

REFERENCES

- Afonso, E. (2007). Developing culturally inclusive philosophy of science teacher education. In I.V. Mutimucuo & M. Cherinda (Eds.), *Proceedings of the 15th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 307-315).
- Airasian, P. (2000). *Assessment in the classroom: A concise approach* (2nd ed.). Boston: McGraw-Hill.
- Airasian, P.W. (2001). *Classroom assessment: concepts and application* (4th ed.). Boston: McGraw-Hill.
- ARG (1999). *Assessment for learning: Beyond the black box*. University of Cambridge: Assessment Reform Group.
- Bardin, L. (1977). *Análise do conteúdo*. Lisboa: Edições 70.
- Bell, B., & Cowie, B. (2001). *Formative assessment and science education*. London: Kluwer Academic Publishers.
- Bereiter, C. (2002). Design research for sustained innovation. *Cognitive Studies Bulletin of the Japanese Cognitive Science Society*, **9**(3), 321-327.
- Black, P. (1998). *Friend or foe? Theory and practice of assessment and testing*. London, Philadelphia: FalmerPress.
- Black, P., & Atkin J.M. (Ed) (1996). *Changing the subject. Innovations in science, mathematics and technology education*. London and New York: Routledge.
- Black, P.; Harrison, C.; Lee, C.; Marshall, B.; Wiliam, D. (2003). *Assessment for learning. Putting it into practice*. London: Open University Press.

- Black, P., & William, D. (1998). Assessment and classroom learning. *Assessing in Education: Principles, policy and practice*, 5(1), 7-74.
- Black, P., & William, D. (2006). Assessment for learning in the classroom. In J. Gardner (Ed.), *Assessment and learning* (pp. 9-25). London, Thousand Oak, New Delhi: Sage Publications.
- Brown, G., Bull, J., & Pendlebury, M. (1997). *Assessing student learning in higher education*. London and New York: Routledge.
- Buendía Gomez, M. (1999). *Educação Moçambicana: História de um processo 1962-1984*. Maputo: Imprensa Universitária.
- Champagne, A.B., Klopfer, L.E., and Anderson, J.H. (1980). Factors influencing the learning of classical mechanics. *American Journal of Physics*, 48(12), 1074-1079.
- Chatterji, M. (2003). *Designing and using tools for educational assessment*. Boston: Allyn and Bacon.
- Chevane, V. N.V. (2002). The impact of two different ways of assessment of the chemistry laboratory classes in the basic science course at the Eduardo Mondlane University. In C. Malcolm, & C. Lubisi (Eds.), *Proceedings of the 10th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 9-14).
- Clement, J. (1982). Students' perceptions in introductory mechanics. *American Journal of Physics*, 50(1), 66-71.
- Clement, J. (1993). Using bridging analogies and anchoring intuitions to deal with students' preconceptions in Physics. *Journal of Research in Science Teaching* Vol 30, nr 10, 1241-1257.

- Cohen, L., Manion, L. & Morrison, K. (2000). *Research methods in education* (5th ed.). New York: Routledge Falmer.
- Coolican, H. (1999). *Research Methods and Statistics in Psychology* (3rd ed.). London: Hodder & Stoughton.
- Cossa, E.F.R. (2007). *A case study of practical work in a cell biology course at the Eduardo Mondlane University in Mozambique*. Doctoral dissertation. Cape Town: University of the Western Cape.
- Creswell, J.W. (2003). *Research design: qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, London, New Delhi: Sage Publications.
- Cupane, A.F. (2007). Towards a culture-sensitive pedagogy of Physics teacher education in Mozambique. In I.V. Mutimucuo & M. Cherinda (Eds.), *Proceedings of the 15th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 335-342).
- Dekkers, P.J.J.M., & Thijs, G.D. (1995). *A teaching sequence for the 'force' concept developed from classroom research on practical work. A strategy for providing means to solve 'dissonance'*. Presentation to the European Conference on Research in Science Education, University of Leeds, 7-11 April 2005, Leeds.
- Dekkers, P.J.J.M. (1997). *Making productive use of student conceptions in Physics education: Developing the concept of force through practical work*. Doctoral dissertation. De Boelelaan (NL): VU Huisdrukkerij, Amsterdam.
- Fagilde, S.A.M. (2002). *Gender patterns in communication in mathematics classrooms: A Mozambican case study*: Doctoral dissertation. Cape Town: University of the Western Cape.
- Fink, A. (1995a). *How to design surveys*. California: Sage publications.
- Fink, A. (1995b). *How to ask survey questions*. California: Sage publications.

- Fink, A. (1995c). *The survey handbook*. California: Sage publications.
- Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.
- Gardner, J. (Ed.) (2006). *Assessment and learning*. London, Thousand Oaks, New Delhi: Sage Publications.
- Garet, M.S., Porter, A.C., Desimone, L. Birman, B., & Yoon, K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4), 915-945.
- Garrett, R.M., and Roberts, I.F. (1982). Demonstration versus Small Group Practical Work in Science Education. A critical review of studies since 1900. *Studies in Science Education*, 9, 109-146.
- Gay, L.R., & Airasian, P. (2003). *Educational research: competencies for analysis and applications*. Columbus, Ohio: Merrill Prentice-Hall.
- Governo de Moçambique (1996). *Boletim da República: Regulamento de avaliação do ensino secundário geral*. Maputo: Imprensa Nacional.
- Gronlund, N.E. (1998). *Assessment of student achievement* (6th ed.). MA: Allyn & Bacon.
- Guskey, T.R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.
- Hadi, S. (2002). *Effective, teacher professional development for implementation of realistic mathematics education in Indonesia*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.

- Hall, G.E., & Hord, S.M. (2001). *Implementing change: Patterns, principles, and potholes*. Massachusetts: Allyn and Bacon.
- Harlen, W. (2006). The role of assessment in developing motivation for learning. In J. Gardner (Ed.), *Assessment and learning* (pp. 61-80). London, Thousand Oaks, New Delhi: Sage Publications.
- Hestenes, D., Wells, M. & Swackhamer, G. (1992). Force concept inventory. In *The Physics Teacher Journal*, vol 30. Tempe: Arizona State University
- Hodson, D. (1993). Re-thinking old ways: Towards a more critical approach to practical work in school science. *Studies in Science Education*, 22, 85-142.
- Howie, S. J. (2002). *English language proficiency and contextual factors influencing mathematics achievement of secondary school pupils in South Africa*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- Howie, S. J. (2006). Presentation to Gauteng Department of Education. Assessment for Learning Conference, May 2006, Johannesburg.
- Huillet, D. (2002). Evolution of in-service and pre-service teachers' conceptions on limits of functions, through participation in a research community. In C. Malcolm, & C. Lubisi (Eds.), *Proceedings of the 10th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 124-129).
- INDE (2005). Proposta de estrutura para o Ensino Secundário Geral (documento em estudo). Maputo: INDE.
- INE (2007). *Statistical Yearbook, 2007*. Maputo: National Institute of Statistics.
- James, M. (2006). Assessment, teaching and theories of learning. In J. Gardner (Ed.), *Assessment and learning* (pp. 47-60). London, Thousand Oaks, New Delhi: Sage Publications.

- James, M., & Pedder, D. (2006). Professional learning as a condition for assessment for learning. In J. Gardner (Ed.), *Assessment and learning* (pp. 27-44). London, Thousand Oaks, New Delhi: Sage Publications.
- Januario, F.M. (1997). Current and final assessment in Mozambican science education: The case study of lower primary schools. In M. Sanders (Ed.), *Proceedings of the 5th Conference of the Southern African Association for Research in Mathematics and Science Education* (pp. 230-236).
- Joyce, B., & Showers, B. (1988, 1995). *Student achievement through staff development*. (1st and 2nd ed.). New York: Longman.
- Johnstone, A.H., & Wham, A.J.B. (1982). The demands of practical work. *Education in Chemistry*, 19, 71-73.
- Kathy, H., & Burke, W. (2003). *Making formative assessment work: effective practice in the primary classroom*. London: Open University Press.
- Kemp, J. & Toperoff, D. (1998). *Guidelines for portfolios assessment in teaching English*. <http://www.anglit.net/main/portfolios/contents#contents>, retrieved August 23, 2006.
- Kouwenhoven, W. (2003). *Designing for competence: Towards a competence-based curriculum for the Faculty of Education of the Eduardo Mondlane University*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- Krathwohl, D.R. (1998). *Methods of educational and social research: An integrated approach* (2nd ed.). New York: Longman.

- Lauchande, C. (2001). Assessment in primary education in Mozambique: Some mathematics results. In I.V. Mutimucuo (Ed.), *Proceedings of the 9th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 297-308).
- Lin, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching* (8th ed.). Columbus, Ohio: Merrill Prentice-Hall.
- Lincoln, Y.S., & Guba, E.G. (2000). Paradigmatic controversies, contradictions, and emerging influences. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 163-188). Thousand Oaks, CA: Sage Publications.
- Machado, A.J.E. (2007). A avaliação: Um dos grandes problemas no processo de ensino e aprendizagem da Matemática no ensino secundário em Moçambique. In I.V. Mutimucuo & M. Cherinda (Eds.), *Proceedings of the 15th Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 220-225).
- Mafumiko, F. (2006). *Micro-scale experimentation as a catalyst for improving the chemistry curriculum in Tanzania*. Doctoral dissertation. Enschede (NL): University of Twente.
- McKenney, S. (2001). *Computer-based support for science education materials developers in Africa: exploring potentials*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- McMillan, J.H. (2001). *Essential assessment concepts for teachers and administrators*. California: Corwin Press.
- MEC (2007). *Relatório Anual de 2006. Documento número 1.01/RAR8*. Oitava Reunião Anual de Revisão do Plano Estratégico de Educação e Cultura. Maputo: MEC.

- MEC & INDE (2007). *Plano Curricular do Ensino Secundário Geral (PCESG): Documento orientador - objetivos, política, estrutura, plano de estudos e estratégias de implementação*. Maputo: Imprensa Universitária.
- Mertens, D.M. (1998). *Research methods in education and psychology: Integrating Diversity with quantitative and qualitative approaches*. Thousand Oaks, CA: Sage Publications.
- Miles, M.B. & Huberman, A.M. (1994). *Qualitative data analysis: an expanded sourcebook* (2nd ed.). Thousand Oaks, London, New Delhi: Sage Publications.
- MinEd (1994). *Indicadores educacionais e efectivos escolares: Ensino primário 1983 1992*. Maputo: Direcção de Planificação, MinEd.
- MinEd (1997). *Programas de Física, 2º Ciclo*. Maputo: Ministério da Educação.
- MinEd (1998). *Education Sector Strategic Plan 1999-2003. Reviving schools and expanding opportunities*. Maputo: Ministry of Education.
- MinEd (1999). *Plano Estratégico da Educação*. Maputo: MinEd.
- MinEd (2001). *Secondary and Secondary Teacher Education Strategic Plan*. Maputo: Ministry of Education.
- MinEd (2003). *Levantamento estatístico anual*. Maputo: MinEd.
- MinEd (2004). *Education Sector Strategic Plan II, 2005-2009 (Draft)*. Maputo: Ministry of Education (Mimeo).
- Moskal, B. M. (2003). Recommendations for developing classroom performance assessments and scoring rubrics. *Practical Assessment, Research & Evaluation*, 8(14). <http://PAREonline.net/getvn.asp?v=8&n=14>, retrieved April 26, 2006.

- Motswiri, M.J. (2004). *Supporting chemistry teachers in implementing formative assessment of investigative practical work in Botswana*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- Muller, J. (2006). *Authentic assessment toolbox*. <http://jonathan.mueller.faculty.noctrl.edu/toolbox/examples.htm>, retrieved April 27, 2006.
- Mutumucuo, I.V. (1998). *Improving students' understanding of energy: A study of the conceptual development of Mozambican first-year university students*. Doctoral dissertation. De Boelelaan (NL): VU Huisdrukkerij, Amsterdam.
- National Research Council (NRC) (2001). *Knowing what students know: the science and design of educational assessment*. Committee on the Foundations of Assessment. J. Pellegrino, N. Chudowsky, and R. Glaser (Eds.). Washington, D.C.: National Academy Press.
- Nieveen, N.M. (1997). *Computer support for curriculum developers: a study on the potential of computer support in the domain of formative curriculum evaluation*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- Nieveen, N.M. (1999). Prototyping to reach product quality. In J. van den Akker, R.M. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.), *Design approaches and tools in education and training*. Boston: Kluwer Academic, 125-136.
- Ogunniyi, M.B. (1986). Two decades of science education in Africa. *Science Education*, 70, 111-112.
- Ottevanger, W.J.W. (2001). *Teacher support materials as a catalyst for science curriculum implementation in Namibia*. Doctoral dissertation. Enschede (NL): PrintPartners Ipskamp.
- Palme, M. (1992). *O significado da escola. Repetência e desistência na escola primária moçambicana*. Maputo: INDE.

- Pelgrum, W.J. (1989). *Educational assessment: Monitoring, evaluation and the curriculum*. De Lier: Academic Boeken Centrum.
- Piaget, J. (1972). *The science of education and the psychology of the child*. New York: Orion Press.
- Plomp, T. (2004). *Quality assurance in Netherlands education*. Workshop held at the University of Pretoria, 5 August.
- Plomp, T. (2006). *Educational Design Research: a research approach to address complex problems in educational practice*. Paper presented at The Fifth International Forum on Educational Technology, October 29-30, Central China Normal University, Wuhan, China.
- Popham, W.J. (2002). *Classroom assessment. What teachers need to know* (3rd ed.). Boston, MA: Allyn and Bacon.
- Popov, O. (1994). *Qualidade e avaliação em Ciências Naturais no Ensino Primário em Moçambique*. Maputo: INDE.
- Race, P., Brown, S., & Smith, B. (2005). *500 tips on assessment* (2nd ed.). London and New York: RoutledgeFalmer.
- Reeves, T.C. (2000). Socially responsible educational technology research. *Educational Technology*, 40(6), 19-28.
- Richey, R., Klein, J., & Nelson, W. (2004). Developmental research: Studies of instructional design and development. In D. Jonassen (Ed.), *Handbook of research on educational communications and technology* (2 ed.) (pp. 1099-1130). Mahwah, NJ: Lawrence Erlbaum Associates.
- Seels, B.B., & Richey, R.C. (1994). *Instructional technology: The definitions and domains of the field*. Washington, DC: Association for Education and Communications and Technology.

- Shavelson, R.J., McDonnell, L.M., & Oakes, J. (1987). *Indicators for monitoring mathematics and science education: a sourcebook*. Santa Monica (CA, USA): The RAND Corporation.
- Sitoe, A. (2006). *Epistemological beliefs and perceptions of education in Africa: An explorative study with high school students in Mozambique*. Doctoral dissertation. Groningen (NL): Centre for Development Studies.
- Stiggins, R. J. (1987). The design and development of performance assessments. *Educational Measurement: Issues and Practice*, 6, 33-42.
- Sykes, G. (1999). Teacher and student learning: Strengthening their connection. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 151-179). San Francisco: Jossey-Bass.
- Tamir, P. (1991). Practical work in school science: An analysis of current practice. In B.E. Woolnouth (Ed.), *Practical science* (pp. 13-20). Milton Keynes: Open University Press.
- Teclé, A. T. (2006). *The potential of a professional development scenario for supporting biology teachers in Eritrea*. Doctoral dissertation. Enschede (NL): University of Twente.
- Tessmer, M. (1993). *Planning and conducting formative evaluations*. London: Kogan Page.
- Thijs, G.D. (1987). Conceptions of force and movement. In J.D. Novak (Ed.). *Proceedings of the Second International Seminar on Misconceptions and Educational Strategies in Science and Mathematics*. Vol. III. Ithaca, N.Y.: Cornell University, pp. 501-513.
- Thijs, A. (1999). *Supporting science curriculum reform in Botswana: the potential for peer coaching*. Doctoral dissertation. Enschede (NL): University of Twente.

- Treagust, D.F., Duit, R., & Fraser, B.J. (1996). *Teaching and learning in science and mathematics*. New York: Teachers College Press.
- UNDP (2000). *Human Development Report – Mozambique*. Maputo: UNDP.
- UNDP (2004). *National Human Development Report, 2003*. Maputo: UNDP.
- van den Akker, J. & Plomp, Tj. (1993). *Development research in curriculum: Propositions and experiences*. Paper presented at AERA Annual Meeting, April 12-16, Atlanta.
- van den Akker, J. (1999). Principles and methods of development research. In J.V.D. Akker, R. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.) (1999). *Design approaches and tools in education and training*. Dordrecht: Kluwer.
- van den Akker, J. (2003). Curriculum perspectives: An introduction. In J. V. D. Akker, W. Kuiper & U. Hameyer (Eds.), *Curriculum landscapes and trends* (pp. 1-10). Dordrecht: Kluwer Academic Publishers.
- van den Akker, J., Gravemeijer, K, McKenney, S., & Nieveen, N. (Eds.). (2006). *Educational design research*. London: Routledge. ISBN10: 0-415-39635-2
- van den Berg, E., & Giddings, G. (1992). *An alternative view of laboratory teaching*. Bentley: Curtin University. Monograph.
- Walker, D. (1992). Methodological issues in curriculum research. In P. Jackson (Ed.), *Handbook of Research in Curriculum* (pp. 98-118). New York: Macmillan.
- Weeden, P., Winter, J. & Broadfoot P. (2002). *Assessment: What's in it for schools?* London: Routledge Falmer.
- White, R., & Gunstone, R. (1992). *Probing understanding*. London, New York and Philadelphia: The Falmer Press

Wiggins, G. P. (1993). *Assessing student performance*. San Francisco: Jossey-Bass Publishers.

Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, London, New Delhi: Sage Publications.



SECTION 1
C: ASSESSMENT PRACTICES APPLIED BY TEACHERS AND THEIR QUALITY

1. Why do you do assessment in your classroom? Tick all that apply.

- a. to maintain social environment in the classroom
- b. to place students
- c. to plan and conduct instruction
- d. to provide feedback and incentives
- e. to diagnose students' strengths and weaknesses
- f. to judge and grade learning and progress
- g. to provide information to policymakers
- h. to satisfy the demands of the parents
- i. others (specify)_____.

2. How well do students understand the purpose of assessment that you apply?
Tick the appropriate box.

- a. don't understand
- b. understand some of it
- c. understand most of it
- d. understand very well

3. How much of the teaching time do you spend in your class on assessment per week? Tick the appropriate box.

- a. less than 1/4h
- b. between 1/4h – 1/2h
- c. between 1/2h – 3/4h
- d. between 3/4h – 1h
- e. more than 1h



4. How often do you use each of the following assessment practices? Tick the appropriate box.

	a. Never	b. Monthly	c. Weekly	d. Daily
4.1 performance assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 portfolio assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 homework	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 paper-and-pencil tests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5 projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.6 quizzes (verbal tests)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.7 worksheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.8 peer-assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. How often do you: Tick the appropriate box.

	a. Never	b. Sometimes	c. Frequently	d. Always
5.1 judge student performance using a certain criterion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2 use scoring sheets to explain in advance each criterion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.3 determine how acceptable is a student's performance really is.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4 determine a student's progress through his/her particular evolving work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.5 allow students to evaluate their own work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.6 allow students to supply their answers to the questions in writing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.7 provide students with direct questions rather than incomplete statements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.8 allow students to assess the work of their colleagues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.9 allow students to assess their own work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.10 use oral questions to judge the student performance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.11 give homework to students.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



SECTION 2

D: RELEVANCE OF ASSESSMENT PRACTICES

1. How do you inform students about a planned assessment? *Tick only one box.*

- a. I never inform them
- b. orally
- c. through a written note
- d. other, specify_____.

2. How do you engage students in the evaluation of their performance? *You can tick more than one box*

- a. I don't involve them at all
- b. by handing the results out
- c. by involving them in self-assessment
- d. by sharing with them the goals to be achieved
- e. by explaining them the implications of the results
- f. by reflecting with them on the assessment data

3. What kind of advice do you give to students when you hand out the results? *Tick only one box.*

- a. I give no advice at all
- b. I give some comments on the students' weaknesses
- c. I give some comments on the students' strengths
- d. I give some comments on both strengths and weaknesses
- e. I do a review and reflection on assessment data
- f. other, specify_____.

4. How often do you use the assessment results in class teaching and assessment?

Tick the appropriate box.

a. Never b. Sometimes c. Frequently d. Always

4.1 to assign a grade	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 to identify strengths and weaknesses of the students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 to help students know and recognize the standards they are aiming for	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 to encourage active involvement of students in their own learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E: END NOTES

	Completely happy	Fairly happy	Partially happy	Not at all happy
1. How did you feel about answering these questions? <i>Tick only one box</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you have any other comments to make?	----- ----- ----- ----- ----- -----			

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE



B.2 TEACHING/LEARNING ENVIRONMENT	UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA		Condition/Comments
	Yes	No	
1. Are there displays in the classroom (such as <i>Physics models, lens, graphs etc.</i>)?			
2. Are there commercial posters on the walls?			
3. What <i>media</i> equipment is available in the classroom (such as <i>computers, overhead projector, TV/Monitors, tape recorders, videos etc.</i>)?			
4. Are there teacher-made posters on the walls?			
5. Does the teacher use worksheets?			
6. Are there displays of students' work?			
7. Has every student got a Physics textbook? (if a group of student shares a textbook indicate how many students are there per group)			
8. Is Physics equipment available? (Note what equipment is available)			
9. Is the available Physics equipment used by the teacher?			
10. Is the available Physics equipment used by the students?			

C. DESCRIPTION OF STUDENTS
1. How many students are in the class including those who are absent?
2. How many boys and girls are in the class?
3. Other comments with regard to the students. (Look at dress, general appearance of the students, jewellery, anything that could be related to SES)
4. Is there anything else that you observed that is important for this research that was not included in this schedule?

D. DESCRIPTION OF TEACHERS ASSESSMENT PRACTICES AND OF THEIR QUALITY

1. Extent to which assessment practices are applied presently

	a	b	c	d	e
1.1 Performance assessment	i) <input type="checkbox"/> N/A	<input type="checkbox"/> student performance is not judged	<input type="checkbox"/> students performance is judged	<input type="checkbox"/> students performance is judged by certain criteria	<input type="checkbox"/> students performance is judged by multiple criteria
	ii) <input type="checkbox"/> N/A	<input type="checkbox"/> criteria are explained	<input type="checkbox"/> some criteria are explained but not by prepared scoring sheets	<input type="checkbox"/> some criteria are explained by prepared scoring sheets	<input type="checkbox"/> all criteria are explained by prepared scoring sheets
	iii) <input type="checkbox"/> N/A	<input type="checkbox"/> acceptability of student's performance is not determined	<input type="checkbox"/> acceptability of student's performance is determined	<input type="checkbox"/> acceptability of student's performance is determined by specific criteria	<input type="checkbox"/> acceptability of student's performance is determined by exclusively through human judgment
1.2 Portfolio assessment	i) <input type="checkbox"/> N/A	<input type="checkbox"/> student progress is not determined	<input type="checkbox"/> student progress is determined	<input type="checkbox"/> student progress is determined by some student evolving work	<input type="checkbox"/> student progress is determined by particular student evolving work
	ii) <input type="checkbox"/> N/A	<input type="checkbox"/> there is no ability of the students to evaluate their own work	<input type="checkbox"/> some students are able to some extent to evaluate their own work	<input type="checkbox"/> the ability of some students to evaluate their own work is increased somewhat	<input type="checkbox"/> the ability of all students to evaluate their own work is greatly increased

	iii) <input type="checkbox"/> N/A	<input type="checkbox"/> the student growth is not evaluated	<input type="checkbox"/> some student growth is evaluated sometimes	<input type="checkbox"/> all student growth is evaluated sometimes	<input type="checkbox"/> all student growth is evaluated over time
1.3 Paper-and-pencil tests	a	b	c		
	i) <input type="checkbox"/> N/A	<input type="checkbox"/> student do not select answers	<input type="checkbox"/> student select answers from many options		
	ii) <input type="checkbox"/> N/A	<input type="checkbox"/> student do not select answers	<input type="checkbox"/> student select the true or false answer		
	iii) <input type="checkbox"/> N/A	<input type="checkbox"/> student do not match answers	<input type="checkbox"/> student match corresponding answers		
	iv) <input type="checkbox"/> N/A	<input type="checkbox"/> student do not supply answers	<input type="checkbox"/> student supply answers through filling in blank spaces or constructing his/her own responses		
	a	b	c	d	e
	i) <input type="checkbox"/> N/A	<input type="checkbox"/> homework is not given	<input type="checkbox"/> homework given but not marked	<input type="checkbox"/> students mark own homework	<input type="checkbox"/> students homework marked by the teacher
	ii) <input type="checkbox"/> N/A	<input type="checkbox"/> homework is not checked by the teacher	<input type="checkbox"/> homework checked monthly by the teacher	<input type="checkbox"/> homework checked weekly by the teacher	<input type="checkbox"/> homework checked daily by the teacher

iii)	<input type="checkbox"/> N/A	<input type="checkbox"/> homework is not shown to parents	<input type="checkbox"/> homework is shown to parents	<input type="checkbox"/> homework is checked by parents	<input type="checkbox"/> homework is signed by the parents
...iii)	<input type="checkbox"/> N/A	<input type="checkbox"/> homework is not checked	<input type="checkbox"/> some homework checked for some students	<input type="checkbox"/> all homework checked for some students	<input type="checkbox"/> all homework checked for all students

1.5 projects	a	b	c	d
i)	<input type="checkbox"/> N/A	<input type="checkbox"/> students do not do an elaborated piece of work	<input type="checkbox"/> students do an elaborated piece of work	<input type="checkbox"/> students do a pre-set elaborated piece of work
ii)	<input type="checkbox"/> N/A	<input type="checkbox"/> students do not have assignments out of school	<input type="checkbox"/> students do some assignments out of school environment	<input type="checkbox"/> students do some assignments out of school environment over several days
iii)	<input type="checkbox"/> N/A	<input type="checkbox"/> students do not produce reports of their work	<input type="checkbox"/> students produce reports of their work	<input type="checkbox"/> students produce reports of a pre-set structure piece of work

1.6 Others

2. The quality of the assessment practices as demonstrated by teachers and students

	a. Never	b. Some of the time	c. Most of the time	d. Always	
2.1. The teacher provides the students with the objectives of the assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments (Cts)_____
2.2 The teacher discusses with the students the intended learning outcomes of the assessment task	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.3 The teacher provides clear and consistent procedures for the assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.4 The resources available are adequate for the requirements of the assessment procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.5 The time allocated is sufficient for the requirements of the assessment procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.6 The teacher assigns homework at the end of each lesson	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.7 The teacher collects the student's assignments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.8 The teacher takes note of each student's mark	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.9 -The teacher explains the students how far they have achieved the intended outcomes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.10 The teacher discusses the assessment results with students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.11 The teacher discusses the assessment results with colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
2.12 The teacher gives feedback to the students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____

3. Are assessment practices appropriate for instruction?

	a	b	c	d	
	Never	Some of the time	Most of the time	Always	
3.1 Students informed about what will be assessed and how	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.2 Relevant procedures and follow-up actions designed in consultation with students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.3 There is a balance between giving marks and giving advice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.4 When possible, students are engaged in the evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.5 When possible, parents are involved in the evaluation of the students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.6 Teachers use assessment practices as integral to teaching	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.7 Teachers involve students in sharing goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.8 Teachers help students know and recognize standards are aiming for	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.9 Teachers provide feedback to students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.10 Teachers involve students in self-assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.11 Teachers involve students in peer-assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.12 Teachers encourage active involvement of students in their own learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____
3.13 Teachers and students are involved in reviewing and reflection on assessment data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts _____

4. How valid and reliable are the assessment practices?

	a	b	c	d	
	Never	Sometimes	Frequently	Always	
4.1 Cover all the important aspects of specific Physics topic to be assessed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comments (Cts)_____
4.2 Assessment methods allow one to make valid decisions on instruction and assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.3 Assessment questions allow students to demonstrate the performance being assessed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.4 Directions and wording are clear enough that students know what is expected of them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.5 Assessment is related to what the students have been taught	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.6 The scoring procedures are clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.7 The scoring procedures are consistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____
4.8 The scoring procedures are unbiased	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cts_____

Appendix C: Interview schedule for teachers

This interview was designed as part of a doctoral study project and will be conducted only for graduation purposes. You and your school were chosen to help the project and your school to find out more about the assessment practices currently in use and, if the need is there, how to improve them. The interview will be conducted in an informal and conducive environment and it will not last more than thirty minutes. All the information to be gathered from the interview is confidential and your identity as interviewee will be kept unknown. Feel free to answer the questions and be as honest as possible.

1. How do you assess your students in the classroom during the year?
-How do you know your students are making progress?
2. How does this compare to the information collected by the exam at the end of the year?
3. What is the purpose of your classroom assessment?
4. Do you think that your students understand the main purposes of the assessment?
- Why?
5. How often do you assess your students per week?
6. What do you understand by “performance assessment”?
-Is this different from what you do, for instance, in paper-and-pencil tests?
7. How do you assess project work?
8. What do you understand by “portfolio assessment”?
- Have you ever determined a student’s progress through his/her particular evolving work?
- How?
9. How do you assess student’s homework?

10. Do you do peer-assessment in your class and can you tell me about this?

-Do you allow students to assess their own work or that of their colleagues?

11. Tell me what do you do with the assessment results of your students

12. How do you evaluate the performance of your students?

13. Do you have any other comments to make?

Appendix D: Interview schedule for school directors

This interview was designed as part of a doctoral study project and will be conducted only for graduation purposes. You and your school were chosen to help the project and your school to find out more about the assessment practices currently used by teachers in your school and, if the need is there, how to improve them. The interview will be conducted in an informal and conducive environment and it will not last more than thirty minutes. All the information to be gathered from the interview is confidential and your identity as interviewee will be kept unknown. Feel free to answer the questions and be as honest as possible.

1. How do teachers assess their students in the classroom during the year?
-How do you know the teachers are assessing their students?
2. How does this compare to the information collected by the exam at the end of the year?
3. What is the purpose of teachers' assessment?
4. Do you think that the teachers understand the main purposes of the assessment?
-Why?
5. Can you tell me about the frequency of teachers' assessment?
- How often do teachers assess their students per week and how do you come to know?
6. What do you understand by "portfolio assessment"?
-Is this different from what teachers do, for instance, in paper-and-pencil tests?
7. Tell me what do you do with the assessment results of students
8. How do you evaluate the performance of your students?
9. Do you have any other comments to make?

Appendix E: Interview schedule for pedagogical officers

This interview was designed as part of a doctoral study project and will be conducted only for graduation purposes. You were chosen to help the project and the schools to find out more about the assessment practices currently used by teachers in schools and, if the need is there, how to improve them. The interview will be conducted in an informal and conducive environment and it will not last more than thirty minutes. All the information to be gathered from the interview is confidential and your identity as interviewee will be kept unknown. Feel free to answer the questions and be as honest as possible.

1. According to the Ministry, what are the objectives of the teachers when they assess their students in the classroom during the year?
2. How does this compare to the information collected by the exam at the end of the year?
3. In your opinion, what should be the purpose of teachers' assessment?
4. Do you think that the teachers understand the main purposes of the assessment?
- *Why?*
5. Can you tell me about the frequency of the inspectorate visits to schools and teachers?
- *What are their main purposes?*
6. What are the Ministry's mechanisms of verifying how teachers are assessing their students?
- *How are they efficient?*
7. What do you understand by "portfolio assessment"?
- *Is this different from what teachers do, for instance, in paper-and-pencil tests?*
8. Tell me what do teachers do with the assessment results of students

9. How do you evaluate the performance of your students?

10. Do you have any other comments to make?

Appendix F: Guide for expert appraisal

My request is that you help me review the evaluation instruments G, H, I, J and K for *consistency* with the design guidelines in documents (a) “Demonstration experiments” and (b) “Template for the Demonstration Experiment Report”. To guide the appraisal the following questions can be considered:

1. Is there consistency between evaluation instruments G to K and:
 - a) Demonstration experiments
 - b) Template for the Demonstration Experiment Report

2. Are the various items in each evaluation instrument (G to K) specific enough to convey the intentions of the developer of establishing *practicality*?

3. Please use questions 1-2 to make comments and suggestions for improvement of the material enclosed.

Appendix G: University students' questionnaire (before tryout)

Dear student,

You have been chosen to participate in the appraisal of the Physics demonstration experiment materials intended to promote Physics learning by specifically focusing on assessing students' understanding of the inertia. The questionnaire focus on how did you perceive *practicality* of the materials as used in the classroom in terms of relevance, structure, content, and presentation as well as the suitability of the POE strategy. The information that you provide will help to improve the teaching and assessment of Physics.

1. Please describe your general impression about the prototype in terms of:

a. Relevance of material:

b. Structure:

c. Relevance of the content:

d. Presentation:

1. What did you like and dislike about the experiments? Why?

2. What things would you like to have taken out of these experiments?

3. What things would you like to have added to these experiments?

4. What potential problems do you foresee about doing these experiments in class?

5. Do you feel that the POE teaching strategy is helpful for students' reasoning?

How?

6. Any other comments or suggestions

Thank you very much for your cooperation!

Appendix H: University student's follow-up interview (before tryout)

Dear student,

The interview focus on how did you perceive *practicality* of the performance assessment materials as used in laboratory demonstrations in terms of relevance of the content, presentation of the material, and the POE strategy.

1. What general comment can you make about the material and the experiments with inertia?
2. At what extent the prototype is useful for the preparation of the experiments?
3. What things would you like to see in the prototype and they are missing?
4. What specific comments can you make for each experiment?
5. What do you feel about the *practicality* of the POE strategy?
6. How do you consider the time allocated for teaching the syllabus to accommodate the suggested strategy?
7. Do you think the teachers will like the approach? Why or why not?
8. Do you think the students will like the approach? Why or why not?
9. Do you think that the teacher's role was clear? And that of the students? Explain.
10. Do you have any comments or suggestions for improvement?

Appendix I: Teacher's evaluation questionnaire (after tryout)

Dear teacher,

You have participated in Physics demonstration experiments intended to enhance Physics learning. The experiments followed a Predict-Observe-Explain (POE) strategy and focused on assessing students' understanding of the concepts of force and inertia. By means of this questionnaire I would like to have your opinions about the approach and the materials used, and your experiences with student performance assessment in the demonstration experiments. The information that you provide will help to improve the design and development of Physics assessment practices and the teaching of Physics in general.

1. General information

Date ____/____/____ Classes taught _____ Your age _____

Academic qualifications _____

Teaching experience (years) _____ In this subject (years) _____

2. General impression of the Physics assessment materials (Part 3 of this document)

2.1 Is the language clear and understandable for students? *Circle on the correct number.*

1. Yes 2. No

If not, explain what the problems were? _____

2.2 Was the description of the experiments clear for the students or did they have many questions? If there were many questions what were the students' questions? _____.

2.3 Were the pictures clear? *Circle on the correct number.*

1. Yes 2. No

If not, what are the needed improvements? _____

2.4 Was the teacher's guide (Part 2 of this document) useful during preparation of the experiments? *Circle on the correct number.*

1. Yes 2. No 3. Partly

Which parts were useful and why? _____

Which parts need improvements and why? _____

2.5 How much time did you spend in each activity?

<i>Activity</i>	<i>Time spent (minutes)</i>
Looking for the equipment	_____
Trying out each experiment	_____
Grouping the students	_____
Introducing the task to the students	_____
Other, specify _____	_____

3. Teaching and assessment strategy

3.1 Was the POE strategy of teaching and assessment practical for students' reasoning?

Circle on the correct number.

1. Yes 2. No 3. Partly

Which parts were useful and why? _____

Which parts need improvements and why? _____

3.2 What was your role as a teacher during the experiment? *Tick one or more options*

Explainer of all students

Active participant

Guide students with difficulties

An interested spectator

Other, specify _____

3.3 Where there students who were not active during the experiments? *Circle on the correct number.*

1. Yes 2. No

If yes, why? _____

3.4 Do you feel that the main objective of these experiments was achieved? *Circle on the correct number.*

1. Yes 2. No

If not, please indicate which particular aspects were not met and why. _____

3.5 Do you feel the prototype as a whole needs any changes or additions? *Circle on the correct number.*

1. Yes 2. No

If yes, what changes? _____

3.6 Any other comments or suggestions: _____

Thank you very much for your cooperation!

Appendix J: Follow-up interview with teachers (after tryout)

The interview focus on how did you perceive *practicality* of the performance assessment materials as used in laboratory demonstrations in terms of relevance of the content, presentation of the material, and the POE strategy.

1. Personal data

Age, qualifications, teaching experience, position in school, others.

2. Expectations

- a. What did you expect about conducting the experiments about force and inertia?
 - i. Organizational problems
 - ii. Discipline problems
 - iii. Other problems
- b. While you were conducting the experiments, were they as you expected? Explain.
- c. After the experiments, have you met your expectations?

3. General impression of the material

- a. Please describe your general impressions about the material and the experiments.
- b. What specific comments can you make for each demonstration experiment?
- c. What did you like and dislike about the demonstration experiments, and why?
- d. What is your impression of the structure and clarity of the assessment materials?
- e. Do you feel that the materials are practical and usable in terms of resources/equipment needed to carry out the experiments? Explain.

- f. Was it easier to follow the POE strategy and how much of this constituted a problem in your guidance of students through the experiments?
- g. How do you consider the time you have for teaching the syllabus to accommodate the suggested practice?

4. Teaching and assessment strategy

- b. What do you feel about the *practicality* of the POE strategy?
- c. Do you think that your role as a teacher was clear? And that of the students?
- d. What do you think was expected of you during the demonstration experiments in terms of formative assessment of the students' work
- e. How do you find the assessment of the students' work through the lab report?
- f. How practical was the use of POE strategy in terms of conducting and assessing the demonstration experiments?
- g. How do you compare the POE strategy with the way you used to conduct your demonstration experiments?
- h. Do you have any comments or suggestions for improvement?

Appendix K: Students' questionnaire (after tryout)

Dear student,

During the last days you were involved in some demonstration experiments about force and inertia. I would be grateful to receive your comments about all the activities you were involved in including the writing of the demonstration experiment report. There are no wrong or right answers and, please, do not discuss your views with someone else while answering this questionnaire.

1. Date ____/____/____ Class _____ Age _____ years old

2. What did you like and dislike about the experiments?

I liked: _____

I disliked: _____

3. What did you like most about the experiments? _____

Please, state the reasons why. _____

4. What did you like least about the experiments? _____

Please, state the reasons why. _____

5. Were the demonstration experiments different from the usual Physics experiments you are used to in your class? *Please tick the appropriate box*

Yes

No

If yes, what were the differences? _____

6. How do you describe your participation in the experiments? *One option in each line*

Passive 1 2 3 4 Active

Dependent 1 2 3 4 Independent

Uninterested 1 2 3 4 Interested

Any other comment: _____

7. Do you think that all other members of your group were active? *Please tick the appropriate box*

Yes

No

If not, why? _____

8. Please tick one or more of the following if you agree with them.

- The prototype was very well structured
- The prototype was unclear and confusing
- The prototype was practical and easy to use in the lab

9. Did you face any problems during the execution of the experiments? *Please tick the appropriate box*

- Yes
- No

If yes, what the problems were?_____

10. Please, write any other comments or suggestions you may have_____.

Thank you very much for your cooperation!

Appendix L: Letter from the Ministry of Education and Culture to schools

TO WHOM IT MAY CONCERN

This is to certify that **Mr Francisco Januário**, from Eduardo Mondlane University, Faculty of Education is authorized to undertake a research project in Francisco Manyanga Secondary School in Maputo. The project, entitled *Investigating and improving assessment practices in secondary schools in Mozambique*, is undertaken in the framework of Mr Januário's doctoral studies held at the University of Pretoria, South Africa. Activities under the project include interactive sessions with Grade 11 and 12 Physics teachers meant to design and develop assessment materials for teachers to use in the classroom. These activities should be undertaken during the normal school period and professional and physical integrity of teachers should be guaranteed.

National Director of General Education

Appendix M: Letter from Eduardo Mondlane University to schools



UNIVERSIDADE EDUARDO MONDLANE
FACULDADE DE EDUCAÇÃO

A Direcção da

Nossa Ref. 287(...)/FACED/05

15 de Agosto de 2005

Assunto - Pedido de permissão para um Estudo

A Faculdade de Educação da Universidade Eduardo Mondlane tem como um dos seus objectivos a melhoria da qualidade do ensino através da elevação da competência do seu corpo docente. Neste âmbito, tem levado a cabo um programa de formação de docentes em diversas áreas educacionais. Neste momento, **o dr. Francisco Januário**, docente desta Faculdade encontra-se envolvido num programa de formação na área de avaliação e controle de qualidade, mais concretamente na disciplina de Física para a 12^a classe do Ensino Secundário Geral, curso diurno.

Assim sendo, a Faculdade gostaria de solicitar permissão, por escrito, à Direcção da Escola que V. Excia dirige para efectuar este trabalho junto dos professores daquela classe e nível. O programa que o docente pretende levar a cabo com os referidos professores consiste no desenvolvimento de protótipos de ensino de Física da 12^a classe sobre um tópico (ex. Mecânica) e de um portfólio de avaliação do mesmo tópico que é uma ferramenta ou *kit* de avaliação que os professores poderão usar na sala de aulas.

Cientes da Vossa colaboração, subscrevemo-nos com alta estima.

Prof Doutor Inocente Mutimucuo

Director Adjunto Para a Investigação e Pós-Graduação

Appendix N: Letter of consent from the researcher to teachers

PEDIDO DE PERMISSÃO DO PROFESSOR PESQUISA E MELHORAMENTO DAS PRÁTICAS DE AVALIAÇÃO EM FÍSICA NAS ESCOLAS SECUNDÁRIAS EM MOCAMBIQUE

Caro professor

Agosto de 2005

Por meio desta carta é convidado a participar num projecto de pesquisa destinado a investigar as práticas de avaliação usadas pelos professores de Física da 12ª classe em Moçambique e como essas práticas podem ser melhoradas. A sua participação no projecto é voluntária e confidencial. Não lhe será pedido a revelar qualquer informação que possa conduzir à identificação da sua identidade, a não ser que manifeste o interesse de ser contactado para ser entrevistado individualmente no âmbito de certificação de informação. Mesmo neste caso, a confidencialidade será garantida e poderá tomar a decisão de abandonar a entrevista a qualquer momento se assim o desejar.

A acompanhar esta carta vai um documento explicando o seu papel no processo de pesquisa.

Os resultados deste estudo serão usados, por um lado, para ajudar na monitoração de melhoramentos qualitativos dos resultados dos alunos e no desempenho do sistema educacional em geral. Por outro lado, espera-se que com o melhoramento das práticas de avaliação por meio de desenvolvimento de protótipos (planos de aula) de ensino de Física e de *portfólios* (kits) de avaliação da mesma disciplina possam servir de ferramenta de apoio ao Ministério de Educação e Cultura na monitoração da qualidade de ensino.

Se desejar participar neste estudo, por favor, assine esta carta como declaração do seu consentimento, i.é., como indicação de que participa no projecto de livre vontade e que compreende que poderá desistir de o fazer a qualquer momento se achar conveniente. A participação nesta fase do projecto não o obriga a participar na posterior entrevista de certificação de informação. No entanto, se decidir participar nesta entrevista, tal participação é também voluntária. Em nenhuma circunstância será revelada à sua escola ou aos seus superiores qualquer informação que o possa prejudicar por ter participado neste projecto.

Assinatura do professor participante _____ Data _____

Assinatura do investigador _____ Data _____

Atenciosamente

dr Francisco Januário

xx

(Teacher's role in the research process)

O papel do professor na pesquisa

O objectivo deste estudo é investigar as práticas de avaliação usadas pelos professores de Física da 12^a classe em Moçambique e como essas práticas podem ser melhoradas. Para isso estão planificadas duas actividades de pesquisa em que o professor estará envolvido.

A primeira consiste no desenho e desenvolvimento de protótipos de ensino de Física da 12^a classe, que são exemplares de planos de aula sobre um tópico (ex. Mecânica) que o professor aborda nas suas aulas. Estes planos contêm passos e estratégias metodológicas de abordagem do tópico nomeadamente a justificação da necessidade de aprendizagem, os objectivos, os conteúdos, as actividades de aprendizagem, o papel do professor na facilitação da aprendizagem e as sugestões de avaliação formativa.

A segunda actividade compreende o desenvolvimento de um portefólio de avaliação do mesmo tópico que é uma ferramenta ou kit de avaliação que o professor poderá usar paralelamente às tradicionais formas de avaliação conhecidas.

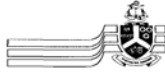
As duas actividades decorrerão sob forma interactiva entre os professores (seleccionados) da disciplina e da classe na sua escola e o investigador. Por vezes será necessário, o envolvimento de alguns alunos seleccionados. As sessões de actividade, ou seja, o desenvolvimento destes materiais decorrerá nas horas normais da actividade do professor,

sendo que não será usado tempo extra à normal actividade laboral. Para casos em que isso possa porventura ocorrer, serão criadas condições logísticas adequadas.

No fim da pesquisa o professor terá dois instrumentos produzidos: um exemplar do plano de aula e um kit de avaliação.

Assinatura do investigador _____


Appendix O: Ethical clearance



UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE DEGREE AND PROJECT	CLEARANCE NUMBER : CS06/03/11 PhD Assessment and Quality Assurance Investigating assessment practices in physics in secondary schools in Mozambique
INVESTIGATOR(S)	F Januario
DEPARTMENT	Curriculum Studies (Centre for Evaluation and Assessment)
DATE CONSIDERED	24 March 2006
DECISION OF THE COMMITTEE	APPROVED

This ethical clearance is valid for 3 years from the date of consideration and may be renewed upon application

CHAIRPERSON OF ETHICS COMMITTEE	Dr C Lubbe 
DATE	24 March 2006
CC	Prof S Howie Mrs Jeannie Beukes

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

Appendix P: Physics Assessment Materials (on a CD - Rom)

xxxxxxxxxxxxxxxxxxxxxxxx

Appendix Q: Certificate of language editing

BERNICE BRADE EDITING

FREELANCE WRITER, PROOF READER AND EDITOR
WEB RESEARCHER AND RESEARCH STRATEGIST
ENGLISH SPECIALIST

Tel. and Fax +27 11 465 4038
Cell 072 287 9859
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28 August 2007

P O Box 940
LONEHILL 2062
South Africa

To whom it may concern

This letter serves to confirm that in August 2007 I proofread
and did the language editing for the Doctoral Thesis of

FRANCISCO JANUARIO

This document is being submitted in fulfilment of the requirements for the
degree

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I have proofread and edited the entire work, except for the Annexures.

This editing principally involves proofreading, language, style and grammar editing; and also checking the text for clarity of meaning, sequence of thought and expression and tenses. I have also noted any inconsistencies in thought, style or logic, and any ambiguities or repetitions of words and phrases, and have corrected those errors which creep into all writing. I have written the corrections on the hard copy and have returned the document to the author who is responsible for inserting these.



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Physics Assessment Materials on Demonstration experiments

(Force and inertia)

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FOR THE TEACHER

PART ONE: INTRODUCTION FOR THE TEACHER

This is a Physics assessment instrument containing materials to be used when teaching and conducting assessment in Physics. The instrument is aimed at investigating and improving assessment practices used by Grade 12 Physics teachers in Mozambican schools. It is based on Mozambican Physics Syllabus for secondary education (Cycle 2, Grades 11 and 12) and uses concepts and materials commonly used by you as a teacher in your daily work. The concepts of *force* and *inertia* are the focus of the assessment materials. In the syllabus some other related topics are dealt with namely friction, space, time, speed, acceleration and the Newton's Laws of motion.

As any assessment is not isolated, but always takes place as part of a teaching and learning process, a set of guidelines on assessment components to be considered when teaching and assessing the concept is provided.

The teaching and assessment strategy used to lead students to understanding the concepts of force and inertia is called *Prediction-Observation-Explanation* (POE). Following this strategy, and in terms of the teaching approach, you may start teaching these concepts by asking students what they already know about them. This introductory session will enable you to facilitate a discussion leading to the comprehension of the topics and using theory and demonstration examples. Then you can guide students to reach to conclusions about the concepts by comparing their initial ideas with what they actually know from their observations and readings of the demonstrations.

In relation to assessment strategy, it is important to start by deciding upon the assessment practice for the concepts. Performance assessment is the appropriate assessment practice to assess force and inertia due not only to its power in assessing students' knowledge but also their competencies. This assessment practice requires students to perform a certain task and assesses their abilities to translate knowledge and understanding into action. Having identified the assessment practice, the POE assessment strategy is applied over the performance assessment practice to specifically assess students' skills and competencies. In this strategy students are required to carry out three different tasks. Firstly, they must predict the outcome of some event, and must justify their prediction. Secondly, they must see or perform a demonstration of the event and must describe what

they see. Finally, they must reconcile any imbalance or conflict between what they predicted and what they have actually observed. In general, students will be required to plan, construct and deliver an original response and to provide evidence of their performance skills.

For more details on how to teach and conduct assessment following the POE strategy, see section 4 (Part 2 of this instrument).

Your comments and suggestions on the quality, design, implementation and evaluation of the instrument are crucial for the improvement of Physics' teaching, learning and assessment.

This instrument consists of five main parts.

- Part 1 (the one you are reading now) presents the place of the concepts of *force*, *inertia*, and *the Newton's First Law* in the Cycle 2 Physics curriculum and the target student population. For your consideration as a teacher, an explanation about how to teach and assess force and inertia concepts using POE strategy is provided in this part. Both teaching and assessment approaches follow the same strategy.
- Part 2 presents an explanation of *components and functions of assessment* to help you develop your own assessment strategies and a practice-oriented teacher's guide containing the *sequence of content and lesson plan*, *some logistical aspects*, and a *plan* on how to teach and assess following the POE strategy.
- Part 3 provides *guidelines* on how to design, mediate and assess demonstration experiments. This section also gives support on *how to provide feedback* to students during and after the course of the demonstration experiments.
- Part 4 starts with presenting *four demonstration experiments* for students to carry out with a set of procedural specifications to guide students through when performing the lab experiments. The section ends with *assessment rubrics* to be used in assessing the students' performance.
- Part 5 presents the *worksheets* that the students will use to carry out the demonstration experiments. The worksheets are composed of two sections: Section 1 (for individual work) corresponds to the first phase of the POE strategy (Prediction) that the students should do before carrying out the demonstration experiment and section 2 (for group work) is the second phase (Observation and Explanation), which is the actual

demonstration experiment and the reconciliation of the data or outcomes. At the end of this section a *glossary of terms* (Appendix P1) used in this instrument and the *Demonstration experiment report Template* (Appendix P2) for students to summarize the demonstration experiments are provided.

PART TWO: COMPONENTS AND FUNCTIONS OF ASSESSMENT

The following subsection provides a description of a number of components and functions of assessment considered relevant when assessing Physics concepts and a glossary of terms used in the document. The concepts of force and inertia are used as examples.

1. Description of the components and functions of the assessment strategy

Five components of assessment strategy are taken into consideration, namely *rationale and setting, aims, content and performance expectations, method, materials and resources, and assessment*.

1.1 Rationale and setting: refers to the aspect of why the teacher is assessing, toward which goals, and in which context the performance assessment is being applied. Reasons for assessing inertia, as it is the case with other topics as well, fall into two main categories, namely formative assessment and summative assessment. For the formative function, inertia is assessed with intention:

- To guide students' improvement through learning from their own mistakes
- To give you, as a teacher, relevant feedback on how your teaching is going
- To help you translate the intended learning outcomes into reality.

For the summative function, the assessment results can help you as a teacher:

- To grade your students
- To check whether educational standards are met, and
- To help students, as graduates, to decide which options to choose in the next educational level.

This draft instrument is more about formative assessment, i.e., the type of assessment you as a teacher undertake regularly in your classroom aimed at monitoring the learning of your students. The aim of this instrument is to assess the students' knowledge and skills of the concepts of force and inertia through a process of carrying out demonstration experiments as to provide you and the students with feedback to improve the students' learning. More specifically, the instrument is designed to enhance students' acquisition of the concepts of force and inertia using demonstration experiments.

As it was referred earlier, students will be assessed in their ability to perform certain tasks. There are several educational contexts where this ability can be assessed. For the topics of force and inertia the classroom context was chosen as the most suitable.

1.2 Content and performance expectations: indicates what is to be taught and assessed, and on which intended learning outcomes the assessment is focused. This assessment component addresses two guiding questions namely (i) *On what content is the assessment focused?* (ii) *What type of knowledge or skills (reasoning, memory or process) is being assessed?*

- The concepts of force and inertia are the focus of assessment. The overall learning expectation is the demonstration and development of explanations about force and inertia.
- As specific learning expectations, at the end of the assessment task students must be able to understand (i) the concepts of force and inertia, and (ii) the relationship between the two concepts and the Newton's Laws of motion.

1.3 Method: it is the most critical assessment component of the materials. Refers to the roles being pursued by both students and teachers to accomplish the aims and tasks described above, the organizational aspects of who is doing what with whom, as well as the point in time where a certain teaching or assessment task is taking place. The component deals with aspects such as:

- (i) A set of tasks that you as a teacher need to undertake in order to prepare the assessment of your students and

- (ii) Your activities or roles during the course of the assessment task including the provision of feedback at the end of the student assessment.

In relation to part (i) it is necessary that you teach the topics that are being assessed following the POE strategy. Demonstrations, explanations and reasoning from experimental data are the most important aspects to be highlighted at this phase. As for part (ii) your role is to monitor and give feedback. Verify whether the students understand what they are doing and identify their strengths and weaknesses. Finally, you must decide on how you are going to assess and evaluate the final ‘product’ of the students’ performance. The suggestion is to use descriptive forms of rating scales or rubrics.

Questions being addressed by this component include (i) *what are the activities of the students?* (ii) *What are the activities of the teacher?* (iii) *With whom are the students doing the assessment?* (v) *At what time in the teaching-learning process the assessment is best applied?* The importance of this component is derived from the context of Mozambican system of education, which is characterized by overcrowded classrooms. Very often and whenever possible, students should and are involved in group work assignments in order to ease the management of the class; but also the individual performance of the students is important particularly for summative purposes. These demonstration experiments will meet both the contexts: students will perform the lab experiments in groups and write the lab report individually. The point in time where certain assessment task is being carried out is also addressed by this component. While some assessment tasks will be conducted simultaneously during the course of the demonstration experiments, others will be carried out at the end. For instance, students will be asked to work in groups carrying out demonstration experiments (performance assessment) and giving explanations of their thoughts; after that they will produce a written report on how did they perform the demonstrations (paper-and-pencil test).

1.4 Materials and resources: this component deals with the question of *what materials and resources are the students being assessed with.* In any assessment task students might require certain type of resources and materials to perform their tasks. Some of the

tasks or strategies will require an adaptation of locally available materials. For example, baseline study findings have revealed that laboratory experiments are almost never conducted in schools due to the lack of lab equipment. In schools where there is some, it is in obsolete conditions. This means that a prior identification of materials and resources for each assessment strategy is of great importance. Amongst other material or equipment the following will be needed for the demonstration experiments: balls, blocks of different mass, but with same substance, bottles, cans, cards, coins, paper, pencils, stopwatches, and cassette players.

1.5 Assessment: besides all other aspects of assessment described above (subsections 1.1 to 1.4) this component address the central question of *how the quality of the students' final product or task is being judged*. Scoring rubrics are used to assess the quality of students' responses and their procedures during the performance task. These rubrics are observable in nature, and they are specific aspects a student should perform to properly carry out the demonstration experiment. In order to develop observable scoring criteria for the proposed POE strategy, analytic scoring rubrics are considered due to its suitability not only for feedback and coaching purposes but also for formative and summative intentions. The rubrics range from poor (0-4), satisfactory (5-9), good (10-14), to excellent (15-20), and are accompanied by detailed descriptions of the different degrees of performance level.

2. Sequence and content of lesson periods

Table 1 summarizes the demonstration experiments presented in this instrument and the corresponding lesson periods.

Table 1: Content and lesson periods

Nr	Demonstration experiment	Lesson period
1	<i>Introduction to the force concept – forces on a soccer ball:</i> The objective of this demonstration experiment is to introduce the concept of force. In order to help students understand this concept, the POE strategy is suggested, which will allow them to compare their commonsense beliefs with the experimental results (scientific theory).	90 minutes
2	<i>Identification and comparison of forces – the trolley:</i> The objective of this demonstration experiment is to help students identify and compare forward and backward forces exerted on a moving object at constant speed. Through empirical evidence the demonstration experiment helps students to understand that they hold some alternative conceptions about the nature of a force which are not necessarily in line with the scientific view.	
3	<i>Introduction to the concept of inertia 1 - a coin on top of a can:</i> The objective of this demonstration experiment is to teach the concept of inertia through analysing the behavior of a coin put on a piece of a card, which is on a can. By using the POE strategy, students are firstly required to predict what will happen to the coin if the card is flicked quickly, then to perform the demonstration experiment themselves (in groups) and finally to draw a reconciliation between the prediction and observation.	90 minutes
4	<i>Introduction to the concept of inertia 2 - a bottle on a paper:</i> This demonstration experiment is also about introducing the concept of inertia when a force is acting on an object at rest. The bottle is put horizontally on a piece of paper, which is on the top of a table. You are required to realise that after flicking quickly the paper, the bottle continues at rest. Again, the POE strategy is used to assess your understanding of inertia.	
5	<i>Demonstration Experiment Report:</i> Explanation of the aim, procedures, methodology, and due date for preparing the laboratory report by students.	

Note: All lessons were planned to fit within the time allocated for Physics lessons in the teacher's timetable (two double periods of 90 minutes, per week).

3. Preparation of the lesson

3.1 Preparation

- Decide on the number of students in a group and on the number of groups per class.
- List all material or equipment required for each group per lesson or demonstration experiment (see also section 1.4).
- Try-out before you hand all the demonstration experiments and make sure they are running properly and as intended.
- Think about potential problems you think students may face during manipulation of the equipment or when carrying out the demonstration experiments. List them down and devise possible solutions.

3.2 Organization of the demonstration experiments

- Grouping of students: Form students' group small enough to allow each student to interact. A suggestion is to have a maximum number of four students per group. Whenever possible, establish gender balance and maintain the same groups for the four lessons. In each group appoint a chairperson to coordinate group tasks (e.g., who will present group results or collect the equipment after the lesson).
- Introducing the task: Explain the purpose of each demonstration experiment at the beginning of each lesson and what is expected from the students.
- End of the lesson: Always ask groups to collect and store the materials immediately after each lesson.

4. Execution of the lesson: a practice-oriented lesson plan

4.1 Start of the lesson (maximum 5 mn)

You may start the lesson by:

- Stating the objectives of the lesson (emphasizing the POE strategy) and clarifying what is to be achieved at the end of the demonstration experiments.

- Explaining the working methodology: tell the students that everyone must work in the classroom and they must work in groups of a maximum number of four students each.

4.2 Activity: demonstration experiments

(i) Prediction (maximum 10 mn)

Start the demonstration experiments by assigning the groups and its distribution in their places. First distribute the Students' Worksheet 1 (about Prediction) for each student. Guide the students in answering this part individually.

- While the students are looking for answers to the questions posed on prediction section, help them to do the reasoning, only as a moderator!

(ii) Demonstration experiment (maximum 15 mn)

Distribute the necessary material for the demonstration experiment and the Students' Worksheet 2 (Observation and Reconciliation). Ask the students to have pencils and sheets of paper for calculations.

- Ask students to perform the demonstration experiment in groups following the steps indicated on the Students Worksheet.
- While they are doing the demonstration experiment and answering to the questions posed on the observation section, keep helping them doing the reasoning, but only as a moderator.

(iii) Reconciliation (maximum 10 mn)

Guide students on how to compare and explain consistencies or lack of them between results from the prediction and from the observation, only as a moderator!

4.3 Assessment and feedback (to be considered throughout the lesson)

As stated earlier in section 4.1 you must start the lesson by asking brief questions to students on what they already know about the concept being examined (or other related) and verify whether the students understood the intended learning outcomes. Then, during

the demonstration experiments, you may formatively evaluate the students' work through:

-observing what students do (individually or in groups) making sure that they are following the working procedures accordingly. Whenever possible, you must ask probing questions (e.g., why this is happening and not the other way round?);

-encouraging students to discuss amongst themselves several aspects of the demonstration experiment;

-allowing students (for instance, during the reconciliation phase) to reflect on differences or similarities of their predictions and on those observed during the demonstration experiments and allow comparisons between their ideas with those of their colleagues.

Remember, your role is to facilitate the students' work, and should act only as a moderator.

4.4 Conclusion and end of the lesson (maximum 5 mn)

You may round off the lesson by:

- Recapitulating the objective of the lesson and explaining at what extent the intended learning outcomes have been achieved;
- Explaining the students what their answers or opinions will be used for and how they are going to evaluate and summarise their demonstration experiments (by writing and submitting a demonstration experiment's report or filling in an evaluation experiment questionnaire);
- Asking students to clean up and return the materials used in the demonstration experiments.

PART THREE: DESIGN GUIDELINES AND FEEDBACK PROVISION

This section intends to provide some guidelines on how to design and monitor demonstration experiments in the classroom and to facilitate students' learning through provision of formative feedback. Since demonstration experiments is some kind of practical work, the design guidelines presented in this section could also be used for any practical work in general.

3.1 Design guidelines

When deciding on preparing laboratory demonstration experiments teachers must consider the design guidelines listed below.

a) Agreement - the teacher and the students must agree on the relevance of the *problem* to be investigated, the *procedures* to be followed, and the *conclusions* of the evaluation of the explanations given during the experimental work.

b) Intended learning outcomes – the teacher must be *prescriptive* about the ideas that the students are supposed to acquire and develop. The students must understand the procedure to be followed in order to achieve the proposed ideas.

c) Students' participation – In practical work, particularly in demonstration experiments the teacher must *produce the event* to be investigated according to the purpose to be achieved, while the students attempt to *interpret it and make sense of it*. In so doing, the teacher may find a balance between his/her expository approach (which has its own educational value) and the student-centred exploratory approach.

d) Type of demonstration experiment and aims - Teachers must avoid having too many aims of the demonstration experiment to be achieved at once. This may lead to none being pursued. Rather, they must *select proper demonstration experiment for the chosen aim* and matching the written instructions with these. Students should not be

involved in activities that may distract their attention from the aim of the demonstration experiment.

e) Critical thinking and reporting – Teachers are to make sure that students develop a *critical attitude towards their actions* and interpret the activity's data only in the light of the experimental work pursued and of their own knowledge and experience. They should also be able to *summarize and report* the main aspects of the demonstration experiment including the central aim and outcome, the basic methods applied, and the underlying theory of the demonstration experiment.

The following is a list of aspects that can be used to monitor students' learning in the context of demonstration experiments. These aspects are mainly aimed at supporting teachers on how to provide formative feedback to students particularly during the course of the demonstration experiments. Support in lesson preparation and in lesson evaluation (summative assessment) is also provided. It is, however, important to note that this list does not intend to suggest reinforcement of rather traditional (i.e., teacher-centred) implementation context of Mozambican teachers but it deliberately contains statements on what is perceived to be relevant teachers' actions for the context of demonstration experiments.

3.2 Feedback provision

When facilitating demonstration experiments teachers must be able:

a) Lesson preparation

- To take time to read the support materials and reflect on the demonstration experiments well in advance. It helps clarify ideas about the outcomes being pursued.
- To assemble and tryout each demonstration experiment before the actually lesson starts. It is crucial for detecting potential problems (e.g., shortage of equipment, time constraints for conducting the demonstration experiment, inappropriate set-ups and procedures).

b) Course of the lesson

- To start the lesson by asking brief introductory questions to students on what they already know about concepts or events to be investigated.
- To state the objectives of the lesson, clarify the outcome to be achieved at the end of the demonstration experiment(s), and explain the teaching and assessment methodology to be followed (including the procedures).
- To observe what students do and ask probing questions to help them reflect on their activities. This is important to focus students' attention on important elements of the demonstration experiment.
- To encourage students to discuss amongst each other. It helps them to develop their own models of learning and the capacity of the class to function as a community of learners.
- To give opportunity to students to reflect on their own tasks and on those of their colleagues in a critical way.
- To keep in mind that the teachers' role in the demonstration experiments is to help students doing the reasoning, and mainly as a moderator.

c) End of lesson

- To provide immediate feedback to students (when asking probing questions) so that they understand at what extent they have achieved the intended purpose. The feedback should preferably be individual and articulated, i. e., congratulatory or critical.
- To round off the lesson by providing a summary of the main conclusions of the laboratory experiment. Give students homework and ask students to prepare a short report about the demonstration experiment(s). Due to large classes and time constraints, a follow-up to the homework and lab reports can be given on following lessons.

PART FOUR: DEMONSTRATION EXPERIMENTS

This section contains (i) four demonstration experiments about force and inertia for you to guide the students through during the performance of the demonstration experiments following the POE strategy and (ii) assessment rubrics to help you judging the quality of the students' demonstrations.

At the end of the laboratory experiments students are required to write a report to summarize the demonstration experiments. The Demonstration Experiment Report Template is provided at the end of this document (see Appendix P2). The numbers in the sections' titles of the template indicate an approximate number of pages, which each section might typically have. These sections might be clearly titled and organized in the exact manner as shown in the template.

4.1 The demonstration experiments

Demonstration experiment nr. 1:

Introduction to the force concept – forces on a soccer ball

The objective of this demonstration experiment is to introduce the concept of force. In order to help students understand this concept, the POE strategy is suggested, which will allow them to compare their commonsense beliefs with the experimental results (scientific theory).

1.1 Equipment required

- Balls
- A pen
- A piece of paper

1.2 Prediction (individually)

In an idealised system, if a ball is kicked up and travels through the air following a certain trajectory (flight path), which of the following force (s) is (are) on the ball during its entire flight? *Put a tick (✓) in the correct answer; only one alternative is correct.*

- (a) The force of gravity only
- (b) The force of gravity and the force of the 'kick'
- (c) The force of gravity, the force of the 'kick' and the force of air resistance
- (d) The force of gravity and the force of air resistance
- (e) The force of the 'kick' and the force of air resistance

Give reasons for your prediction: _____

1.3 Observation: demonstration experiment (in groups)

In groups of four students each, they should perform the following demonstration experiment:

Kick a soccer ball to travel through the air with a trajectory (flight path) similar to that in Figure 1.

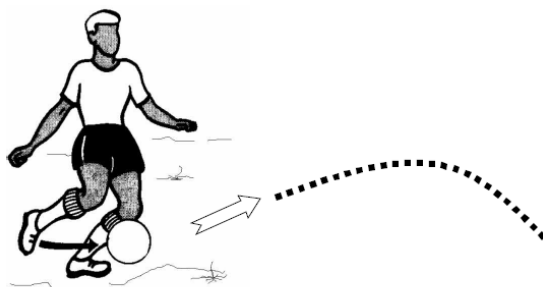


Figure 1: A soccer ball kicked into the air

Repeat the demonstration experiment at least three times. With the help of a graphical representation, indicate which of the following force (s) acts (are) on the ball during its entire flight. *Only one alternative is correct.*

- a) The force of gravity only
- b) The force of gravity and the force of the 'kick'
- c) The force of gravity, the force of the 'kick' and the force of air resistance
- d) The force of gravity and the force of air resistance
- (e) The force of the 'kick' and the force of air resistance

Give explanation of your answer _____

1.4 Reconciliation between prediction and observation (individually):

a) Compare the results of the prediction and those of the demonstration experiment.

Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

Yes No

b) Justify your answer. _____

In an idealised system the ‘correct’ Newtonian response is (a). Taking into account the air resistance, (d) is the correct option. However, the most commonsense students’ misconception is reflected by answers like (b), (c) and (e). This is because students normally think that the force of the kick supplies an impetus to the ball. They develop a kind of ‘container’ metaphor about the impetus concept through which they think that every object is like a container that can store a supply of impetus to keep it moving.

Demonstration experiment nr. 2:

Identification and comparison of forces – the trolley

The objective of this demonstration experiment is to help students identify and compare forward and backward forces exerted on a moving object at constant speed. Through empirical evidence, the demonstration experiment helps students to understand that they hold some alternative conceptions about the nature of force which are not necessarily in line with the scientific view.

2.1 Equipment required

- Trolley
- Spring balances
- Masses
- Strings
- Pulleys
- Cassette player

2.2 Prediction (individually)

A trolley is placed on a smooth and horizontal runway, with spring balances attached to the front and back. At the back, a hanging mass - big enough so that the friction is negligible - is attached to the spring balance by means of string and pulleys.

If the trolley is pulled forward with different and constant speeds (zero, small, medium) how the forward and backward forces will compare for each speed? *Use the symbols: = (equal), < (smaller), > (bigger), << (much smaller), >> (much bigger).*

a) Enter your predictions in the table 1:

Table 1

Speed of the trolley (constant)	Prediction
Zero	F _{forward}F _{backward}
Small	F _{forward}F _{backward}
Medium	F _{forward}F _{backward}

Give reasons for your prediction: _____

2.3 Observation: demonstration experiment (in groups)

In groups of four students each, perform the following demonstration experiment:

Place a trolley on a smooth and horizontal runway, with spring balances attached to front and back as shown in the Figure 2.

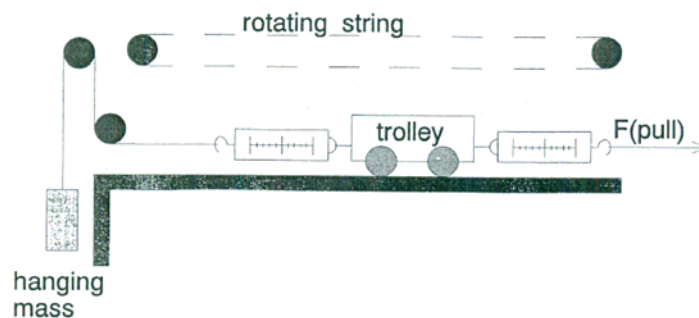


Figure 2: Identification and comparison of forces

Notes: - A trolley is placed on a horizontal runway

-A forward force F_{pull} is exerted by hand on the trolley and a backward force is exerted by the hanging mass on the trolley.

-Forces are measured by spring balances as shown in the figure.

-The force of friction is neglected.

- Only take notes about the horizontal forces on the trolley.

Pull slowly (forward force F_{pull}) the trolley until it is halfway down the runway. Keep it stationary there ($v = 0$), read the spring balances and fill in your observations in table 2. Then, measure the forces in case the trolley is moving. One student should try to give the trolley the same speed using a string as shown above ($v = \text{constant}$), while others take the readings of the spring balances while the trolley moves. Repeat the demonstration experiment using different speeds (small, medium) and see how forward and backward forces will compare. Enter the results in the table 2.

Table 2

Speed of the trolley (constant)	Fforward	Fbackward
Zero		
Small		
Medium		

2.4 Reconciliation between prediction and observation (individually):

With the results of table 2 fill in table 3 and compare the results with those of your predictions (in table 1).

Table 3

Speed of the trolley (constant)	Observed
Zero	FforwardFbackward
Small	FforwardFbackward
Medium	FforwardFbackward

How the forward and backward forces compare for each speed on the moving trolley?_____

Comparing the tables 1 and 3, explain what the results are._____

Demonstration experiment nr. 3:

Introduction to the concept of inertia - a coin on top of a can

The objective of this demonstration experiment is to introduce the concept of inertia through analysing the behavior of a coin put on a piece of a card, which is on a can. By using the POE strategy, students are firstly required to predict what will happen to the coin if the card is flicked quickly, then to perform the demonstration experiment themselves (in groups) and, finally, to draw a reconciliation between the prediction and observation.

3.1 Equipment required:

- A coin
- A piece of a card
- A can

3.2 Prediction (individually)

A coin is placed on a piece of a card, which is on a can. If the card is flicked quickly the coin: *Put a tick (✓) in the correct answer*

- a) Will be dragged off with the card
- b) Will stay where it was (on the top of the can)
- c) Other (specify): _____

Give reasons for your prediction: _____

3.3 Observation: demonstration experiment (in groups)

In groups of four students each, perform the following demonstration experiment:

Place a coin on a piece of a card on the top of a can, as shown in Figure 3. Flick the card quickly. Describe your observation.

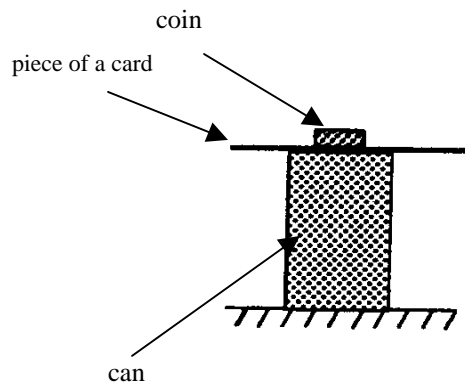


Figure 3: A coin on top of a can

Repeat the demonstration experiment twice. Describe what you observe regarding what is happening with the coin. _____

Explain why _____

3.4 Reconciliation between prediction and observation:

a) Compare the results of the prediction and those of the demonstration experiment.

Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

Yes No

b) Justify your answer. _____

In the prediction 3.2, the correct answer is (b); the coin will stay on the top of the can. Two particular elements are relevant in this demonstration experiment, namely the speed and the friction force. If the card is flicked slowly the coin will be dragged off with the card, because the friction between the card and the coin is enough to overcome the inertia of the coin. Flicking the card quickly means the friction force is too small to maintain the coin in its position on the card. The coin tends to stay in the same position relative to the can, as before the card was flicked.

Demonstration experiment nr. 4:

Introduction to the concept of inertia - a bottle on a paper

This demonstration experiment is also about introducing the concept of inertia. The bottle is put horizontally on a piece of paper, which is on the top of a table. Again, the POE strategy is used to assess your understanding of inertia.

4.1 Equipment required:

- A table
- An A4 piece of paper
- A bottle

4.2 Prediction (individually)

A bottle is horizontally put on a piece of paper, which is on the table. If the piece of paper is flicked quickly, the bottle: *Put a tick (✓) in the correct answer*

- (a) Will remain at rest on the top of table
- (b) Will roll and, eventually, fall off
- (c) Will be dragged off with the paper
- (a) Other (specify): _____

Give reasons for your prediction: _____

4.3 Observation: demonstration experiment (in groups)

In groups of four students each, perform the following demonstration experiment:

Place horizontally a bottle on a piece of a paper on a table, as shown in Figure 4.

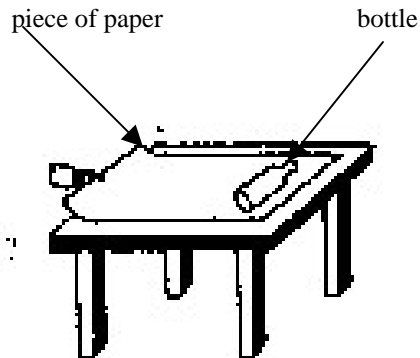


Figure 4: A bottle on a paper

Flick horizontally the paper quickly. Describe your observation. Repeat twice the demonstration experiment. Describe what you observe regarding what is happening with the bottle.

Explain why the bottle does not move with the piece of paper.

4.4 Reconciliation between prediction and observation:

a) Compare the results of the prediction and those of the demonstration experiment.

Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

Yes No

b) Justify your answer. _____

In the prediction 4.2, the correct answer is (a); the bottle will remain at rest on the top of table. The tendency of the bottle to remain in the same position in relation to the table is caused by the friction force which is too small to overcome the inertia of the bottle with the table.

4.2 The assessment rubrics

The following rubrics are to be used to assess the performance of your students for the demonstration experiments (Muller, 2006):

Table 2: Rubrics for assessing students' performance in laboratory experiments

	Poor (0-4)	Satisfactory (5-9)	Good (10-14)	Excellent (15-20)	Score
Demonstration Experiment 1 (criteria)	Students' predictions illogical and not consistent, justifications of the answers not given, equipment not organized, data not accurately recorded, comparison between the results of the predictions and those of the experiment neither consistent nor logical, rambling presentation of the explanations.	At least 25% of students' predictions logical but not consistent, justifications of some of the answers not always given, no organization of the equipment, data not accurately recorded, comparison between the results of the predictions and those of the experiment neither consistent nor logical and a summary of the main explanations and justification given.	At least 75% of the predictions is made and justified. The experiment was repeated at least twice and data were recorded. The comparison of the results between prediction and observation not always appropriately made. A brief summary of the conclusions is presented at the end of the experiment but no sound explanations and justification are given.	All possible predictions were made and justified. The experiment was repeated at least twice and data accurately recorded. Comparison of the results between prediction and observation appropriately made. A brief summary of the conclusions is presented at the end of the experiment and sound explanation and justification are given.	20
Demonstration Experiment 2 (criteria)	Students' predictions illogical and not consistent, justifications of the answers not given, equipment not organized, data not accurately recorded, comparison between the results of the predictions and those of the experiment neither consistent nor logical, rambling presentation of the final explanation.	At least 25% of students' predictions logical but not consistent, justifications of some of the answers not always given, no organization of the equipment, data not accurately recorded, comparison between the results of the predictions and those of the experiment neither consistent nor logical and a summary of the main results given.	At least 75% of the predictions is made and justified. The experiment was repeated and data were recorded. The comparison of the results between prediction and observation not always appropriately made. A brief summary of the final results is presented at the end of the experiment but no sound justifications are given.	All possible predictions were made and justified. The experiment was repeated and data accurately recorded. Comparison of the results between prediction and observation appropriately made. A brief summary of the final results conclusions is presented at the end of the experiment and sound justifications are given.	20

<p>Demonstration Experiment 3 (criteria)</p>	<p>Students' predictions illogical and not consistent, justifications of the answers not given, equipment not organized, not enough variation of the pace during flicking of the card, comparison between the results of the predictions and those of the experiment neither consistent nor logical, rambling presentation of the explanations.</p>	<p>At least 25% of students' predictions logical but not consistent, justifications of the answers not always given, no organization of the equipment, not enough variation of the pace during flicking of the card, comparison between the results of the predictions and those of the experiment sometimes logical but not consistent, rambling presentation of the explanations.</p>	<p>At least 75% of the predictions was made and justified. Students set and perform the experiment properly and accurately. The fact that the piece of the card has accurate measures was well taken care of, the variation of pacing during the flicking of the card were appropriate, the results of the prediction and those of the experiment were well compared, but a sound justification of the final results not given.</p>	<p>All possible predictions were made and justified. Students set and performed the experiment properly and accurately. The fact that the piece of the card has accurate measures was well taken care of, the variation of pacing during the flicking of the card were appropriate, the results of the prediction and those of the experiment were well compared, and a sound and brief summary of the final results presented.</p>	<p>20</p>
<p>Demonstration Experiment 4 (criteria)</p>	<p>Students' predictions illogical and not consistent, justifications of the answers not given, equipment not organized, observations not given, data not accurately recorded, comparison between the results of the predictions and those of the demonstration experiment neither consistent nor logical, rambling presentation of the explanations.</p>	<p>At least 25% of students' predictions logical but not consistent, justifications of some of the answers not always given, no organization of the equipment, data not accurately measured, comparison between the results of the predictions and those of the demonstration experiment neither consistent nor logical and a summary of the main results given.</p>	<p>At least 75% of the predictions is made and justified. The demonstration experiment was repeated twice and data were recorded. The comparison of the results between prediction and observation not always appropriately made. A brief summary of the main results is presented.</p>	<p>All possible predictions are made and justified. The demonstration experiment was repeated twice and data accurately recorded. The variation of pacing during the flicking of the paper was appropriate. Comparison of the results between prediction and observation appropriately made. A brief summary of the main results is presented at the end of the demonstration experiment and sound justifications given.</p>	<p>20</p>

FOR STUDENTS

PART FIVE: STUDENTS' WORKSHEETS

SECTION 1

(For individual work)

Demonstration experiment nr. 1:

Introduction to the force concept – forces on a soccer ball

1.1 Prediction

In an idealised system, if a ball is kicked up and travels through the air following a certain trajectory (flight path), which of the following force (s) is (are) on the ball during its entire flight? *Put a tick (✓) in the correct answer; only one alternative is correct.*

- a) The force of gravity only
- b) The force of gravity and the force of the 'kick'
- c) The force of gravity, the force of the 'kick' and the force of air resistance
- d) The force of gravity and the force of air resistance
- e) The force of the 'kick' and the force of air resistance

Give reasons for your prediction: _____

1.2 Observation: demonstration experiment (Go to section 2)

1.3 Reconciliation between prediction and observation:

- a) Compare the results of the prediction and those of the demonstration experiment.

Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

- Yes No

- b) Justify your answer. _____

Demonstration experiment nr. 2:

Identification and comparison of forces – the trolley

2.1 Prediction

A trolley is placed on a smooth and horizontal runway, with spring balances attached to the front and back. At the back, a hanging mass - big enough so that the friction is negligible - is attached to the spring balance by means of string and pulleys.

If the trolley is pulled forward with different and constant speeds (zero, small, medium) how the forward and backward forces will compare for each speed? *Use the symbols: = (equal), < (smaller), > (bigger), << (much smaller), >> (much bigger).*

a) Enter your predictions in the table 1:

Table 1

Speed of the trolley (constant)	Prediction
Zero	F _{forward}F _{backward}
Small	F _{forward}F _{backward}
Medium	F _{forward}F _{backward}

Give reasons for your prediction: _____

2.2 Observation: demonstration experiment (Go to section 2)

2.3 Reconciliation between prediction and observation:

With the results of table 2 fill in table 3 and compare the results with those of your predictions (in table 1).

Table 3

Speed of the trolley (constant)	Observed
Zero	F _{forward}F _{backward}
Small	F _{forward}F _{backward}
Medium	F _{forward}F _{backward}

How the forward and backward forces compare for each speed on the moving trolley?

Comparing the tables 1 and 3, explain what the results are. _____

Demonstration experiment nr. 3:

Introduction to the inertia concept - a coin on top of a can

3.1 Prediction

A coin is placed on a piece of a card, which is on a can. If the card is flicked quickly the coin: *Put a tick (✓) in the correct answer*

- a) Will be dragged off with the card
- b) Will stay where it was (on the top of the can)
- c) Other (specify): _____

Give reasons for your prediction: _____

3.2 Observation: demonstration experiment (Go to section 2)

3.3 Reconciliation between prediction and observation:

- a) Compare the results of the prediction and those of the demonstration experiment. Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

Yes No

- b) Justify your answer. _____

Demonstration experiment 4:

Introduction to the concept of inertia - a bottle on a paper

4.1 Prediction

A bottle is horizontally put on a piece of paper, which is on the table. If the piece of paper is flicked quickly, the bottle:

- (a) Will remain at rest on the top of table
- (b) Will roll and, eventually, fall off
- (c) Will be dragged off with the paper
- (d) Other (specify): _____

Give reasons for your prediction _____

4.2 Observation: demonstration experiment (Go to Section 2)

4.3 Reconciliation between prediction and observation

- a) Compare the results of the prediction and those of the demonstration experiment. Are the results of the demonstration experiment equal to those of your prediction? *Put a tick (✓) in the correct answer.*

Yes No

- b) Justify your answer. _____

SECTION 2
(For group work)

Demonstration experiment nr. 1:

Introduction to force concept – forces on a soccer ball

1.2 Observation: demonstration experiment

Equipment required

- Balls
- A pen
- A piece of paper

In groups of four students each, they should perform the following demonstration experiment:

Kick a soccer ball down to travel through the air with a trajectory (flight path) similar to that in Figure 1.

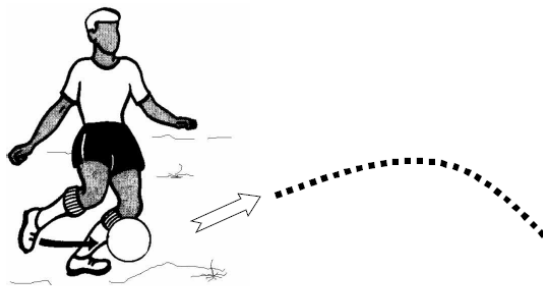


Figure 1: A soccer ball kicked into the air

Repeat the demonstration experiment at least three times. With the help of a graphical representation, indicate which of the following force (s) acts (are) on the ball during its entire flight. *Only one alternative is correct.*

- (a) The force of gravity only
- (b) The force of gravity and the force of the ‘kick’
- (c) The force of gravity, the force of the ‘kick’ and the force of air resistance
- (d) The force of gravity and the force of air resistance
- (e) The force of the ‘kick’ and the force of air resistance

Give explanation of your answer _____

Demonstration experiment nr. 2:

Identification and comparison of forces – the trolley

2.2 Observation

Equipment required

- Trolley
- Spring balances
- Masses
- Strings
- Pulleys
- Cassette player

In groups of four students each, perform the following demonstration experiment:

Place a trolley on a smooth and horizontal runway, with spring balances attached to front and back as shown in the Figure 2.

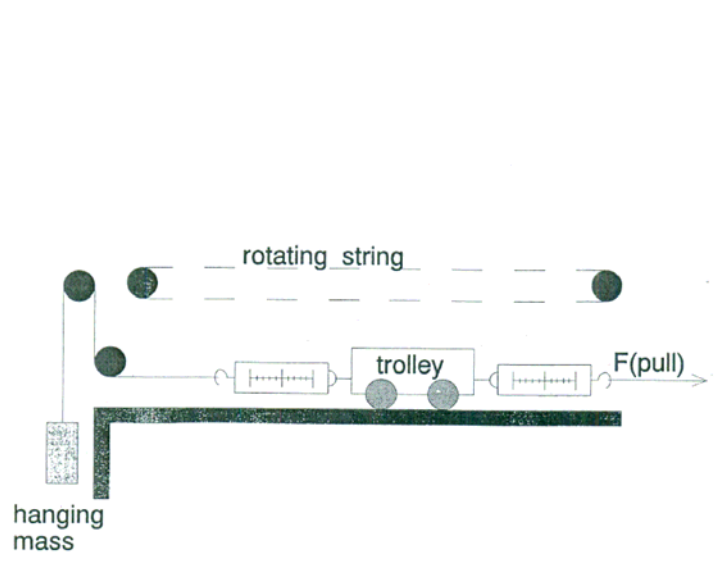


Figure 2: Identification and comparison of forces

Notes: - A trolley is placed on a horizontal runway

-A forward force F_{pull} is exerted by hand on the trolley and a backward force is exerted by the hanging mass on the trolley

-Forces are measured by spring balances as shown in the figure.

-The force of friction is neglected.

- Only take notes about the horizontal forces on the trolley.

Pull slowly (forward force F_{pull}) the trolley until it is halfway down the runway. Keep it stationary there ($v=0$), read the spring balances and fill in your observations in table 2. Then, measure the forces in case the trolley is moving. One student should try to give the trolley the same speed using a string as shown above ($v=\text{constant}$), while others take the readings of the spring balances while the trolley moves. Repeat the demonstration experiment using different speeds (small, medium) and see how forward and backward forces will compare. Enter the results in the table 2.

Table 2

Speed of the trolley (constant)	Fforward	Fbackward
Zero		
Small		
Medium		

Demonstration experiment nr. 3:

Introduction to the inertia concept - a coin on top of a can

3.2 Observation: demonstration experiment

Equipment required:

- A coin
- A piece of a card
- A can

In groups of four students each, perform the following demonstration experiment:

Place a coin on a piece of a card on the top of a can, as shown in Figure 3. Flick the card quickly. Describe your observation.

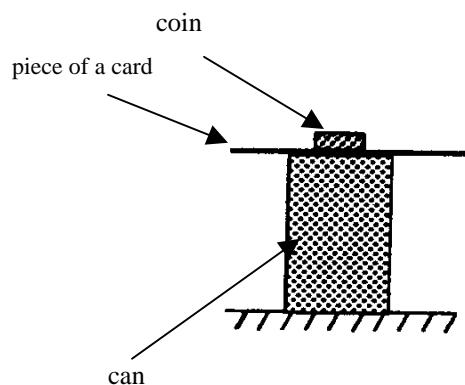


Figure 3: A coin on top of a can

Repeat the demonstration experiment twice. Describe what you observe regarding what is happening with the coin. _____

Explain why _____

Demonstration experiment nr. 4:

Introduction to the concept of inertia - a bottle on a paper

4.2 *Observation:* demonstration experiment

Equipment required:

- A table
- An A4 piece of paper
- A bottle

In groups of four students each, perform the following demonstration experiment:

Place horizontally a bottle on a piece of a paper on a table, as shown in Figure 4.

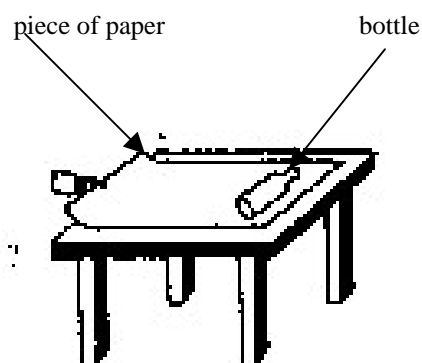


Figure 4: A bottle on a paper

Flick horizontally the paper quickly. Describe your observation. Repeat twice the demonstration experiment. Describe what you observe regarding what is happening with the

bottle. _____

Explain why the bottle does not move with the piece of paper _____

Appendix P1

Glossary of terms

The following is the explanation of the terms or concepts used in this document.

- *Assessment* - any systematic process of collecting, synthesising, and interpreting information that helps teachers to understand their learners, monitor instruction, and establish a viable classroom climate (Airasian, 2001). This process involves more than administering, scoring and grading paper-and-pencil tests, and includes the full range of information that teachers can gather in their classrooms.
- *Assessment practice or assessment strategy* - all kinds of formal and informal assessments used by teachers in schools from the traditional approaches of paper-and pencil tests to a more constructivist and dynamic process of gathering information following some prescribed guidelines.
- *Constructivism* – a learning theory where the learning environment is determined by prior knowledge, i.e., what the learners already have in their minds before being exposed to learning. The underlying principle of this theory is that students construct their own learning. Self-monitoring and self-regulation are the most relevant aspects of learning in this theory, and the role of the teacher is to help students to acquire understanding and to develop strategies to solve problems.
- *Effectiveness* – refers to three main aspects (Ottevanger, 2001): (i) the consistency between what is intended to be taught by the material and what is effectively being taught, (ii) the consistency between what is intended to be taught by the material and how the students experience the lessons with the material, (iii) the consistency between what is intended to be taught by the material and what the students are really learning. Briefly, effectiveness in the context of this document is defined as a measure of the usefulness of the teaching and assessment materials from the intended to the attained learning.
- *Formative assessment* – an assessment process in which information gathered (not only from formal assessments) about learning is *evoked* and then *used* to modify the teaching and learning activities in which teachers and students are engaged (Black *et al.*, 2003). This definition not only broadens the sources of evidence but more importantly solidifies the idea that the information

obtained has a subsequent impact on teaching and learning. Examples of formative assessment are informal observations, verbal tests, homework, students' questions, and worksheets. In summary, formative assessment serves to monitor the teaching and learning process while it is still in progress, occurs during the process, is informal, and it is meant to improve and change the process while it is still going on.

- *Performance assessment* – a kind of assessment that requires students to demonstrate the application of skills or knowledge to a particular context (Moskal, 2003). When, for instance, a student is required to produce constructions such as science experiment reports, book reviews, class projects these assessments are termed performance assessments.
- *Practicality* – refers to the extent to which users (and other experts) consider certain product or intervention as appealing and usable in 'normal' or desired conditions. In the context of this document the teaching and assessment materials are considered practical when they reach at the stage in which all potential constraints (e.g., time, materials availability) are well taken care of, and they can therefore be normally used in the classroom.
- *Prototype* - a model upon which other similar materials are based. It represents all products that are designed before the final product is constructed and fully implemented in practice (Nieveen, 1999). In its initial stage a prototype can be developed, discussed, and modified as required to build consensus. Through the process of developing a prototype, developers come to an agreement on what to show and how to show it. In the context of this document prototypes are Physics exemplary materials on teaching and assessment for teachers to use in the classroom.
- *Summative assessment* – an assessment process where the information collected (from formal assessments) is used to judge the success of the teaching and learning activities (Airasian, 2001). Such formal assessments usually come at the end of classroom process or activity, and when it is difficult to alter or rectify what has already occurred. Summative assessment is used mainly to assess the outcomes of instruction and is exemplified by end-of-chapter tests, term tests, projects, and final examinations. Briefly, summative assessment is meant to judge the overall success of a process at its completion, occurs at the end of the process, is formal, and serves to grade, place and promote students.

Appendix P2

The Demonstration Experiment Report Template for Students

0. Due Date:

The following due date has been tentatively assigned for the completion of your report. Meeting the deadline will ensure that you receive useful and timely feedback from your teacher.

Submission of Demonstration Experiment Report: Friday, 15 September 2006

1. Suggestions:

Your success in this task will be evaluated using a 0-20 scale. Your understanding of Physics concepts and your ability to design, conduct, and communicate the results of the demonstration experiments is the focus of the assessment. This document is a formal lab report, which will reflect your level of success. For this reason, it is important that you understand exactly what should be included in the report and how it should be put together. Directions for each step of the process have been described for this task.

2. Content and organization of the report:

The demonstration experiment report should include the following sections:

- Title Page (1p): includes a meaningful title for your lab report and the names of the students who participated in the demonstration experiments. Feel free to include a colorful picture (graphic, map, table, etc.) on the page if you wish to do so.
- Purpose (1p): a paragraph in which you succinctly describe your overall performance task and state the goal of your report; the purpose should be clearly stated and to the point. Procedural steps should not be discussed in this section.
- Procedure (2pp): A step-by-step procedure, which describes what did you do and how you did it. The procedure always ties into the purpose of the demonstration experiment; that is, the procedure describes in detail the steps, which an experimenter must take in order to accomplish the stated purpose. The procedure should be so specific and clearly stated that an outsider could repeat the demonstration experiment without knowing anything about it. The procedure must be accompanied by informative diagrams of the experimental set-up for each part of the task.
- Theoretical Background (3-4pp): describe and discuss the concepts of force and inertia. Include a discussion of other related concepts that you think you have dealt with during the demonstration experiments.

- Data (2-3pp): include an organized description of the POE strategy with emphasis on how you have developed your reasoning during the prediction and explanation stages. You can use whatever format that makes the data most revealing of the focus of your reasoning.
- Conclusions (1-2pp): briefly describe the focus of each demonstration experiment, comment on your overall understanding of force and inertia concepts and of other related concepts. Identify and describe potential source of error and discuss how, if this occur, might impact on your results and conclusions. Include a paragraph or more in which you identify and discuss any suggested changes in the employed POE strategy.