079125

HAL Id: hal-03079125

<https://hal.science/hal-03079125v1>

Submitted on 8 Jul 2021

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CONCEPTIONS ABOUT “MESAUREMENT” AND “ATTRIBUTE” OF PRE-SERVICE PRIMARY SCHOOL TEACHERS IN FRANCE

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The teaching of the concepts of “attribute” and “measurement” at primary school in France is an interdisciplinary issue shared by mathematics and physics teaching. On the one hand, those concepts are necessary to build the concept of number in mathematics, and on the other hand to understand the nature of science and the science-based approach. We wonder what would be the conceptions that pre-service teachers could have about both concepts at the end of their training. First, we passed a word-association test. Trainees had to take a definite position about a list of words that referred to attributes or measurements. We compared our results with the ones obtained in a previous study (Passelaigue and Munier, 2015). Thus we looked if a change of curriculum could have an effect on the way they define those words. Our results were consistent with the previous ones. We obtained that trainees linked the concept of attributes with something vague, ill-defined, whereas measurement concept is related to something precise. Second, we used another test in which the trainees had to reason about the number of data to collect and the way to make a decision about measurement values. Our results showed two dimensions. When trainees reasoned about measurement data, they mostly thought that collecting several values was necessary to define a measurement value. Also, they noticed that error sources are necessary to be taken into account to enhance the measurement process and obtain better measurement values.

Keywords: Initial Teacher Education (Pre-service), Measurement, Primary School.

ATTRIBUTE¹ AND MEASUREMENT IN LITERATURE

Literature in mathematics and physics education raises often the question of the status of attributes and measurement in primary teaching. Since 2011, French curriculum of mathematics spotlights both issues. It focuses particularly on the building of the number. New curriculum of 2015 for primary school confirmed this trend (MEN, 2015). Brousseau (2002) explains that teaching quantities at primary level is valuable in many ways. But Chesnais and Munier (2015) set out that the practical issues of measurement and the uncertainties are often set aside during the teaching of mathematics. These two notions are mostly linked with the experimental sciences teaching. They appear in the curriculum at the end of primary school for pupils of ten years old. But a differential treatment of the reality between physics and mathematics still exists at primary school. For this reason, we wonder how pre-service teachers of primary school understand and use each concept of attribute and measurement.

French pre-service teachers of primary school serve one year of training after passing a competitive examination. This training is focused on the teaching aspect of their future job. Most of them have a non-scientific education before their pre-service. Thus, they are not familiar with several concepts of mathematics and experimental science. In a preliminary study, we would like to know which conceptions about measurement and attribute they have before they serve a full service.

¹ The concept of “grandeur” in French could be translated in English as quantity, magnitude or attribute. The choice to use in this text the term “attribute” is consistent with many English language standards and with research on mathematics education as described by Munier & Passelaigue (2015).

METHODOLOGY

Theoretical framework

In one hand, Passelaigue & Munier (2015) conducted a preliminary paper-and-pencil study on the pre-service teachers' knowledge on the measurement and attribute concepts. They administered it to 91 trainees in 2008. Trainees had to take a definite position about a list of words that referred to attributes or measurements. They also had to provide a definition for each term in order to explain their choice. Authors obtained that teacher trainees have a minimal understanding of the scientific terms "attribute" and "measurement". They seemed to better understand the concept of measurement than the one of attribute. They often described the concept of attribute as "something vague, ill defined, not very precise". Trainees also explained that "an attribute is only an approximate quality" until it is measured.

In another hand, Maisch et al. (2008) looked how 65 first year university physics students reason about measurement. Authors defined a three categories setting tool. This tool categorise the way students reason when they have to achieve tests dealing with measuring process and data treatment or when they have to realise by themselves a measurement procedure. Three lines of reasoning (Point, Mixed or Set reasoning) are described depending on the number of data, the way to collect it, and the nature of the value measured. Authors obtained that student reasoning are not consistent when they have to answer a test or when they have to solve a problem by using a measurement procedure.

As curricula changed since the Passelaigue & Munier study, we wonder if their results would be consistent with the new ones obtained with similar trainees. Moreover, we would like to know which line of reasoning those trainees would use when they have to make a choice about the number of data to collect to take a measurement. First we think that our results would be similar to the Passelaigue & Munier' ones, as the majority of our trainees are not confident with the targeted concepts. Second, we think our trainees would mostly use a mixed reasoning based on their everyday life experience.

Questionnaire and analysis framework

In June 2018, we passed a test similar to the Passelaigue & Munier's one to 60 pre-service teachers at the end of their training year. They had first to define the terms of "Attribute" and of "Measurement". Then they had to take a definite position about a list of words that referred to attributes or measurements. They could decide to not connect a word with one of both concepts (using "*"). They also had to justify their choice. Words were the ones of the Passelaigue & Munier's study: volume, length, comparison, equivalence, instrument, gram, decimetre, unit, measurement standard, uncertainty, precision, number. We decided to add the word "estimate", included in the 2015 curriculum. We added a part of the test used by Maisch et al. (2008) to study trainees reasoning about measurement processing. Three fictional characters debated around the way to consider the distance covered by a ball dropped from a table. Three situations were described: the ball is dropped once, two times, and 5 times. The height of the ball dropped is the same but distances of impacts on the ground change. In the two first situations, each character suggested either to keep this value, to collect a new value, or to collect several new values. In the last situation, trainees had to decide which the final result for the distance is. In each situation, trainees had to justify their choices.

RESULTS AND DISCUSSION

Considering trainees' answers dealing with the list of words, we obtained consistent results with the Passelaigue & Munier's ones. Averages of correct answers are similar (56,6% in our study vs 60,3% in the Passelaigue & Munier's study). As for the Passelaigue & Munier's study, many trainees explained that

“Attributes are something vague”, and “Measurement is something precise”. Those explanations were used also to justify the assortment of the different words in the list to both concepts. Thus some trainees explained “uncertainty” and “estimation” are linked to “Attribute” (51,7% for “estimation”, 48,2% for “uncertainty”). They justified it by linking those words to as something vague or inaccurate. Instead, “units”, “decimetre”, “gram” were linked to “Measurement” as they are dealing to something precise.

In the other end, when trainees had to take a decision on the number of data to collect, they mostly used a Mixed reasoning (62,8%). They often suggested to treat data with an average calculus (23,2%). Several justifications involved the idea of effects of variables (such as wind, initial speed, frictions forces...) on the data collected (18,5%). Those explanations could either be understood as the identification of errors sources or a way to explain that the true value cannot be obtained because of those factors. This variance stresses the significance of knowing how trainees consider the measurement process and their position for nature of science (Buffler et al., 2009). Finally, 23,1% of our trainees declared a strategy dealing with the research of a gap in which the true value could be situated (Set reasoning) but only one trainee spoke about uncertainties.

CONCLUSION

First, French pre-service teachers show a lack of understanding of the concepts of attributes or measurement. This result is consistent with results obtained in the Passelaigue and Munier’s study. The change of the curricula did not affect the way trainees understood the concepts of attribute and measurement. Indeed trainees connect attributes to something vague and measurement to something precise. This interpretation is deviated from the nature of the concepts they would have to teach. Second, when they have to reason about collecting data with a measurement, they mostly have ideas of statistical processes (average calculus) and seem to research error sources to explain and deal with variation of a result. This preliminary study showed us the relevance to better know how pre-service teachers handle a measuring act and how they are able to link it to the concepts they would have to teach. The next part of this ongoing study would be to analyse how student manage to process a measurement task related to the one they could use in their future teaching. Then we would also look to how they use knowledge already present in the mathematics and physics curriculum they would have to teach.

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