

**Accelerating the Transition to a Circular Plastic Economy in Nigeria through 3D Printing  
Technology: Investigating Knowledge and Capacity in Universities**

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## **Introduction**

The circular economy has gained increasing attention among scholars and experts as a guiding principle to ensure sustainable environmental practices. The concept can be explained by frameworks such as the 3Rs of reduce, reuse and recycle (Manickam and Duraisamy, 2019), and the 9Rs, which include refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover (Potting et al., 2017). Furthermore, digital technologies such as mobile applications, geographical information system (GIS) and 3D printing are seen as critical enablers of the circular economy (Uçar, Le Dain and Joly, 2020), despite some criticisms. Although available literature has established that 3D printing technology is positively disruptive and critical for the facilitation of the circular economy, there are still limited studies on the roles required by universities to drive positive actions, especially in the Global South. This paper examines variables such as knowledge and capacity for 3D printing in Nigerian universities and their relationship to foster positive circular plastic economy actions in the society. The study specifically tests the following hypotheses:

$H_1$  Knowledge of plastic waste problem has a positive relationship with plastic waste management action.

$H_2$  Understanding of 3D printing technology has a positive relationship with plastic waste management action.

$H_3$  Understanding of 3D printing sub-technology has a positive relationship with plastic waste management action.

## **Methodology**

This study used a quantitative approach, by firstly designing a Likert scale questionnaire to capture relevant variables from students. A total of 151 students responded to the survey which was hosted on Google Forms. The data was analysed using Structural Equation Modelling (SEM). As the study was interested in exploring likely factors that influence actions of students to manage plastic waste rather than attempting to predict the factors, it opted for the covariance-based SEM (CB-SEM) instead of the partial least squares SEM (PLS-SEM). The study built a model to investigate the relationship between students' 3D printing technology capabilities and their plastic waste management action. An assessment was also conducted to establish the relationship between understanding of 3D printing and understanding of another sub technology of 3D printing (Filtech) with plastic management action. Prior to discussing the estimation results, the study undertook analysis of goodness of fit of the models that concluded the model's goodness of fit was good.

**Results and Discussions**

The results, presented in Figure 1, indicate that knowledge plays a significant role in accelerating plastic waste management actions in Nigerian universities. This finding is consistent across both Model 1 and Model 2. The results also reveal that understanding of 3D printing and sub-technology, Filtech, has a positive relationship with plastic waste management action, but this relationship is statistically insignificant. Therefore, the study suggests that Nigerian universities should focus on building students' knowledge of the plastic waste problem and awareness of disruptive technologies like 3D printing and Filtech. The study also found that web applications have a positive relationship with plastic waste management actions, but further research is required to understand the possibilities of web applications in promoting positive actions of Nigerian students in the circular plastic economy in Nigerian universities and other developing economies.

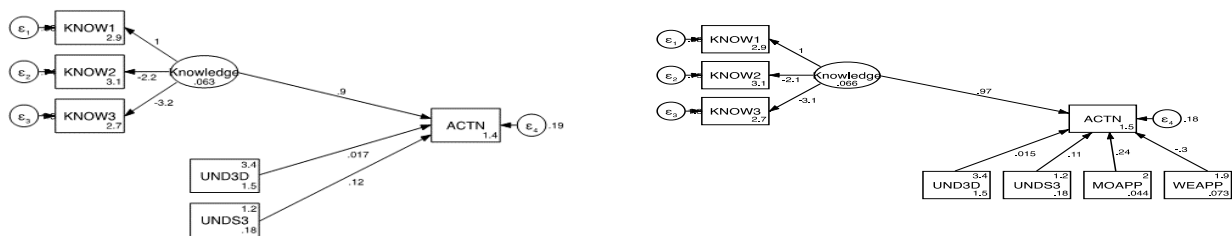


Figure 1: (a) Model 1 Path Diagram Results (b) Model 2 Path Diagram Results

The study's results have significant implications for Nigerian universities and sustainability efforts in Nigeria. The study shows that while there has been significant progress on web applications, there appears to be relatively little traction on 3D printing technology and sub-technology, Filtech. This result raises important issues for higher institutions such as universities and sustainability efforts in Nigeria. The study suggests that Nigerian universities may not have the capacity or capability to fill in the technology gap, and more needs to be done to increase knowledge of the plastic waste problem and awareness of disruptive technologies such as 3D printers and sub-technology, Filtech.

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