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Misinterpretation of why black students do not pursue studies in the biological sciences

We contest the findings and methodology of the recently published commentary (Nattrass N., S Afr J Sci. 2020; 116(5/6), Art. #7864). We echo the many previous voices and calls for concern over the tenuous methodology and unsubstantiated 'conclusions' of this commentary. Below we provide specific details about each of the instances where this commentary is technically unsound.

General premise

The premise of the commentary is itself flawed. Biology students in other universities reflect the racial profile of the country. For instance, data from our own institution indicate that black student enrolment in the biological sciences has nearly doubled in the last decade (from ~640 students in 2010 to 1150 students in 2020), while other groups' enrolment has remained constant. Consequently, the assumption in the title: that black students are not choosing biological sciences is not valid.

Data collection

The data collection was conducted in an opportunistic manner, not randomly. Random sampling is a necessity to exclude bias in this kind of study. As a result, the statistical methods used were not appropriate, since they assume randomness: for instance, it is not appropriate to calculate exact P-values with a non-random sample. Thus, to claim a representative sample was taken is unsubstantiated, and the conclusions drawn cannot be validly reached. It is further an unacceptably long inferential stretch to go from a small, non-random sample of UCT students to 'black students' in general.

Data analysis and interpretation

It is unclear whether the methodology was geared to test a specific hypothesis or to find a model that best fit the selected variables. The author's framing of the commentary suggests that it was meant to test the hypothesis that a number of pre-selected variables may influence a student's choice when considering studies in the biological sciences. However, as written, the analytical approach appears to use model selection, rather than test an *a priori* hypothesis. The author describes variables that appear to be sequentially added to the model before a best-fit model is selected. Instead of using *the best-fit models*, *where 'black South African' is no longer a significant variable*, the author makes inferences about each model. An appropriate approach would be to run a hypothesis test, where all variables are included (e.g., Regression 2.5 and Regression 3.4) and then interpret the relative importance of each variable within this chosen set of variables.

We wish to highlight that if a model selection approach was used, the variable 'black South African' effectively disappears as a significant variable in the models discussed. Accordingly, there are a number of potential flaws in the 'data analysis' that are worth highlighting. First, for the full, best-fit models, most of the R^2 values are low (pseudo-R^2 < 0.21; Regression 2.5 and Regression 3.4). When 'black South African' is included alone as a variable, the R^2 values for both Regression 2.1 and Regression 3.1 are below 0.025. We recognise that low R^2 values do not mean there is no relationship between the dependent and independent variables, since this must be judged also in the light of the sample size. Nevertheless, the extremely low values reported suggest there is considerable variation not explained in the single variable models. Therefore, other variables not included are likely to be far more important independent variables.

Further, the variable that makes the largest contribution to explaining variability in the Regression 2 is 'Agrees 'I support wildlife conservation but have no interest in having a career in it''. At this point, the variable 'black South African' is far from significant and no interaction effect is shown to support that these are linked to the dependent variable. The same outcome is apparent when additional variables are added to Regression 2 and Regression 3. Once extra independent variables are added to the regression, 'black South African' is no longer a significant independent variable. Moreover, and importantly, **the links between the variables 'black South African' and 'materialist values' are not supported by the data presented**. Table 1 shows Fisher's exact tests for several variables, but it does not include materialist values. Regression 3 shows no significance for the variable 'black South African' when the materialist index is included in the regression.

The author acknowledges that the variable 'black South African' is not significant when values and attitude are added into the regressions: '*Regression 2.3 includes whether the respondent agreed with the statement 'I support wildlife conservation but have no interest in having a career in it'. This turned out to be the largest single determinant of whether a student considered studying biological sciences or not. Importantly, including it rendered the other variables statistically insignificant. The variable 'black South African' remained statistically insignificant in Regressions 2.3, 2.4 and 2.5, and when dropped (Regression 2.6) the model improves*' (Nattrass 2020, p1) and elsewhere. Despite the data not supporting 'black South African' as a significant variable in the dataset, the author still includes statements regarding black South African students being associated with materialist values and negative attitudes towards wildlife (Nattrass 2020, p2). As such, these 'conclusions' are flawed, due to either missing or misinterpretation of the data.

Additionally, the findings of Loubser (2018), one of three cited works in the commentary, appear to contradict the finding that black South Africans may have a negative attitude towards the environment (see Loubser 2018, p23). There are possible flaws in this line of questioning too. For instance, many environmental protection activities have the potential to create win-win scenarios, such as increasing economic value and protecting the environment (e.g., clearing alien invasive plants increases water yields, while restoring native species). However, the simple line of questioning used in Loubser (2018) suggested that black South Africans are more likely to support economically costly environmental protection than other racial groups in South Africa. This suggests that black South Africans in this study favoured the protection of the environment over materialist values and contradicts the 'conclusions' of the commentary but this was not emphasised or acknowledged.

Ethical issues

The commentary appears to violate the South African Journal of Science's (SAJS) ethics policy

which states that ALL submissions and reported research conducted on people must be approved by an institutional ethics committee and such approval must be included in the methods section. This commentary qualifies as a submission that is reporting 'research' and 'data' collected and analysed by the author. As such, this commentary should be held to the ethical standards set out by the journal itself. It is unclear from the publication whether this study received the necessary ethics approval as this information was excluded from the commentary. The study should have had ethics clearance based on policies that all South African universities and SAJS subscribe to and such clearance should have been included with the commentary per the journal policy. We note that academic freedom or freedom of expression has its limits. Its limits begin where unjustified claims and flawed assumptions and conclusions are made which may continue stereotyping black people in an offensive way. Academic freedom does not free SAJS broadly from upholding ethical standards for any published pieces.

Conclusion

We stress that the 'conclusions' of this commentary are unsubstantiated by the data presented, and therefore baseless. Publishing it in the SAJS gives legitimacy to the 'findings' and sets back any meaningful debate on how we continue the work of transforming our society in general and academia in particular.

We respect the journal's freedom to publish opinion pieces, but we are concerned that a study that is actually a piece of experimental work should be masquerading as an opinion, and therefore evading the thorough peer-review that a journal of SAJS's standing must adhere to. The technically flawed data and analysis gives the 'opinion' an undeserved weight. Even though it appears in a commentary section, a non-expert would infer that this work has been through peer review and is held to the same high standards of other SAJS publications. In this case, the conclusions drawn could serve to promote ideological assumptions that are deeply rooted in a racialised and racist history. There is a plausible risk that the commentary could be used to further bolster racist arguments, racial in-sensitivity, used in a manner to perpetuate harmful racist stereotypes, and devalue efforts to diversify the fields of science, technology, engineering, and mathematics (STEM). 'Scientific racism' has been used in the past to justify racist policies like apartheid and to make an argument about the inferiority of black students/learners and indigenous people.

We sincerely hope that the SAJS Editorial board considers the loss of integrity that such a flawed commentary brings to a publication supported by the Academy of Science of South Africa, specifically at a time when South Africa needs everyone, especially academics, to work towards inclusivity within STEM fields.