DEVELOPMENT OF CHEMISTRY LEARNERS' PROBLEM-SOLVING SKILLS

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Learners can experience science in the real world by interacting with materials, collaborating with peers, and engaging in a problem-solving process. Notwithstanding, secondary school learners' problem-solving skills can be developed by using an instructional strategy that actively involves them in the learning process instead of sorely focusing on content learned. This paper shows how the production of materials for teaching and learning can go hand-in-hand with the development of learners' PSS through the implementation of a Hands-on Instructional Model (HIM) in chemistry lessons. This study was a Design-based Research using a convergent mixed- method approach. The data was collected using lesson observation protocol, focus group discussions guide, and problem-solving test. On the aspect of the development of PSS, learners were enhanced with the skills to solve an ordinary chemistry problem and the criteria of observation were on the ways learners identify a problem, the approach used to solve the problem, and whether they could reflect on the answer they obtained. Therefore, it is suggested that HIM should be used frequently to enhance learners' active engagement in chemistry lessons and for further development of their PSS.

One of the skills needed in the 21stcentury is thinking skills including metacognitive skills. Many studies showed that undergraduate students who used metacognitive skills are more successful in learning. This study aims to illustrate using metacognitive skills as a solution in chemistry problem solving and undergraduate students' respond. The indicators were goal setting, identify the known knowledge, determining the learning strategies, monitoring the relevance of the known knowledge with learning strategies, monitoring the goal achievement in the making conclusions, and evaluating the process and thinking outcomes, and (2) most of the undergraduate students are pleasant to join to this learning activity. Based on the results of this study, metacognitive skills can beusedasa solution in chemistry problem-solving.

The study revealed that learners' PSS considerably improved due to the implementation of the designed HIM intervention. This was manifested in the way learners were able to identify problems in different given classroom activities, their ability to prepare instructional materials to be used in chemistry lessons. Also, some concepts that seemed to be difficult in mole concept and volumetric analysis topics became more understandable when learning was contextualized and associated with learners' prior experiences through HIM. The designed approach has a pedagogical significance to both chemistry teachers and learners as it increased accessibility and availability of instructional materials for meaningful learning. Not only that, but learners can manage to work comfortably and independently in absence of their teachers. Besides, through the implementation of the hands-on activities, learners experienced ownership of their learning process by playing part in searching for the appropriate instructional materials for their learning. This is not only actively engaging learners in the lesson but also elevates a lifelong learning perspective. In addition to that, learners' ability to solve real-life problems related to their learning was also enhanced. Nevertheless, this research informs both curriculum developers and implementers on the essence of integrating the designed HIM in other science subjects other than chemistry at all levels with a similar learning environment as in this study. This can create a generation that can challenge scientific issues and solve the emerging problems in this ever-changing technology. Therefore, we boldly conclude that if the designed intervention is given the needed attention; learners' P-S ability and skills can be enhanced.Based on the key findings of this study, we recommend the implementation of HIM in chemistry classrooms of similar educational contexts as those in this study. Besides, more emphasis should be directed to the frequent use of hands-on activities not only in chemistry but also in other science subjects to make the whole process of learning science authentic and improve educational practice. Also, researchers should endeavor to conduct studies that put the learners at the center of the learning process. The paradigm shifts from teachers being the center of all aspects of the learning process can empower learners to take charge of the learning and reduce teachers' workload. Finally, the shift of the paradigm can create a meaningful learning environment which in turn will enhance nurturing of a generation of independent learners equipped with skills essential for the fast- growing 21st-century world's economy.