

## Biased by analytical equipment

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Today, in scientific events often a certain separation between researchers from laboratories with highly sophisticated equipment and those from less privileged laboratories can be observed. It is not an uncommon situation that results presented at conferences are rubbish or ridiculed because the investigator only used low-end analytical methods. The assessment of the study is then biased based on the equipment, regardless of the actual quality of the study.

There are also many similar biases regionally, e.g. regarding gender, origin, age and hierarchy or position, etc. Nevertheless, the difference is that (fatal enough) the latter biases are rather regionally or culturally driven, while the perception that high-level research requires high level and often exclusive equipment seems to be global. This can lead to a situation that excellent research on a highly relevant topic, but with standard methods, is often considered as unsound and will be less appreciated in the scientific community than poor research on a topic with negligible relevance and lower excellence, only because the latter study used some fancy and scarce equipment or a device from a certain producer. While this equipment battle also affects institutes within one and the same country, institutes of the global South are automatically more dramatically affected, since the investment in research is generally much lower. This gives a perceived higher credibility to institutes of rich economies, regardless of the quality of the scientific approach or the ambition. In return this sets back the ambitions of many excellent researchers from developing countries, who give their best to provide the best possible results within their environment, and despite all the limitations.

In many African countries it is very common to have universities with professors who teach, and only teach. Scientific output is strongly limited by the lack of equipment that is standard in European or an American universities. For example, a Fourier Transform Infrared (FTIR) Spectrometer is a basic piece of equipment used to do structural analysis in a fast and efficient way. It is also considered relatively cheap compared to more sophisticated techniques like Nuclear Magnetic Resonance (NMR). Nevertheless, spectroscopy is unavailable in many universities across the African continent. Unless you are either fortunate enough to be at an institute that has such instruments or know someone who works in such an institute, you are likely to never see or use a spectrometer in your studies. In such extreme cases, researchers have to opt to do mostly theoretical studies or reviews. In as much as there is a real struggle for equipment, it is not to say that science is still not being done through collaborative methods. The top three universities in Africa are all in the same country and even there, researchers are constantly reminded of the cost of equipment. In as much as this could make you a cautious researcher, it can hinder you from exploring different ideas because of the cost factor being a burden. However, with or without the expensive analytical method, solid scientific output is still possible, and this needs to be acknowledged.

The needlessness of arrogant manners for working in a sophisticated laboratory environment is getting very clear, considering that most fundamental scientific milestones were made more than 80 years ago with equipment that today could only be described as shabby and antique. Yet, we admire the brilliance and clarity of the researchers of these days. In fact, we admire them, because they were excellent researchers with incredible intellectual properties that made the maximum of their capacities within the given framework. In this context we must not mix up research excellence with excellence of the laboratory facilities. In other words, excellent equipment does not automatically make an excellent researcher! Good analytical equipment can only help lifting good research to a higher level, it cannot convert dispensable research to quality research.

While public discussions in conferences are extremely important, it is also important to follow some rules of good conduct, in order to rather close than widen the gap between researchers with different equipment levels.

- The assessment of a study should focus on the scientific approach.
- A study should always be considered within the context of the boundary framework of the researcher. In this context, one can learn from every study.
- Conference discussions are no vanity fair for the questioners at the cost of the presenter.
- It is better to offer support (e.g. with a final investigation that could be the cherry on the cake) than to dispose a study, because of their lack of sophisticated methods.
- Socially determined expectations should be examined. If within a scientific community, a special kind of expensive technique is often used but within some scientific studies it cannot be used due to inaccessibility, then that specific equipment cannot be used as bar for whether a piece of research is good or not.
- Scientists holding a position of authority in a specific field have the responsibility to encourage an unbiased and purely scientific view of research being presented by those who may not have been able to follow a sophisticated method but still managed to get a result worth discussion.
- If we consider that the publishing community is counterintuitively becoming more and more exclusive, it is very likely that very good research may not be published in an 'A rated' journal. This cannot be a base to discredit the science.
- Difference in historical and conceptual perspectives also can affect expectations about standards of research practice and research. That should also be considered when examining scientific work.

There are certain values, practices and scientific principles that guide research. If a piece of research has integrity and can be defended on the basis of a sound hypothesis and a systematic study to prove the hypothesis then it should be judged solely on scientific merit and not the complexity of the equipment used. Instead of ridiculing scientist for not using the most expensive lab equipment, question whether you can follow the science and how you can contribute to it being better.



Nevertheless, without any doubt the research questions of today increasingly demand for some highly sophisticated methods. If they are hardly accessible, e.g. for many African researchers, this automatically means that there is demand for cooperation with other laboratories. This has implications. Research works have to be planned in a different way right from the scratch. Researchers must be trained on very methodologic skills as they cannot afford trial and error experimental approaches once the need for cooperation is there. If a colleague is asked for a friendship service to do testing with fancy equipment, the credit that is given should not be overburdened by useless experiments. Eventually, it also means thinking about what to give in return, and possibly it comes along with the need to include further co-authors, who may not have had the strongest intellectual part in the study. And due to the existing better publication platforms in Europe or North America the European or American researchers might (on intention or unintentionally) receive greater attention than the inventor.

Eventually, international cooperation is required and important, but there are implications. Research excellence does definitively not depend on excellent equipment, but this must not be an excuse for politicians to avoid investments in research facilities. A good research infrastructure makes life easier for local researchers and helps lifting running research to a higher level. And it helps to master the technology transfer into society. Therefore, African governments are well advised to see the benefits of investing into a functioning research infrastructure.