

## **Development of the secondary school quantum physics-stem (SSQP-stem) instructional module for physics teachers: A fuzzy delphi method (FDM) approach**

### **ABSTRACT**

Education transformation demands teachers to rethink the purpose of teaching for a more meaningful and sustainable education. It requires effective teaching to improve knowledge transfer efficiency and generate successful educators with teaching strategies that positively impact students' life and career, including instilling critical skill sets and introducing new concepts with real-world applications. Therefore, an instructional module with an integrated STEM education approach for physics teachers in conducting quantum physics (QP) lessons was developed through expert consensus under the Fuzzy Delphi Method (FDM). This study obtained sixteen experts' consensus using a questionnaire for data collection. The questionnaire with a seven-point linguistic scale was generated from the TABA Curriculum model components and the Physics Standards-based Curriculum and Assessment Document (DSKP). The results of the data analysis identified that 100 out of 103 elements of the instructional module were accepted based on the expert consensus value  $\geq 75\%$ , the threshold value ( $d$ )  $\leq 0.2$ , and the fuzzy score ( $A$ ) ( $\alpha$  – cut) value  $\geq 0.5$ . The experts suggested that three items from the learning outcomes component need to be replaced with more appropriate items. Overall, the components and elements of the instructional module were accepted, with several adjustments and corrections done to improve the module's content appropriateness.