Informing poverty reduction through a teacher professional development framework for supporting inquiry-based science education

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Abstract

One of the pillars of the fight against poverty is education in general, and science education in particular. Although inquiry-based teaching is widely incorporated in science curricula around the world, inquiry-based teaching is a complex and daunting task for many teachers. Also, the preparation of teachers to implement this strategy is a major challenge. In the current research, we addressed the lack of a content and construct valid Professional Development (PD) Framework for supporting teachers in relation to inquiry-based curriculum units. The framework consists of a goal, learning phases, learning theory, PD strategy, support, motivation, and an instructional model. We are using a cyclical educational design research-based process to generate design principles and then the framework. In the first research cycle, we have used a systematic review of suitable literature to generate a design principle per component of the framework, which we have screened with reference to well-known characteristics of effective (science) teacher PD. The result is seven tentative design principles and the first version of the PD Framework. The second research cycle, which is underway, involves an instrument validation study, prior to the expert appraisal of the framework. While the appraisal will yield a revised version of the framework, this version will lack the attending to contextual factors component of a PD framework. Researchers could consider incorporating the component in diverse contexts, such as in relation to resource-constrained South African schools. Thus, this study shall inform science teacher PD, and poverty reduction efforts in different contexts.

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Introduction

Poverty reduction is a worldwide priority and a requirement for sustainable development (Singh & Chudasama, 2020). Education in general, and science education specifically, is a critical component in any poverty reduction strategy (Albergaria-Almeida & Martinho, 2015; Oranga, Obuba, & Nyakundi, 2020). One strategy in science education that is incorporated in curricula internationally, is the inquiry-based teaching and learning strategy. However, it has been noted that for many science teachers, inquiry-based teaching is a daunting task, while the preparation of teachers to implement this strategy is a major challenge (Fitzgerald, Danaia, & McKinnon, 2019).

In the current research, we addressed the lack of a content and construct valid Professional Development (PD) Framework for supporting teachers in relation to inquiry-based curriculum units. A teacher PD framework has been described as the blueprint of a PD programme, with its key components consisting of the goal, learning phases, learning theory, PD strategy, support, motivation, instructional model, and attending to contextual factors (Stolk, Bulte, De Jong, & Pilot, 2012). Educational design research can be used when developing an intervention (in this case the framework), to address an educational problem, with the associated design principles providing key characteristics of the intervention (Plomp, 2013). Design research generally involves three phases: preliminary research, development, and summative evaluation (Dunn, Hattie, & Bowles, 2019). The current research is limited to the first two phases, the first of which incorporates a review of similar interventions. The development phase is a cyclical process involving adequate formative evaluation and revision of the intervention.

Methodology

In the preliminary research phase, we have used eleven databases to identify 78 articles involving teacher PD design. After extracting data from the articles in relation to each component of a PD framework, except the attending to contextual factors component, we have generated a tentative design principle per component, leading to the first version of the framework.

In the development phase, we have screened the framework for content validity, using the ten characteristics of effective (science) teacher PD in Capps, Crawford, and Constas (2012). Expert appraisal of the content validity, shall focus on the inclusion, omission, elaboration, and reviewing of various elements in the framework. Expert appraisal of the construct validity shall focus on the arrangement of the phases and cycles in the framework. In the expert appraisal of the content and construct validity of the framework, we shall use twelve experts in public universities in South Africa and Germany.

Results and discussion

Our tentative results are seven design principles and the first version of the desired PD framework. The version incorporates seven key components and a number of best practices in PD. The practices include the whole teacher approach that focusses on multiple factors, including competencies and practice (Chen & McCray, 2012). Considering that the only readily available PD framework is one for supporting chemistry teachers in the design of context-based curriculum units (Stolk et al., 2012), the current results although tentative, address a gap in the science teacher PD literature.

It is worth noting that even after the upcoming expert appraisal, the PD Framework shall be lacking the attending to contextual factors component. Teacher PD, needs to be

well adapted to the socio-cultural context of participants (Rundgren, 2018). Thus, after expert appraisal, we plan, in a separate study, to conduct a context analysis to upgrade the PD framework to one for supporting teachers in inquiry-based practical work in resource-constrained South African physical sciences classrooms. The upgrading shall be the end of the development phase of the design research we have thus commenced. In the summative evaluation phase, we shall translate the framework into a PD programme, and evaluate the programme for effectiveness and practically. The ensuing version of the PD framework, shall be an example of the completed version of the current generic and tentative version. Its use by PD providers shall promote inquiry-based science education, enhance science teacher quality, while supporting poverty reduction in resource-constrained communities.

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