**Title: HPrEd: A Tuned Ensemble With Model-Agnostic XAI to Explain Social Media's Association With Academic Productivity**

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**Abstract:** Social media plays a crucial role in shaping students' academic productivity, both as an effective learning tool and as a source of confusion. However, most studies are limited to basic statistical analysis or a single machine learning model, which often lacks structured evaluation and interpretability. Such methods typically perform poorly on heterogeneous datasets and fail to provide sufficient insights for practical applications. To overcome these limitations, this study proposes a soft voting ensemble called Hybrid Productivity Prediction (HPrEd), which combines multiple machine learning (ML) models. Modelagnostic explainable AI (XAI) techniques LIME and SHAP are used to analyze the relationship between social media engagement and academic productivity. SMOTE is applied to reduce class asymmetry and RFE is used to select the best features. To select the appropriate model for HPrEd, a systematic comparison was made between three ML model families: tree-based, distance-based, and neural network-based, where Extra Trees, k-NN, and MLP were combined based on their complementary strengths. The robustness of the model was verified through 5-fold cross-validation. HPrEd achieved the highest recall of 98.25% and only 0.53% false alarm probability (PF). SHAP analysis showed that delay in starting studies, decreased attention to academic work, increased coursework distraction, and perceived productivity in the absence of social media were the most influential factors, with normalized SHAP values ranging from $-1.2\times10-16$ to $+1.6\times10-16$ . Additionally, the LIME-based local interpretation found that moderate levels of multitasking during study (0.62), significant feelings of time loss (1.59), high self-reported academic impact (1.67), and low ability to limit social media use (45) had the greatest impact on individual predictors, with class probability exceeding 99%. Overall, the results suggest that excessive social media use is associated with decreased academic productivity, but moderate levels of use may be helpful in increasing attention in some cases. These insights provide guidance for educators and policymakers and support future longitudinal research.

**Key words:** Social networking (online) , Productivity , Machine learning , Explainable AI , Analytical models , Predictive models , Accuracy , Multitasking , Distance measurement

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