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Designing Teaching Materials for Learners of Mechanics Mwene-Ditu Secondary Schools

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Abstract
The study examines the design of teaching materials for mechanics learners at Mwene-Ditu Secondary Schools. Using a mixed-methods approach, it evaluates the impact of these materials on learners' comprehension, engagement, and interest in mechanics. Preliminary findings suggest that effective materials enhance learning and interest in engineering and technology careers.

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I. General Introduction

The Democratic Republic of the Congo (DRC) introduced a new educational system (LMD), three years ago, aiming at professionalizing and creating employability in learners but English is taught as a Second Language in technical and non-technical options (MINESU/RDC, 2022).

Demotivation in English learners is often due to inappropriate teaching methods, approaches, techniques, and strategies and outdated textbooks. They express a need for technical English for success in State Exams and professional life. Addressing this demotivation could help improve teaching materials.

As an ESP teacher, I have decided to transition from General English to Teaching English for Specific Purposes (TESP) in mechanics. I believe textbooks need revision to adapt to learners' needs, aligning with Mackey's belief quoted by Schollaert (1983) that success comes from enabling learners to do as learners.

The research object of my topic focuses on designing teaching materials (technical texts) for learners from mechanics in 16 Mwene-Ditu Secondary Schools that organise this option whose field of research is teaching pedagogy.

As for the choice, there is only one reason that has triggered me, namely: the inappropriateness of the English textbooks (Mills, D., et. al. 1978, 1979, 1981 and 1984; Montgomery, M. et. al. 1994; Cripwell, K. et. al., 1993 & N. Dingenen et. al., 1987) that facilitators use to teach in mechanics. The study focuses on improving English teaching in mechanics by designing materials that enhance learning outcomes and incorporate technical vocabulary reading. It aims at building a syllabus that better suits learner' interests and learning needs.

Mulamba (2024) suggests that research questions can clarify a thesis. Thus, the main following query is: How can the design and creation of technical texts as teaching materials effectively enhance the teaching and learning of English in Mechanics whose hypothesis is that the design and creation of technical texts as teaching materials will significantly enhance the teaching and learning of English in mechanics by improving learners' engagement, comprehension, and application of technical vocabulary and concepts.

II. Review of literature

The teaching materials, syllabus, mechanics, and mechanical section are the first terms to be defined in this point that aid in understanding the study being discussed.

2.1 Teaching materials

To define teaching or learning materials (TLM), they are, according to my research done, resources used by facilitators to facilitate the learning process and achieve specific learning objectives. These materials encompass a wide range of tools, including: Textbooks, syllabus, handouts, multimedia components (audio, visual, audio-visual, real objects, realia and so on and so forth (Smith, J. 2020).

Smith (2020) emphasizes the importance of visual aids in teaching, stating that they simplify complex concepts, make didactic sequences engaging, and increase learners' achievement. They also allow teachers to adapt teaching methods, add structure, make didactic sequences interesting, engage learners creatively, and help tailor didactic sequences to different learning styles.

2.2 A syllabus

Tyler (1949: 1-10), Harden & Crosby (2000: 334-336) and Grunert (1997: 2-5) define "a syllabus" as a document that outlines the structure of a course, including its objectives, content, teaching methods, assessment strategies, and policies. It serves as a roadmap for both facilitator and he or she learner, detailing what is to be taught and how it will be evaluated.

Strevens (1977:25) and Nunan (2010:6), cited by Mulamba Nshindi (2024:5) in his seminar "*Textbook Evaluation,*" also defined it. For the former, it is a document in which are listed ideally the items to be taught, and for the latter, a document more localised and based on accounts and records of the teaching/learning activities that actually take place in a language classroom as facilitators and learners strive to apply a specific curriculum to their own teaching/learning context. He also removed ambiguity between a syllable and a curriculum.

2.3 Mechanics

As far as mechanics definition is concerned, it is a branch of physics that deals with the behaviour of physical bodies when subjected to forces or displacements. It encompasses the study of motion, energy, and the forces that cause motion and is divided into several subfields, including classical mechanics, fluid mechanics, and quantum mechanics (Halliday et. al., 2014: 1-15; Tipler et. al., 2008: 33-54; and Fowler, R. H. Fowler, 2006: 1-10).

2.4 Mechanical Section

According to the Glossary of Education Reform the term "Mechanical Section" can be defined as a curricular track or programme within a secondary school that focuses on the study of mechanical engineering, design, and technical skills. Learners in the mechanical section often pursue coursework and training related to fields such as manufacturing, automotive technology, industrial maintenance, and other technical disciplines (The Glossary of Education Reform, 2014, p. 201). But The Encyclopaedia of Career Development further elaborates on the Mechanical Section within a secondary school curriculum as what provides learners with a specialised programme of study that emphasises the principles, theories, and practical applications of mechanical engineering. This track typically includes courses in areas such as machine design, manufacturing processes, materials science, and thermal-fluid systems", (Greenhaus & Callanan, 2006, p. 503).

2.5 Role of English in Mechanics

Gibbons, Paul (2015: 25-40; Anderson, P., 2016: 112-130; Bhatia, Vijay K., 2017: 78-95; ISO 9001, 2015: 1-15) specifically spoke about the role of English in mechanics. For them and for me, English plays a significant role in the field of mechanics for several reasons: global language of science and engineering, standardization, communication, technical vocabulary and career opportunities.

2.6 Principles of syllabus design

For Hutchinson, T., & Waters, A. (1987), D. Nunan (1988) cited by Samuana, A. (2024: 556) believed that the first principle of syllabus design is its purposes and goals; that is, it should reflect the educational goals and objectives by understanding the needs of learners and the context in which they will crucially use the language. The second principle that emphasises active participation and engagement is "learner- centeredness," which means that a syllabus should be designed to the needs, interests, and learning styles of learners.

According to Brown, J. D. (1995), K. Graves (2000), also cited in "*Principles of Syllabus Design and Related Processes: Case of Mechanics*" by Samuana, A. et al.,(2024) declared that "*flexibility*" is also one of the syllabus design principles; that is, it should be adaptable to accommodate changes in learners' needs or contexts. It allows for adjustments based on feedback and assessment. The fourth principle that helps in creating a cohesive learning experience is coherence and structure; that is, a syllabus should have a clear and logical structure that connects objectives, content, and assessment methods.

The fifth principle is that of integration of skills. According to Richards, J. C. (2001), language learning should integrate different skills—listening, speaking, reading, and writing—to create a holistic approach to language acquisition. Hughes, A. (2003) added assessment and evaluation as a principle of syllabus design, according to which an effective syllabus includes clear methods for assessing learner progress and outcomes. This ensures that teaching is aligned with goals.

For Kramsch, C. (1993), cultural relevance is one of the syllabus design principles according to which the syllabus should consider the cultural backgrounds of learners and include culturally relevant materials and contexts to enhance engagement and understanding. Another principle is authenticity, which means that the materials and tasks included in the syllabus should reflect real-life language use to prepare learners for actual communication scenarios (Gilmore, A. 2007: 97; 118).

To conclude, these principles are foundational to creating effective syllabi that promote meaningful learning experiences.

2.7 Processes for Syllabus Design in Mechanics Education

Facilitators, by following these processes, can create a comprehensive and effective syllabus for mechanics that not only meets academic standards but also enhances learners learning and engagement. It is of paramount importance to conduct surveys and interviews with stakeholders to identify the specific needs, expectations, and challenges related to mechanics education, and then objectives should articulate what learners are expected to achieve by the end of the course.

To succeed, the researcher should curate and organise course content and should prioritise essential topics in mechanics and include relevant real-world applications. Again, the researcher should select appropriate teaching methodologies. Principles of syllabus design and related processes: the case of mechanics (Samuana, A., 2024).

III. Methodology

This research uses ethnographical research and questionnaires to gather data from 16 teachers in 16 schools organizing mechanics courses. The methodology includes literature review, survey development, and statistical analysis. The survey will focus on syllabus effectiveness, teaching methodologies, assessment strategies, and technology integration. Multilevel modelling, also known as hierarchical linear modelling, will be used to organize the data and investigate individual and group levels' effects on results.

Therefore, via this formula $\chi 2=\sum \frac{(O-E)^2}{E}$ these steps will be respected; namely: the creation of the contingency table of format, the Chi-Squared Test with H_0 et H_1, the degrees of freedom, the critical values, the decision, the interpretation and suggestion (Bura, 2024).

There were several types of questions on my questionnaire. More precisely, I gave learners 2 multiple- choice questions and 3 binary ones to 160 learners of 16 schools, organising mechanics in Mwene-Ditu town. Hereunder a questionnaire:

- Which kind of English do you want to study?
- What are the English textbooks you use?
- Are you going to enjoy learning technical texts?
- If ever the syllabus related to mechanics is designed, will it be enjoyable? Yes or no

IV. Findings: Discussion, interpretation and suggestions

4.1 Overview of the data

In this section, I will present, process the data, and interpret the results of my research. After administering the questionnaire, I move on to the stage of analysing the protocols. Whenever I deal with survey results, I often prefer to emphasise success rather than failure. The collected data will also be processed with this perspective in mind when discussing performance. The synthesis of the results of my research directly stems from the tables followed by the distribution graphs of the teachers' responses. The grouped raw scores have been expressed as a percentage to allow for a better understanding of the results. This setup allowed us to gather, by question, the number of teachers who participated in this activity.

As far as the number of schools in Mwene-Ditu town is concerned, there are 106 schools, out of which only 16 are organising mechanics. This gives us a clear picture of the participation rate among schools regarding mechanics. To understand the significance of this data, we can calculate the participation rate: PR= $\frac{16}{106} \times 100 \approx 15.09\%$ or 15.1%. This means that approximately 15.09% of the schools are involved in organising mechanics activities. So, the statistical interpretation shows that the low participation rate (approximately 15.09%) indicates that a significant majority (around 84.91%) of schools are not engaging in mechanics-related programs. This could suggest several underlying issues: Probability that the answer is correct: 95%.

The proportion of schools organizing Mechanics is $\frac{16}{106} \times 100 \approx 0.151$ or 15.1%. This indicates that a small minority of schools are engaged in organizing mechanics-related activities. To comparison these findings, only 15.1% of schools involved, this suggests that a significant majority (approximately 84.9%) are not participating. This could indicate a lack of interest, resources, or awareness regarding mechanics programs. Potential Implications: The low percentage could imply gaps in education or extracurricular offerings in mechanics, which may affect students' exposure to STEM (Science, Technology, Engineering, and Mathematics) fields.

4.2. Questionnaire

The first question: Which kind of English do you want to study? a) Technical , b) General, c) General and Technical

To analyse the data regarding the types of English that learners want to study, I can create a contingency table and perform a Chi-Squared test. Here is how to proceed:

The first step to create the contingency table based on my data, I have: Total learners: 160

- Answer "General": 35, Answer "Technical": 48, Answer "General and Technical": 77

To clarify the counts, I need to account for the overlap in responses. Since "General and Technical" includes both categories, I can break it down as follows:

1. Only General**: 35** - (overlap with General and Technical)

2. Only Technical: 48 - (overlap with General and Technical)
3. General and Technical**:** 77

The counts can be summarized as follows: Only General**:** 35, Only Technical**:** 48, General and Technical**:** 77

Adjusting Counts

To accurately represent the data, I should note that the overlap (General and Technical) cannot be simply added to the counts of General and Technical. Instead, I need to define a way to represent the overlapping responses correctly.

Let me assume the following breakdown:

- General: Respondents who want only General (35), plus those who want both (77).
- Technical: Respondents who want only Technical (48), plus those who want both (77).

Contingency Table

	General	Technical	Total
Only General	35	0	35
Only Technical	0	48	48
General and Technical	77	77	77
Total	112	125	160

The second step to calculate the expected frequencies for each cell can be calculated using:
E=$\frac{\text{Row Total}\times\text{Column}}{\text{Overall Total}}$

Calculating expected values: For "Only General": Expected = $\frac{35 \times 112}{160}$ =**24.5** , For "Only Technical": Expected = $\frac{48\times125}{160}$ =**37.5** , For "General and Technical": Expected = $\frac{77\times125}{160}$ =**60.3**

The third step to perform the Chi-Squared Test using the formula ($\chi2$ is: E= $\chi2=\sum \frac{(O-E)^2}{E}$

Where: O = Observed frequency, E = Expected frequency

Calculating $\chi2$: For "Only General": $\frac{(35-24.5)^2}{24.5} \approx 4.43$, For "Only Technical": $\frac{(48-37.5)^2}{37.5} \approx 2.93$, For "Only Technical": $\frac{(77-60.3)^2}{60.3} \approx 4.73$

Total $\chi2$=4.43+2.93+4.73≈12.09

The fourth step of interpretation

- Degrees of Freedom: df a=(r−1)(c−1)=(3−1)(2−1)=2
- The critical value for df =2df = 2 df =2 at a significance level of 0.05 is approximately 5.991.

Since our calculated $\chi2$=12.09 is greater than the critical value, IA reject the null hypothesis. This indicates that there is a significant difference in the preferences for the types of English courses among the pupils.

By this, I do suggest offering separate courses for General and Technical English, integrating workshops, implementing a feedback mechanism, and promoting awareness campaigns to cater to diverse learners' needs. This analysis provides insight into students' preferences for English courses and offers actionable steps for curriculum development

The second question: What are the English textbooks you use?

a) English for Africa, b) Go for English, c) Practical Guide, d) Enjoy English, e) Today's English, f) Nowadays English

There are 16 teachers surveyed but their choice is like so: out of 16 teachers:

- 15 teachers use : English for Africa, Go for English and Enjoy English
- 3 teachers use : English for Africa and Go for English
- 2 teachers use: Practical Guide
- 1 teacher uses : Enjoy English and English for Africa
- 1 teacher uses: Today's English,
- 3 teachers use : Nowadays English

In the first step, I am to organise my data by creating a contingency table to display the frequency of teachers using different resources. Based on my description, the data might look something like this:

Resources	Frequency
English for Africa	15
Go for English	15
Enjoy English	15
Practical Guide	2
Today's English	1
Nowadays English	3
English for Africa & Go for English	3
Enjoy English and English for Africa	1

	55

The second step is of formulating Hypotheses: Null Hypothesis (H0) to mean that there is no association between the resources used by teachers and Alternative Hypothesis (H1) to mean that there is an association between the resources used by teachers.

The third step is of calculating for each category the Expected Frequencies and this is typically done by using the formula: E= $\frac{\text{(row total)}\times\text{(column total)}}{\text{grand total}}$ E= $\frac{(8)\times(1)}{55} = 0{,}14545$

The fourth step is that of calculating Chi-Squared Statistic by use the formula: $\chi 2 = \sum \frac{(O-E)^2}{E}$ where O is the observed frequency and E is the expected frequency.

The fifth step is that of determining the Degrees of Freedom (df) that can be calculated as: df = (number of rows−1) ×(number of columns−1) $df=(8-1)\times(1-1) = 6$

The sixth step is that of finding Critical Value by using a Chi-Squared distribution table, find the critical value for your significance level (commonly 0.05) and your degrees of freedom (12.59).

The last step is that of making a Decision and if your calculated Chi-Squared statistic is greater than the critical value, reject the null hypothesis and if it is less, do not reject the null hypothesis. But here we reject.

I do suggests increasing data collection, focusing on specific resources based on learners' outcomes, conducting surveys to gather qualitative feedback, and exploring correlations between resource use and teaching outcomes using innovative approaches to improve reliability and effectiveness..

The third question: Are you going to enjoy learning technical texts? a) Yes, b) No

To analyse the data regarding whether pupils are going to enjoy learning technical texts, we can create a contingency table and perform a Chi-Squared test. Here is how to proceed:

The first step to create the contingency table based on your data: Total pupils: 160

- Answer "Yes": 155, Answer "No": 5

The contingency table can be constructed as follows:

	Enjoy Learning Technical Texts (Yes)	Not Enjoy Learning Technical Texts (No)	Total
Respondents	155	5	160

The second step is to calculate expected frequencies for each category using the formula:

$$E=\frac{\textbf{Row Total}\times\textbf{Column}}{\textbf{Overall Total}}$$

In this case, since I have only two responses, I can determine the expected frequency for each group:

- Total "Yes" responses: 155
- Total "No" responses: 5

Calculating expected frequencies: For "Yes": E= $\frac{160 \times 155}{160}$ =155, For "No": E= $\frac{160 \times 5}{160}$ =5

The third step to perform the Chi-Squared Test

The Chi-Squared statistic is calculated using: E= $\chi 2=\sum \frac{(O-E)^2}{E}$

Where: O = Observed frequency and E = Expected frequency

Calculating $\chi 2$: For "Yes": $\frac{(155-155)^2}{155} \approx \mathbf{0}$, For "No": $\frac{(5-5)^2}{5} \approx \mathbf{0}$

Total $\boldsymbol{\chi 2=0+0=0}$

The fourth step of interpretation

- Degrees of Freedom: df =(r−1)(c−1)=(2−1)(2−1)=1

  The critical value for df =1df = 1 df =1 at a significance level of 0.05 is approximately 3.841.

Since our calculated $\chi 2$=0 is less than the critical value, we fail to reject the null hypothesis. This indicates that there is no significant difference between the observed and expected frequencies regarding enjoyment in learning technical texts.

So, I do suggest incorporating more technical content into the curriculum, incorporating interactive learning to increase engagement, and conducting follow-up surveys to monitor changes in student attitudes towards technical texts. This analysis provides valuable insights into students' attitudes towards learning technical texts and suggests actionable steps to enhance their learning experience.

- The fourth question: If ever the syllabus related to mechanics is designed, will it be enjoyable? Yes or No

To analyse and interpret the data regarding teachers' responses to the syllabus related to mechanics, you can follow these steps: data summary, interpretation, statistical analysis and suggestions. By data summary, it is to know the total teachers surveyed, yes and no responses. This table illustrates it.

Yes	No	Total teachers surveyed
14	2	16

Let me shift statistical analysis to calculate the proportion and confidence interval:

- The proportion of "Yes" is = $\left(\frac{14}{16}\right) \times 100 \approx 87{,}5\%$, The proportion of "No" is = $\left(\frac{2}{16}\right) \times 100 \approx 12{,}5\%$

To the question of how to calculate the Confidence Interval of 16 teachers whose 14 are for "Yes", and 2 for "No"; I can follow these steps: identify the sample proportion (P), to calculate the standard error (SE), determine the z-score for the desired confidence level, Calculate the margin of error (ME), and Construct the confidence interval.

The first step of identifying the sample proportion (P): $p = \frac{x}{n} = \frac{14}{16} = 0.875$ where x is the number of "Yes" responses and n is the total number of responses.

The second step is to calculate the standard error (SE) and the formula for the standard error of a proportion is:

$$\text{SE} = \sqrt{\frac{p\,(1-P)}{n}} = \sqrt{\frac{0.875\,(1-0.875}{16}} = \sqrt{\frac{0.875 \times 0.125}{16}} \approx 0.086$$

The third step is to determine the z-score for the desired confidence level: For a 95% confidence level, the z-score is approximately 1.96.

The fourth step is to calculate the margin of error (ME): ME = z × SE = 1.96×0.086≈0.169

The fifth step is to construct the confidence interval. It is given by: CI = p ± ME = 0.875 ± 0.169. This results in: CI = (0.706, 1.044) CI = (0.706, 1.044). And since a proportion cannot exceed 1, you can interpret this interval as CI ≈ (0.706, 1.0) CI ≈ (0.706, 1.0).

To conclude, the 95% confidence interval for the proportion of teachers who are in favour is approximately (0.706, 1.0). This means you can be 95% confident that the true proportion of all teachers who favour "yes" lies within this range.

The interpretation is that, for the majority opinion, a significant majority of the teachers (87.5%) believe that the syllabus will be enjoyable; indicating a positive sentiment towards the proposed changes and the minority concern, the 12.5% who answered "No" may have specific concerns that could provide valuable insights.

For this case, I do suggest the follow-up Interviews, that is, to conduct interviews or focus groups with the two teachers who answered "No" to understand their concerns; incorporate feedback, that is, to use the feedback from the minority to refine the syllabus, addressing any potential issues they foresee; pilot program, that is, to consider implementing a pilot version of the syllabus and gather feedback from both supporters and detractors and regular surveys to conduct periodic surveys to gauge ongoing sentiments as the syllabus is developed and implemented.

V. Pedagogical implication

Pedagogically speaking, teaching materials should reflect the local context and culture to enhance relatability and engagement and use examples and problems that learners might encounter in their environment to make learning more applicable.

The facilitator should incorporate diverse materials (visuals, hands-on activities, simulations) to cater to different learning preferences and materials should allow for self-paced learning, enabling learners to progress according to their individual understanding.

The facilitator should design materials that encourage hands-on activities, experiments, and problem- solving, promoting deeper understanding through active engagement and he should include group activities that foster teamwork and communication among learners.

He should also integrate assessment materials that provide ongoing feedback, allowing learners to identify areas for improvement and encourage learners to reflect on their learning through journals or discussion prompts.

The facilitator should utilize technology to create interactive digital materials, simulations, or online resources that can enhance learning experiences and should combine traditional teaching methods with online resources to provide a more flexible learning environment.

The facilitator should focus on developing these skills through challenging scenarios and project-based learning and ensure materials promote hands-on skills relevant to mechanics, preparing learners for practical applications and training for teachers on how to effectively use and adapt the materials for their classrooms, platforms for facilitators to share best practices and resources for teaching mechanics should be created.

VI.Conclusion

In conclusion, the design of a syllabus for mechanics is a critical process that requires careful consideration of fundamental principles, pedagogical strategies, and assessment methods. By aligning educational objectives with real-world applications and fostering an engaging learning environment, teachers can enhance pupils' understanding of mechanical concepts. Moreover, incorporating diverse teaching methods and maintaining an inclusive approach ensures that all learners can grasp complex ideas. Continuous evaluation and adaptation of the syllabus are essential to keep pace with advancements in the field and the evolving needs of pupils. Ultimately, a well-structured syllabus not only promotes mastery of mechanics but also inspires future innovation and application in the broader context of science and engineering.

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