



Investigating and improving assessment practices in Physics in secondary schools in Mozambique

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List of Acronyms

ACP – *Actividades de Controle Parcial*
Activities of Partial Control

ACS – *Actividades de Controle Sistemático*
Activities of Systematic Control

ADDIE – Analysis-Design-Development-Intervention-Evaluation

CNECE – *Concelho Nacional de Exames, Certificação e Equivalências*
National Council of Exams, Certification and Equivalences

DINEG - *Direcção Nacional do Ensino Geral*
National Directorate of General Education

EP1 – *Ensino/Escola Primário(a) do 1 Grau*
Lower Primary Education/School

EP2 – *Ensino/Escola Primário(a) do 2 Grau*
Upper Primary Education/School

ESG – *Ensino Secundário Geral*
General Secondary Education

ESG1 – *Ensino Secundário Geral do 1 Ciclo*
General Secondary Education, Cycle 1

ESG2 – *Ensino Secundário Geral do 2 Ciclo*
General Secondary Education, Cycle 2

INDE – *Instituto Nacional de Desenvolvimento da Educação*
National Institute for Development of Education

IPO – Input-Process-Output

MEC – Ministry of Education and Culture

MinEd – *Ministério da Educação*
Ministry of Education

NGO – Non Government Organisation

PAM – Physics Assessment Materials

POE – Predict-Observe-Explain

UNDP – United Nations Development Programme

SNE – *Sistema Nacional de Educação*
National System of Education

UEM – *Universidade Eduardo Mondlane*
Eduardo Mondlane University

UP – *Universidade Pedagógica*
Pedagogic University

Declaration

I declare that this thesis is my own, unaided work. It is being submitted for the Degree of Doctor of Philosophy in the University of Pretoria, South Africa. It has not been submitted before for any degree or examination in any other University.

Francisco Maria Januário

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Summary

Assessment, an integral part of teaching and learning, is a planned process of identifying, gathering and interpreting information about the performance of students. However, concerns have been raised about how assessment is being conducted in schools and so the aim of this study is to investigate and improve assessment practices used by Grade 12 secondary school Physics teachers in Mozambique, Africa. The study addresses the question of *what assessment practices do Grade 12 teachers in Physics in Mozambique apply and how can they be improved?* and it adopted a twofold research approach. A Baseline Survey aimed at gaining an overall impression of the assessment practices used by secondary school Physics teachers and an Intervention Study aimed at producing improvements on teacher assessment practices. The preliminary research followed a survey research method, while the intervention applied an educational design research approach. In the survey three questions were investigated: (i) *What assessments practices do Grade 12 Physics teachers apply?* (ii) *What is the quality of the assessment practices?* and (iii) *How relevant can the assessment practices be for student learning?* To address these questions a purposive sample of 12 Physics teachers, four school directors and five educational officers was selected. The survey was conducted in six secondary schools purposefully selected throughout the country and data were collected via interviews, questionnaires, classroom observations and written notes. The Intervention Study was designed to answer the question of *how teacher assessment practices can be improved.* This phase of the study involved a design, a classroom tryout, and a systematic evaluation of a series of exemplary Physics assessment materials (prototypes) in a context of demonstration experiments. The prototypes were developed for the concepts of force and inertia and their validity and practicality were verified using appraisal by experts, university students, teachers, and students. Classroom tryout was conducted with two teachers and their 62 students in two secondary schools.

Baseline Survey findings indicate that the most used assessment practices in schools are paper-and-pencil tests, verbal tests, and homework, while projects, portfolios, and peer-

assessments are the less frequently used ones. Oral communication during lessons, written work, presentations, notebooks, laboratory work, and ability to solve problems were used as quality criteria for the teachers' assessment. It was shown that the most frequently assessed student activity was written work, followed by the ability of students to solve problems, while laboratory work was the activity that was never assessed by many of the researched teachers. Another quality criterion used was the type of feedback given by teachers to students, which indicated that teachers were giving expressed (both congratulatory and critical), personal and timely feedback. It emerged that teachers often involve the students in the evaluation of their performance through reflection of assessment results and in addition, encourage students to engage in active learning.

Findings from the Intervention Study indicate that (i) teachers liked the presentation and structure of the materials following the Predict-Observe-Explain (POE) strategy and regarded their personal commitment as crucial for achieving the desired experimental results; (ii) students also liked most the POE strategy because it allowed them to develop their own explanations of the observed events and highlighted the role of teachers during the tryout as crucial for the success of the experiments.

The main conclusion of this study is that assessment practices undertaken by Physics teachers in Mozambican secondary schools are of poor quality and there is a need for improvement. This must be done by developing and applying exemplary assessment materials with the potential to improve performance assessment practices associated with demonstration experiments in Physics. The study recommends that the Ministry of Education and Culture and teacher training institutions should promote the training of teachers in developing exemplary assessment materials for their own use in schools. These materials should contain specific guidelines on how to conduct effective assessment practices.

Key words: Assessment practices, demonstration experiments, force, formative assessment, formative feedback, inertia, performance assessment, Physics assessment materials, practical work, prototypes.

Resumo

A avaliação, uma parte integrante de ensino e aprendizagem, é um processo planificado de identificação, recolha e interpretação de informação acerca do desempenho dos alunos. No entanto, tem se levantado preocupações sobre a forma como a avaliação é levada a cabo nas escolas. Neste sentido, o objectivo deste estudo é investigar e procurar melhorar as práticas de avaliação usadas pelos professores de Física da 12^a classe no ensino secundário em Moçambique, África. O estudo aborda a questão sobre *que práticas de avaliação os professores de Física da 12^a classe em Moçambique usam e como elas podem ser melhoradas* e adopta uma abordagem de investigação dualista. Um Estudo de Base (pesquisa exploratória) destinado a obter uma impressão geral das práticas de avaliação usadas pelos professores de Física no ensino secundário e um Estudo de Intervenção com o intuito de produzir melhoramentos nessas práticas. A investigação preliminar obedeceu ao método de Inquérito, enquanto a intervenção empregou a abordagem de Pesquisa de Concepção Educacional – outrora conhecida por Pesquisa de Desenvolvimento. No Estudo de Base foram investigadas três perguntas: (i) *Quais são as práticas de avaliação usadas pelos professores de Física da 12^a classe?* (ii) *Qual é a qualidade dessas práticas de avaliação?* (iii) *Quão relevantes essas práticas de avaliação são para a aprendizagem dos alunos?* Para responder a estas perguntas foi seleccionada uma amostra por conveniência composta por 12 professores de Física, quatro directores de escola e cinco técnicos de educação. O Inquérito foi levado a cabo em seis escolas secundárias convenientemente seleccionadas ao longo de todo o país e os dados foram recolhidos por meio de entrevistas, questionários, observações na sala de aulas e notas escritas. O Estudo de Intervenção foi concebido para responder à pergunta sobre *como é que as práticas de avaliação dos professores podem ser melhoradas*. Esta fase do estudo envolveu a concepção, o ensaio na sala de aulas e a avaliação sistemática de uma série de exemplares de materiais de avaliação de Física (protótipos) no contexto de experiências de demonstração laboratoriais. Os protótipos foram desenvolvidos para os conceitos de força e inércia e a sua validade e praticabilidade foram verificadas com o auxílio de especialistas da área, estudantes universitários, professores e alunos do

ensino secundário. O ensaio na sala de aulas foi realizado com dois professores e seus 62 alunos em duas escolas secundárias.

Os resultados do Estudo de Base indicam que as práticas de avaliação mais usadas nas escolas são os testes de papel-e-lápis, as perguntas orais e o trabalho de casa, enquanto os projectos, os portfólios e a avaliação dos colegas são as menos frequentemente usadas. A comunicação oral durante as aulas, o trabalho escrito, as apresentações, as notas nos cadernos, os trabalhos laboratoriais e a habilidade dos alunos de resolver problemas foram usados como critérios de qualidade para a avaliação levada a cabo pelos professores. Emergiu que a actividade dos alunos frequentemente avaliada pelos professores era o trabalho escrito, seguida da habilidade dos alunos de resolver problemas, enquanto o trabalho laboratorial foi a actividade que nunca era avaliada pela maioria dos professores alvo da pesquisa. Outro critério de qualidade usado foi o tipo de retroalimentação (*feedback*) dado pelos professores aos alunos, o qual indicou que os professores davam uma retroalimentação expressa (certo ou errado), pessoal e em tempo. Os resultados mostraram igualmente que os professores, muitas vezes, envolvem os alunos na avaliação do desempenho deles através de discussões de reflexão acerca dos resultados das avaliações e encorajam os alunos a se empenharem na aprendizagem activa.

Os resultados do Estudo de Intervenção indicam que (i) os professores gostaram da apresentação e da estrutura dos protótipos seguindo a estratégia Previsão-Observação-Explicação (POE) e consideraram o seu cometimento pessoal como crucial para o alcance dos resultados experimentais desejados; (ii) os alunos também gostaram muito da estratégia POE porque lhes permitiu formular as suas próprias explicações dos eventos observados e referiram o papel do professor durante o ensaio como crucial para o sucesso das experiências.

A principal conclusão deste estudo é de que as práticas de avaliação levadas a cabo pelos professores de Física nas escolas secundárias Moçambicanas são de uma qualidade pobre e precisam de ser melhoradas. Isto deve ser dado pela concepção e uso de exemplares de

materiais de avaliação que tenham potencial para melhorar as práticas de avaliação de desempenho em associação às experiências de demonstração laboratoriais em Física. Este estudo recomenda que o Ministério de Educação e Cultura e as instituições de formação de professores promovam a formação e capacitação de professores em matérias de concepção de exemplares de materiais de avaliação para o seu próprio uso nas escolas. Estes materiais devem conter instruções específicas sobre como conduzir práticas de avaliação efectivas.

Palavras-chave: Avaliação de desempenho, avaliação formativa, experiências de demonstração laboratoriais, força, inércia, materiais de avaliação de Física, práticas de avaliação, protótipos, retroalimentação formativa, trabalho prático.

Dedication

To my parents Maria Francisca Semende (1935 – 1986) and Januário Julai for sending me to school; and my elder sister Vitorina Januário for carrying me and my school bag during my first year of schooling.

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