



International Conference on Emerging Technology and Interdisciplinary Sciences (ICETIS 2024)

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Virtual



ICETIS



Editors

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Dedication

This conference proceeding is dedicated to our beloved Dr. Krishnan Umachandran for his unwavering support, role, impact, and mentorship. ICETIS and Jozac Publisher's family will continue to miss him.

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The papers in this conference proceeding undergo a peer-review process which covers the views, opinions, and findings of the authors without modification or alteration. The author's contributions were not based on the editor's endorsement or approval.

Declaration of the peer review process

Emerging technologies are changing our world through ideas and academic research publications. The International Conference on Emerging Technology and Interdisciplinary Sciences (ICETIS 2024) with **ISBN: 978-1-0370-2977-6 (print)** and **978-1-0370-2978-3 (e-book)** titled "Application of technology for social change" brings scholars, students, and professional experts across the globe into one platform to share robust ideas and knowledge on how emerging technologies can reshare interdisciplinary research and disciplines. The proceedings are the expert contributions of the authors, sharing their innovative knowledge to improve our society.

ICETIS 2024 applied a peer-review process to improve all the received and published manuscripts. Each of the manuscripts received for ICETIS 2024 was scrutinized: Firstly, every manuscript was screened and then evaluated by the editorial team against suitability to the conference and quality of the content. Secondly, good quality and suitable manuscripts were selected. Thirdly, the plagiarism checks were done using Turnitin Plagiarism Check (TPC) in all the selected manuscripts. Fourthly, all manuscripts with acceptable plagiarism rates were submitted for a double-blind peer review process by experts in the field. The reviewers (experts) review, and then send the review reports that have been captured, and the report outcomes are sent to the individual corresponding authors to address the recommendations and concerns raised by the experts.

ICETIS 2024 values the peer-review process contributions in enhancing the overall quality of the conference proceedings. The conference proceedings promote interdisciplinary research empowering readers with a new research knowledge on the role and application of digital technologies in solving interdisciplinary social issues.

Preface

The third virtual International Conference on Emerging Technology and Interdisciplinary Sciences (ICETIS 2024), held on 29th November 2024 themed “**Application of technology for social change**” enlightened scholars, students, professionals, and industry role players on interdisciplinary and intradisciplinary research interest to improve academic discourse and opening new insight on the role of emerging technologies in resolving social issues.

The conference proceedings covered research areas like artificial intelligence (AI), machine learning, education, health, humanities, and social sciences. The conference presented three international expert keynote speakers who addressed fundamental topics. The first speaker highlighted the recent technology development in different sectors, the second speaker unpacked the pros and cons of AI in higher education, and the third speaker explored the newer trends in emerging technologies and interdisciplinary sciences. These speakers used their expertise to enlighten the audience with wider knowledge through their topics.

The ICETIS 2024 witnessed scholars across regions of the world with almost 200 participants. The conference received lots of papers and less than 20 papers were considered and presented at the conference. All the considered manuscripts were revised by the authors following the review expert's reports, after which the editorial team decided on whether to accept the manuscripts in the proceedings or to reject them. The conference proceedings passed through rigorous review and editorial processes which enhanced its academic quality and integrity.

Through this conference proceedings, the readers are offered current and newest research areas of interest and findings on the role of emerging technologies in shaping social knowledge and discourse. The ICETIS 2024 was a success because of the hard work of the organizing committee members, who worked effortlessly in using their experiences and experts to put together this quality of proceedings in advancing academic knowledge. The authors were well appreciated for their good and quality submissions, and for conducting original research and considering ICETIS 2024 to showcase their academic research findings to the benefit of society.

ICETIS 2024 Organising Committee believes that readers will find this conference proceedings and all the published papers worthy to be used in their respective research, teaching, and industrial and professional practice.

29th November 2024.

ICETIS 2024 Organising Committee

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Table of Contents

Editors	i
Dedication.....	ii
Copyright.....	iii
Declaration of the peer review process	iii
Preface	iv
Conference Committees (CC).....	viii
Theme 1:.....	1
Basic Sciences, Engineering, and Technologies (BSET).....	1
An exploration of novice programmers’ actual software development processes and use of quality appraisal techniques	2
An academic’s personal perspective on the integration of educational technology in higher education for teaching and learning	16
Technostress factors among students in the adoption of Generative Artificial Intelligence (GenAI) in higher education: A rapid review narrative	26
A model to integrate Generative Artificial Intelligence to improve student academic performance in South African universities.....	35
Enhancing AI digital literacy among South African youth: A model for inclusive participation	43
Theme 2:.....	50
Education and Educational Technology (EET)	50
A teacher’s plight to career progression: A narrative inquiry.....	51
Critical research thinking: A recipe for academic writing success and publications.....	80
Theme 3:.....	86
Emerging Technologies in Agriculture (ETA).....	86
Effects of wet and dry milling on the viscoelastic properties of tofu (meat analogue) from soybean (Glycine max) and sesame (Sesamum indicum) blends coagulated with tamarind	87

Theme 1: Basic Sciences, Engineering, and Technologies (BSET)

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An exploration of novice programmers' actual software development processes and use of quality appraisal techniques

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Abstract: Achieving high-quality software projects is a central goal in Software Engineering, with best practices typically taught to Computer Science (CS) undergraduates. The Personal Software Process (PSP) framework guides developers in good development practices, yet incorporating PSP principles into curricula has encountered challenges, particularly in students' effective use of quality appraisal techniques (QATs) such as design, design review, and code review. This study investigated attributes influencing novice programmers' use of QATs within the PSP context. An experimental case study was conducted involving six third-year CS students. Data were collected through actual process measurements and narrative feedback to compare their perceived and actual development processes. The analysis revealed significant discrepancies between students' perceived and actual use of QATs. Critical success factors affecting the adoption of QATs were identified, including an understanding of development phases, technical programming skills, accuracy in measurement data, ability to identify defects, design and review skills, and motivational orientation. These findings contribute a list of attributes serving as cautionary guidelines for educators aiming to enhance software development practices among novice programmers. Addressing these factors can improve the integration of PSP principles and the effective use of QATs in educational settings.

Keywords: Novice programmers, Personal software process, Process measurement data, Quality appraisal techniques, Software development processes, Software quality improvement

Introduction

Software review methods are widely used in industry to improve the quality of software programs (Fagan, 1976; Schach, 2011), as testing alone is seen as a very ineffective and time-consuming debugging strategy (Schach, 2011). Humphrey (1994; 1999) created the Personal Software Process (PSP) that guides software developers in the use of process measurement and quality appraisal techniques (QATs) (in the form of personal design reviews and code reviews) to improve the quality of their programs. He suggests that educators must shift their focus from the programs the students create to the data of the students' processes (Humphrey, 1999). Various researchers reported their experiences incorporating PSP in educational environments (Börstler et al., 2002; Contreras-Vas et al., 2021; Kusakabe et al., 2020; Quinn, 2023; Towhidnejad & Salimi, 1996). Despite its potential to bridge the gap between industry and educational training, PSP is not widely used in academic settings (Pando Soto & Rodríguez Rafael, 2020)—with very limited examples from the past ten years.

The aim of this paper is twofold. Firstly, to form a better understanding of the differences between novice programmers' perceived and actual development processes (including using QATs) through the use of actual process measurement data (as prescribed by the PSP framework), supplemented by narrative data. Secondly,

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to identify attributes that could potentially influence novice programmers' use of QATs. This is also in line with Humphrey's (1999) suggestion that educators shift their focus from the programs that the students create to the data of the processes they use.

Literature review

According to Humphrey (2005), effective defect management is essential to managing costs and schedules during software development and also contributes to software quality. Humphrey states that testing alone is not the most effective way to remove defects. He proposes the inclusion of additional quality appraisal techniques such as inspections, walkthroughs and personal reviews. Humphrey (2005) regards inspections and walkthroughs as team quality techniques. He proposes that individual software developers should review their work before peer inspection, hence the term "personal reviews". He indicates that, despite all the literature that guides software developers on "good" practices and effective methods, a software developer's only generally accepted short-term priority is "coding and testing".

Both positive and negative effects of using PSP principles in educational environments have been noted. On the positive side, the use of a defined and measurement process made students more aware of the shortcomings in their current development practices (Börstler et al., 2002; Carrington et al., 2001; Grove, 1998) and had a positive impact on the students' attitudes toward software process improvement (Grove, 1998). After being introduced to code reviews, students were able to remove defects earlier in the development life cycle (Grove, 1998; Hou & Tomayko, 1998; Prechelt, 2001; Rong et al., 2016; Towhidnejad & Salimi, 1996) and consequently spent less time in testing/debugging. Early defect removal or defect prevention is an attribute of a "mature process" that can be applied to "immature" software processes (Prechelt, 2001, p. 57). Detailed designs were highlighted as a major contributor to defect prevention (Grove, 1998; Rong et al., 2016).

On the negative side, the following problems were noted about the use of PSP principles:

- Students struggled to capture accurate and reliable data (Carrington et al., 2001; Contreras-Vas et al., 2021; Grove, 1998; Kusakabe et al., 2020; Prechelt, 2001; Towhidnejad & Salimi, 1996). Some studies attributed this to students' inability to distinguish between the development phases (Carrington et al., 2001; Grove, 1998). Carrington et al. (2001) emphasised that students struggle to distinguish between the various phases when they code and test one line of code at a time. Prechelt (2001), however, attributed the inaccurate data to a lack of self-discipline on the students' side and labelled it as a "personality issue" (p. 61). When students struggled with basic programming skills, the additional tasks of capturing data caused a cognitive overload (Carrington et al., 2001). In this regard, Börstler et al. (2002) recommend only introducing PSP topics in more advanced programming courses, while Grove (1998) instead created and used a scaled-down version of PSP.
- Many students abandoned the use of PSP practices. In a number of studies, students objected to process measurement because they either found it unrelated to software development (Bullers, 2004; Towhidnejad & Salimi, 1996) or regarded it as extra effort (Börstler et al., 2002; Carrington et al., 2001; Contreras-Vas et al., 2021; Hou & Tomayko, 1998; Kusakabe et al., 2020). In some studies, students objected to the use of the PSP defined process because this process was not compatible with their current development practices (Carrington et al., 2001) or they regarded it as too strict and therefore could not see the potential benefits of using this disciplined process (Börstler et al., 2002; Pando Soto & Rodríguez Rafael, 2020).
- Students struggled with the application of PSP principles even though they demonstrated accurate theoretical knowledge of these principles (Contreras-Vas et al., 2021; Kusakabe et al., 2020).
- Students with limited software development experience are unable to adjust their processes according to lessons learnt from past experience (Kusakabe et al., 2020; Rong et al., 2016).

Humphrey (1999) claims that one of the biggest challenges in software development is to convince software developers to adopt better practices as they tend to stick to a personal process that they have developed from the first small program they have written. Actual process measurement data could also better indicate the quality of students' development processes. In addition, several authors (Hu 2016; McCracken et al., 2001) have proposed using narrative data to gain better insight into students' development processes. Rong et al.

(2012) also suggested that there could be other attributes that might influence students' use of quality processes.

Research method

For this investigation, an integrated experimental case study approach (Plowright, 2011) was followed to gain a deeper understanding of novice programmers' actual development processes and their use of QATs through the collection of both actual process measurement data and narrative data. The discussion in the following sub-sections explains the sampling decisions, methodology, and data collection methods

Sampling decisions

The population for this study included all third-year CS students enrolled for the software development stream at a selected university in South Africa. These students already had intermediate programming skills and experience in the use of software defect removal strategies. Since I wished to select only a small subset of the population for this research study phase, I employed purposive sampling (Babbie, 2010). I therefore identified a total of 15 top performing students from my third- and fourth-year courses who I believed possessed the necessary skills to complete the various activities that would form part of the study. A participant information sheet was distributed to all the identified students as an invitation to participate in the research activity. Therefore, the sampling strategy can also be regarded as convenient (Patton, 2015) since I had easy access to the participants. Participants also had to be available during a pre-determined time slot – minimising any potential logistical issues. The resultant sample comprised six male students in their third year of study in the software development stream.

Methodology and data collection methods

The methodology followed for the experimental case study comprised the six steps as summarised in Table 1. Data was collected during five of these steps. The various data collection strategies included making observations, asking questions (pre-activity questionnaire, post-activity questionnaire, and focus group discussion) and analysing artefacts (Process Dashboard® data and program code) (Plowright, 2011). Each of the six steps and the corresponding data collection strategies (where applicable) are described in more detail in the following sub-sections.

Table 1: Summary of methodology and data collection strategies

Activity	Duration	Rationale
1. Participants complete pre-activity questionnaire	pre- 5 – 10 min	Gather information regarding participants' perceived software development processes.
2. Instructor presents performance measurement tutorial.	1 hour	Teach participants to capture process measures and interpret process data.
3. Participants do programming exercise.	3 hours	Capture process measures while doing programming exercise (Participants).
4. Instructor makes observations.		Record participant behaviour and questions asked (Instructor).
5. Participants complete post-activity questionnaire	post- 15 – 20 min	Explore participants' perceptions of process measurement and evaluate their process improvement proposals.
6. Instructor conducts a focus group discussion with participants	20 min	Gain deeper insights into participants' development processes.

Pre-activity questionnaire

The pre-activity questionnaire (paper-based self-completion format) integrated both structured (close-ended questions) and less structured (open-ended questions) approaches to asking questions (Babbie, 2010). In the software development processes section, nine questions were included to gather information regarding the participants' perceptions of the software development processes they typically follow while working on programming assignments (see Table 2). Each of these questions was explicitly structured to relate to one of the levels of Humphrey's (2005) PSP framework (PSP0, PSP1, or PSP2).

Performance measurement tutorial

After completion of the pre-activity questionnaire, I (as the instructor) conducted a tutorial activity to teach the participants how to log and interpret performance measurement data using the Process Dashboard®

software. This software application is part of an open-source initiative to support developers in using PSP or Team Software Process (TSP). Process Dashboard[®] offers essential data collection, planning, tracking, analysis, and export functionalities.

Table 2: Origin of questionnaire questions

Category	Related questions	Question type	PSP level
Software development process and basic measurement	Q1: Software Life Cycle model	MCQ (multiple answer)	PSP0
	Q2: Percentage time spent in development phases	Open-ended (totalled to 100%)	PSP0
	Q6: Record defects	Yes / No	PSP0
	Q7: Record actual time in phases	Yes / No	PSP0
Quality management and design	Q3: Use of defect removal strategies	MCQ (multiple answer)	PSP2
	Q4: Use of checklist	MCQ (multiple answer)	PSP2
	Q5: Source of checklist	MCQ (single answer)	PSP2
	Q9: Defect removal effectiveness	MCQ (multiple answer)	PSP2
	Q9: Design modelling technique	MCQ (multiple answer)	PSP2.1
Performance	Q10: Average mark for programming assignments	Rating (10-point scale)	n/a
	Q11: Reason for failure	MCQ (single answer)	n/a

As part of the tutorial, participants worked on a programming exercise to practice the capturing of process measurements with Process Dashboard[®]. I started the tutorial with a discussion of the generic PSP2.1 process script, which gave an overview of the different development phases and the required steps of each phase. Specific attention was also paid to defect types and examples of each. The participants then completed the tutorial exercise while following the PSP2.1 process script and capturing measurements. I adapted the tool so that the participants only logged actual data and not any planning or estimation data. As part of the tutorial, I also discussed the analysis and interpretation of time and defect data at the end of the exercise. One hour was set aside for the completion of the entire tutorial. This included instructor-led explanations and discussions. No data (for research purposes) was collected during this step.

Programming exercise

After the tutorial, the participants completed an individual programming exercise. The purpose of the exercise was to:

- Use Process Dashboard[®] to capture process measurement data while doing a programming assignment following the PSP2.1 process script.
- Capture the following process data through Process Dashboard[®]:
 - Time spent in development phases.
 - Defects injected and removed in specific phases.
 - Time spent removing defects.
 - Size of the product.
- Interpret data collected through Process Dashboard[®].

For the programming exercise, the participants had to implement the code to simulate the “Quick Pick Option” of the South African National Lottery (LOTTO[®]) draw. The participants could use any resources, including the Internet, to complete this activity. While they worked on the individual programming exercise, I moved between the participants and recorded any relevant observations as well as all questions asked by the participants. Participants were given three hours to complete the programming exercise.

Post-activity questionnaire

After this exercise, the participants had to complete a post-activity questionnaire with primarily open-ended questions. This questionnaire aimed to explore the participants’ views regarding the capturing and interpreting of process measurement data and their beliefs on how this data could be used to improve their personal development process.

Focus group discussion

As the final step of data collection, a focus group discussion was included to gather narrative data on the participants’ development processes. Initially planned with all six participants, only three attended despite

offering rescheduling options to those who declined. The discussion, conducted the day after the participants completed the first five activities, focused on the actual processes each participant followed to solve the programming problem.

Data analysis

For data analysis, Microsoft Excel was utilised for numerical data, while narrative data was analysed in NVivo 11. The built-in Process Dashboard[®] functionality was used to export a summary of each participant's captured process measurement data to Microsoft Excel spreadsheets for further analysis and comparison. For the purpose of this analysis (and the discussions to follow), data collected through the pre-questionnaire were labelled as "perceived" since it painted a picture of the software development processes, as well as the basic measurement, quality management and design strategies that the participants *thought* they typically used in their programming assignments. In contrast, the data collected through artefact analysis (process measurement data and program code) were labelled as "actual" since it was collected or created during or in direct response to an actual programming activity. Since the study involved six participants only, I was able to do an in-depth analysis of each participant's individual data. During the analysis process, I used the various guidelines as set out in Humphrey's (2000) PSP quality measures to evaluate the collected data.

Result and discussion

This section presents the findings from the experimental case study, integrating both the quantitative process measurement data and the qualitative narrative feedback from participants.

Instructor observations

I made the following main observations while the participants were completing the programming exercise:

- Participants searched the Internet to find solutions for the exercise.
- No designs were created to solve the exercise problem.
- Some participants forgot to start and stop the Process Dashboard[®] timer when switching phases.
- Some defects were not logged.
- Participants struggled to distinguish between the "coding" and the "testing" phases.
- Participants struggled to describe their logged defects.

Given the participants' inability to distinguish between the coding and the testing phase, they did not log their re-work coding in the correct phase. Most of them logged that time under coding, which explained why re-work (testing) time was lower than coding time. More precise measurements would therefore have resulted in much higher testing times.

Overall Process Dashboard[®] performance analysis

The six participants took 135 minutes on average to create the program. This time frame included all phases of development: planning, design, design review, coding, code review, and testing. I decided to end the programming exercise after 150 minutes as enough useful experimental data had been accumulated. At that time, the participants also indicated that they would not be able to identify and fix all remaining defects even without a time limit. The participants on average spent their actual development time as follows: 17% on planning, 1% on design, 0% on design reviews, 45% on coding, 1% on code reviews, and 36% on testing or debugging.

If averages are compared, the actual time that these participants spent on the design was much lower than the perceived times reported in the pre-questionnaire. Most of them also spent much more time in testing than expected. However, the actual testing time would be much higher if they had to continue to produce fully functional programs. The participants on average produced 45 lines of code, which resulted in a productivity of 20 lines of code per hour. They recorded an average of five defects with 90% of these defects injected during coding. The limited actual time spent on designs explains why most defects were injected during coding. Ninety-five percent of the defects were removed in the testing phase – an indicator that debugging was used as the primary technique for defect removal. Given the average time spent on reviews (1%), it is not surprising that so few defects (2%) were discovered during reviews. Since the participants (on average) only spent 1% of their actual time in the design phase, the complete absence of design reviews is understandable.

This resulted in defects being discovered late in the development life cycle (testing), which made it more difficult to identify them.

Differences between perceived and actual software development processes

Table 3 summarises and compares the perceived and actual design practices followed by the participants during the experimental case study.

Table 3: Comparison of participants' perceived and actual design practices

Participant	% Time spent on designs		Design modelling techniques	
	Perceived	Actual	Perceived	Actual
1	10%	3.23%	Use cases	Code comments
2	10%	2.84%	Flowcharts Pseudo code	None
3	10%	0	Flowcharts	None
4	15%	0	Use cases Flowcharts	None
5	15%	1.88%	DFD Flowcharts	None
6	20%	0	DFD Flowcharts Class diagrams	None

All the participants spent much less time on design than initially perceived. Despite the substantial amount of perceived design time (ranging from 10% to 20%), most of the participants spent almost no time on designs. Similarly to the students in Hou and Tomayko's (1998) study, some of the participants in this study created no design documentation even though they captured time in the design phase. The participants' small amount of actual design time also corresponded with the design modelling techniques that they used (none) and the total lack of formal design documentation. Other design studies also noted a similar lack of designs (Eckerdal et al., 2006; Lotus et al., 2011). In Eckerdal et al.'s (2006) study, 80% of the students created either no designs or made no significant progress toward design. The only exception in this study was Participant 1, who used some form of design modelling. This participant's design can be classified in the "informal design" category of Thomas et al. (2014) as it was only text-based.

Table 4 summarises and compares the participants' perceived and actual time spent in testing/debugging and coding during the experiment. Comparisons of the participants' perceived and actual time-in-phase data are complicated by the fact that students generally struggle to distinguish between the development phases (Grove, 1998) and consequently find it difficult to capture accurate and reliable process data (Towhidnejad & Salimi, 1996). Except for Participant 5, most participants in this study completely underestimated the time that they usually spent resolving defects during testing. Although the actual coding time for Participant 2 and Participant 4 was higher than perceived, they both indicated that they should have captured even more time in testing because much of their coding occurred due to re-work to resolve defects (which should have been logged as testing time). Carrington et al. (2001) emphasise that when students write a program by incrementally compiling and testing one line of code at a time, they cannot log data in the correct prescribed PSP phases. The higher-than-expected testing times could also indicate that participants did more "fixing than coding" instead of the code-and-fix strategy that most of them believed they typically used.

Table 4: Comparison of participants' perceived and actual testing/debugging and coding time

Participant	% Time spent on testing		% Time spent on coding	
	Perceived	Actual	Perceived	Actual
1	6%	47.60%	55%	32.30%
2	15%	19.10%	60%	70.20%
3	10%	49.67%	40%	33.30%
4	15%	39.00%	40%	46.50%
5	10%	3.75%	40%	84.40%
6	10%	69.90%	20%	7.08%

Early defect removal occurs when defects are removed before the testing/debugging phase (Humphrey, 2005). This is accomplished through the use of design reviews and code reviews (as examples of QATs). Table 5 summarises and compares the participants' perceived and actual defect removal strategies, and their perceived

and actual time spent on these strategies. Except for Participant 1, all the participants used debugging as their only defect removal strategy during the programming exercise. According to Humphrey (1999), one of the biggest challenges in software development is persuading developers to use effective methods. Although Participant 1 indicated that he typically only used debugging, he attempted to use design reviews and code reviews during the programming exercise. The low amount of time he spent on design review and code review was, however, not indicative of someone who really depended on these strategies to remove defects.

Table 5: Comparison of participants' perceived and actual defect removal strategies

Participant	Defect removal strategy		% Time spent on design review		% Time spent on code review		% Time spent on testing/debugging	
	Perceived	Actual	Perceived	Actual	Perceived	Actual	Perceived	Actual
1	Debugging	Design review Code review Debugging	4%	0.81%	0%	6.45%	6%	47.60%
2	Debugging	Debugging	0%	0%	10%	0%	15%	19.10%
3	Code review Debugging	Debugging	5%	0%	15%	0%	10%	49.67%
4	Debugging	Debugging	5%	0%	0%	0%	15%	39.00%
5	Design review Code review Debugging	Debugging	15%	0%	10%	0%	10%	3.75%
6	Design review Code review Debugging	Debugging	5%	0%	25%	0%	10%	69.90%

Participant 2 and Participant 4 indicated debugging as their only perceived defect removal strategy, which corresponded with their use thereof during the exercise. Participants 3, 5, and 6 indicated that they typically used other strategies (design review and code review) but only used debugging during the exercise. Of interest is the large amount of perceived time these three participants believed they were using for design reviews and code reviews. This might directly influence the time they thought they spent on testing/debugging because they believed they would pick up defects earlier in the life cycle (with design reviews and code reviews). The low perceived design review times might indicate the participants' inability to create reviewable designs (Humphrey, 2000). However, it is still questionable that some participants indicated they used design reviews and even assigned a substantial amount of time to it. At the same time, they did not do any designs. Since even small programming exercises require some code to be written, there will always be at least some code to review. In Towhidnejad and Salimi's (1996) study, students found it easier to adopt code reviews as part of their quality improvement process because they regarded it as more closely related to programming. However, software developers tend to stick to a personal process they have developed from the first small program they have written, and it is not easy to convince them to adopt better practices (Humphrey, 1999).

Attributes influencing the use of QATs

The discussion in this section takes a reflective look at all the collected evidence using PSP0 and PSP2 as lenses to identify specific problems experienced by the participants in following these guidelines/practices. Since adopting QATs would likely require a change in behaviour from the participants, the self-theory of intelligence is included as a third, supporting lens for this discussion. Ultimately, these identified problems are related to attributes that could potentially influence novice programmers' use of QATs.

PSP0: Software development process and basic measurements

Four potentially influencing attributes were identified using PSP0 as the first lens for this reflection.

Understanding of development phases

One of the PSP quality improvement practices states: "To do high-quality work, you must measure and manage the quality of your development process" (Humphrey, 2005: 157). Given defects' negative impact on the quality of the development process, it is not surprising that "most software professionals agree that it is a good idea to remove defects early, and they are even willing to try doing it" (Humphrey, 2005: 142). In this study, the participants tried to do the same, but they all opted for a code-and-fix development process, which is not the best strategy to follow for early defect removal. Therefore, they spent most of their actual

development time in the planning, coding and testing phases. The code-and-fix model does not make provisions for any phases that can be linked to quality appraisal practices, such as design, design review, and code review (Schach, 2011). Some participants indicated that they did not know exactly what to do in these development phases (design, design review, code review) but acknowledged that the process measurement data made them aware that something needed to be done in these phases. Participant 4 indicated that he mostly “*confused coding and testing*”, while Participant 2 attributed his struggles to the fact that he “*could not differentiate on what must be done on each phase*”. As for process improvement, Participant 2 proposed “*try[ing] to understand what must be done in each phase*” and “*spend[ing] more time on design, design review and code review*”. In this regard, Participant 1 proposed that for process improvement he should “*learn how to do design effectively*” and “*spend more time reviewing so I don’t do more of code and fix*”. Participant 5 indicated that the recording of time data in specified phases forced him to “*attend all sections as far as possible*”. This indicates that Participant 5 did not know exactly what to do in each phase.

Technical programming skills

One of the code review principles of PSP is that one must produce a reviewable product (Humphrey, 2005). Only Participant 2 created a fully functional program for the programming exercise while Participant 1 successfully implemented most of the major functionalities. Participant 6 indicated that his biggest problem was his lack of technical programming skills, which was the main reason why he produced only a small amount of workable code. As for process improvement, he suggested: “*recapping on OPG1 stuff [the basics of coding] because my problem was mainly syntax and logical errors*”. Participant 5 also produced very few lines of workable code and used data structures beyond his technical capability. In his post-questionnaire, however, he did not mention any shortcomings in his technical ability to produce code. Participant 4 produced slightly more workable code than Participants 5 and 6, but in his post-questionnaire stated that process measurement data “*is good for making one see his/her problems in software development*”.

Accuracy of measurement data

Time measurement data is typically used to “analyse your process, to understand strengths and weaknesses, and to improve” (Humphrey, 2005: 15). Therefore, the accuracy of time data will directly influence process improvement decisions. All the participants indicated that they had some difficulty capturing accurate time data in the correct phase. Participants 5 and 6 did not indicate any specific problems with capturing accurate time data but acknowledged that capturing process measurement data is “*new*” to them. The most common problem that the participants experienced was distinguishing between “*re-work*” (as result of fixing a defect) and normal work. The re-work time was supposed to be logged under the phase in which the defect was discovered. If this is not done correctly, it will be impossible to accurately compute the efficiency of the defect removal strategy. This confusion could be attributed to the nature of the code-and-fix process model whereby most coding occurs because of the fixing of defects. Towhidnejad and Salimi (1996) also reported that only half of their students collected accurate and reliable data.

Ability to find and fix defects

From the participants’ defect descriptions, it was evident that some of them could not resolve all the defects regardless of their defect removal strategy. Since these participants mostly relied on testing to resolve defects, it could point to a lack of debugging skills. Humphrey (2005) explained that in reviews you “find defects directly”, and in testing you “only get the symptoms”. Only Participants 1 and 2 managed to create 100% working programs. Their defect descriptions were much better than the rest of the participants as they described the cause of the defects and not the consequence thereof. Participant 3 had vague generic descriptions (e.g. “*Syntax Error*” and “*Output Format Wrong*”) that at best indicated the kind of defect that occurred, but not the cause of the defect. Participant 4 had one vague description (“*Could not create a list*”) that described the consequence of the defect and not the cause thereof. The remainder of his identified defects were described as “*Unknown*” and it was therefore not clear if he managed to resolve these defects. Participants 5 and 6 each had one defect description. In both cases the defect description reflected unresolved defects.

In PSP, defect descriptions are used to create personalised checklist items (Humphrey, 2005). These descriptions therefore need to be clear and precise. Most participants in this study indicated some difficulty logging all defects and also struggled to describe the defects. Poor descriptions of defects are likely to lead to difficulties when this data must be used to create personal checklist items. When not all defects are logged, it can lead to misinterpretation of the severity of defects and the causes of the lost time in the phase during which the defect was removed.

PSP2: Quality Management and Design

In using PSP2 as the second lens for this reflection, three potentially influencing attributes were identified: design skills, design review and code review skills, and value of process measurement data.

Design skills

The PSP quality-management strategy recommends that developers' first focus should be on producing "a thorough and complete design and then document[ing] the design with the four PSP design templates" (Humphrey, 2005: 155). Even though Humphrey claimed that the "reviewability" of a design is not that important if you review your own designs, he also stated that "without a well-documented and complete design, it is impossible to do a competent design review" (Humphrey, 2005: 185). All the participants in this study indicated some formal design modelling techniques that they typically used, but none of them attempted to use any of these techniques to create formal design documentation. Some participants also indicated that they did not know how to create effective designs. In explaining his strategies for process improvement, Participant 1 said that he would have to "*learn how to design effectively*" and "*design the requirements, review to identify defects so that I have less design defects when I code*".

Design review and code review skills

Participants 1 and 2 indicated that they typically did not do reviews and therefore did not use any checklists. Participant 4 also indicated that he did not do reviews but created checklists based on his previous defects and existing checklists. Participant 3 indicated that he typically used checklists for code reviews compiled from his previous defects and from existing checklists, but he ended up not doing any reviews. Participants 5 and 6 also indicated that they typically made use of checklists for code reviews, compiled from their own defects, but ended up not doing any reviews.

However, only Participant 1 ended up doing some form of reviews. He described his technique as follows: "*In my design review I actually ensured that my requirements were well design[ed], even though I just passed through it*".

"*For my code review I actually commented what was required by the requirements*".

"*[I] spend little time on reviewing by just scanning through [the] code and initial design*".

Value of process measurement data

The main purpose of requesting the participants to gather process measurement data on their own development processes was to provide them with an opportunity to reflect on this data and to propose process improvements or changes based on the collected data. After the participants analysed their own process measurement data, they were therefore probed to propose process changes on how to reduce their testing time and methods to remove defects earlier in the life cycle. Specific attention was given to proposals that would influence early defect removal and reduce the time spent in testing. In reviewing these proposals, I was specifically looking for indications that a participant's reflection on his time and defect data showed some signs that could be interpreted as encouragement to use QATs (design reviews and code reviews). The participants displayed varying interpretations of their process measurement data and the potential value of the data. Table 6 summarises the participants' responses in this regard.

The PSP quality guidelines claim that quality can only be improved if it is measured and that the quality measurements should indicate "the effectiveness of the process for removing the defects" (Humphrey, 2005: 143). Participants 1, 2, 4 and 6 believed that debugging is the most effective defect removal strategy, which corresponded with their usage thereof. Participants 3 and 5 believed that code reviews are the most effective method for removing defects but ended up not doing any code reviews at all. Only Participant 1 made use of

reviews and resolved one defect during code review at an efficiency rate that is just lower than his debugging efficiency rate. Those participants who did not do any reviews, consequently had no measurements to indicate the effectiveness of their use of QATs. Without the existence of these efficiency metrics there will be no motivation to adopt QATs as defect removal strategies.

Overall, the participants who struggled to produce a working program (Participants 3, 4, 5, and 6) displayed a less meaningful interpretation of their process measurement data. Their improvement proposals focused more on changing the activities in their current software process than on changing the process itself. Even though their current software development processes did not result in good performance, they still believed that they followed the optimum process and just needed to perform better at what they were already doing. On the contrary, the better performing participants (Participants 1 and 2) proposed process-oriented changes such as spending more time on creating effective designs and learning how to do more effective reviews. Although their current practices resulted in success, they were still motivated to find ways to further improve the quality of their current process, beyond their current capability.

Table 6: Summary of participants’ proposed process changes

	How to reduce test time	How to remove defects earlier	Changes to development process
1	<ul style="list-style-type: none"> • Spend more time reviewing. • Design the requirements and then review to identify defects of the design. • Spend more time on code review after completing each segment of code. • Find and fix defects earlier by doing reviews. 	<ul style="list-style-type: none"> • Do more thorough reviews. 	<ul style="list-style-type: none"> • Learn to do design effectively. • Spend more time on reviewing. • Do not do code-and-fix.
2	<ul style="list-style-type: none"> • Do each phase step-by-step. • Try to identify and fix defects as early as possible. 	<ul style="list-style-type: none"> • Do design reviews and code reviews. 	<ul style="list-style-type: none"> • Spend more time on design, design review and code review. • Try to understand what must be done on each phase.
3	<ul style="list-style-type: none"> • Plan well. • Code efficient. • Review design for accuracy. • Fix problems as quickly as possible during testing. 	<ul style="list-style-type: none"> • Review code. • Compile more often. • Do better planning to minimise defects. 	<ul style="list-style-type: none"> • Fast coding. • Plan well before implementing anything.
4	<ul style="list-style-type: none"> • Code in full before testing. • Correct all defects at once. 	<ul style="list-style-type: none"> • Do not spend too much time on one defect. 	<ul style="list-style-type: none"> • No changes.
5	<ul style="list-style-type: none"> • Keep track of time spent in phases. • Do designs. 	<ul style="list-style-type: none"> • Do better because this was bad. 	<ul style="list-style-type: none"> • Become familiar with the data capturing tool (Process Dashboard[®]). • Remember to log all defects.
6	<ul style="list-style-type: none"> • Recap the basics of coding. • Avoid syntax and logical errors. 	<ul style="list-style-type: none"> • Do code review and design review. 	<ul style="list-style-type: none"> • Know the basics (programming principles and language syntax).

Self-theory of intelligence

Through the participants’ post-mortems (as recorded in the post-questionnaire and focus group discussion), they have provided some personal insights regarding their own intelligence and abilities. According to Dweck’s (2000) Self-theory of Intelligence, a student’s implicit assessment of their own intelligence and abilities could ultimately influence their individual motivations and behaviours. Given the development processes followed by the participants in the programming exercise, the actual adoption of QATs would require a fairly drastic change in normal “development” behaviour from them. It is also likely that not all participants will be equally motivated to adopt such a new behaviour. In using self-theory of intelligence as the third lens for this reflection, two behavioural attributes were identified.

Motivation

As part of her self-theory of intelligence, Dweck (2000) described the reactions of students in situations of failure as a “helpless” pattern. Some of these “helpless” responses were visible in the post-questionnaire responses of the participants. Participants 4, 5 and 6 blamed their own inability to get used to the new

environment (Process Dashboard[©]), the new practices and the unfamiliar problem as their reason(s) for failure (to capture accurate time and defect data) as is evident from the following responses:

Participant 4: *“My mind is slowly getting used to it [the process of capturing data], so as a result I confused times”*.

Participant 5: *“Remembering to always check time was a problem because I was used to just coding”*.
“Just getting used to adjust to this new system”.

Participant 6: *“The big problem is being new to a program. If I get used to it, it would not be a problem”*.
“I forgot the steps to follow since the problem is new to me”.

Signs of “helplessness” were also observed during the focus group discussion. Participants 4, 5 and 6 acknowledged a deterioration in their problem-solving strategies and described how they made use of maladaptive practices such as “cargo culting” (O’Dell, 2017: 78) to produce code. Some of these participants also indicated that they “gave up”. According to Participant 4, more time would not have helped him: *“Even if I had more time, I would not be able to solve this problem”*. Participant 5 realised that he had *“more failure than success”* and that he, in future, *“would try to do much better than this because this was fairly bad enough”*. Participant 6 condemned his ability by blaming his lack of basic programming skills: *“Recapping on OPG1 stuff [the basic of coding] because my main problem was syntax and logical errors”*. The other three participants (1, 2, and 3) never showed any signs of questioning or blaming their own abilities. Instead, they started devising self-improvement strategies - thereby portraying behaviours that can be more closely linked to what Dweck (2000) referred to as the “mastery-oriented” pattern.

Behaviour

Linking to another attribute of the self-theory of intelligence, some participants revealed a “performance goal” orientation in which they “want to look smart (to themselves or others) and avoid looking dumb” (Dweck, 2000). In their perceived time-in-phase process data (as captured in the pre-questionnaire), Participants 5 and 6 indicated a process that included enough time in the design, design review and code review phases to remove defects early in the life cycle. Their perceived defect removal strategies also indicated that they used QATs such as design reviews and code reviews. Only Participants 5 and 6 indicated that they used all the listed defect removal strategies (design review, code review and debugging). Participant 3 indicated that he used code reviews and debugging. However, during the programming exercise, Participants 3, 5 and 6 ended up not using any of their perceived QATs and did not spend any time at all on design, design reviews or code reviews. Participants 3, 4, 5 and 6 indicated that they used checklists based on previous defects for conducting reviews. Not one of these participants described their defects clearly so that it could be used for future defect prevention as checklist items. Participants 5 and 6 were the only participants who could not produce workable programs during the programming exercise. As for their process improvement proposals, not one of Participants 4, 5 and 6 revealed any “learning-oriented goals” (Dweck, 2000) that could ultimately contribute to the use of QATs. Despite only being able to produce a partially working program, Participant 4 even went as far as stating that he would not make any changes to his current software development process. Although Participant 3 made some unsubstantiated statements for process improvement, there was some indication of awareness of the use of QATs to reduce testing time and to find defects earlier in the life cycle - as is evident from the following quotes:

“I would review my design for accuracy”.

“I should review my code”.

“Planning well before implementing anything”.

On the contrary, both Participant 1 and Participant 2 did not try to “look smart” when they completed the pre-questionnaire. Both participants indicated that they only used debugging as defect removal strategy and that they did not use any checklists. There was also no indication of the creation of checklists based on previously collected personal data. During the programming exercise, only Participant 1 used code s. Participants 1 and 2 also captured the most defects in their error logs and the high quality of their defect descriptions made theirs the only descriptions that could be usable for future defect prevention. In the post-questionnaire, both of these participants also indicated some learning-oriented goals that could ultimately contribute to their use of QATs: Participant 1: *“Learn how to do designs effectively”*.

“Spend more time on reviewing and fixing while reviewing” instead of “just scanning through code and the initial design”.

Participant 2: “Spend more time on design, design reviews and code reviews”.

“Try to understand what must be done in each phase”.

These goals “reflected a desire to learn new skills, master new tasks, or understand new things” as specified by Dweck (2000) as being attributes of beholders of an incremental theory of intelligence. It is therefore interesting to note that only Participants 1 and 2 managed to produce completely functional programs.

Table 7 provides a summary of the identified skills and behavioural characteristics of each participant, mapped to the identified attributes.

Table 7: Mapping of participants skills and behaviours to identified attributes

Attributes	Participant					
	1	2	3	4	5	6
PSP0						
Understanding of development phases	X	X	X	X	X	X
Technical programming skills	✓	✓	✓	✓	X	X
Accuracy of measurement data	X	X	X	X	X	X
Ability to find and fix defects	✓	✓	✓	✓	X	X
PSP2						
Design skills	X	X	X	X	X	X
Design review and code review skills	X	X	X	X	X	X
Value of process measurement data	✓	✓	X	X	X	X
Self-theory of intelligence						
Motivation orientation	Mastery	Mastery	Mastery	Helpless	Helpless	Helpless
Achievement goal orientation	Learning	Learning	Performance	Performance	Performance	Performance

Conclusion

This study investigated the discrepancies between novice programmers' perceived and actual software development processes, with a particular focus on their use of QATs within a PSP framework. By analysing actual process measurement data alongside narrative feedback from participants, we aimed to identify attributes that influence the adoption of QATs among novice programmers.

The findings revealed significant gaps between what the participants believed they practiced and what they actually did during the programming exercise. Despite reporting the use of design, design reviews, and code reviews in their perceived development processes, most participants did not implement these practices when faced with an actual programming task. Instead, they predominantly engaged in coding and debugging activities, allocating minimal time to design and review phases. This discrepancy suggests that while novice programmers may understand the theoretical importance of QATs, they struggle to integrate these practices into their actual workflows.

The following difficulties were identified that could potentially hinder the effective use of QATs among novice programmers:

- Lack of understanding of what exactly needs to be done in the prescribed development phases;
- Lack of technical programming skills;
- Inaccurate measurement data;
- Inability to identify defects;
- Lack of design review and code review skills;
- Lack of design skills;
- Inability to interpret measurement data;
- Helpless motivational orientation during problem solving; and

- Lack of learning-oriented achievement goals.

The study's limitations include a small sample size and the use of participants from a single institution, which may affect the generalisability of the results. Future research should consider larger, more diverse populations to validate these findings. Longitudinal studies could also provide insights into how novice programmers' use of QATs evolves over time with continued practice and education. Additionally, exploring the impact of different teaching methodologies on the adoption of QATs could offer valuable guidance for educators.

By identifying the critical factors that influence novice programmers' use of QATs, this study contributes valuable insights to the field of computer science education. Addressing the identified challenges through targeted educational interventions can promote the effective adoption of QATs, leading to improved software development practices among novice programmers. Ultimately, fostering these skills and behaviours is essential for preparing students to meet the quality demands of the software industry and to excel in their future professional endeavours.

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References

1. Börstler, J., Carrington, D., Hislop, G.W., Lisack, S., Olson, K., & Williams, L. (2002). Teaching PSP: Challenges and Lessons Learned. *IEEE Software*, 19(5), 42-48.
2. Bullers, W.I. (2004, January). Personal software process in the database course. In R. Lister & A. Young (Eds.), *Proceedings of the 6th Australian Conference on Computing Education (ACE'04)* (Vol. 30, pp. 25-31). Australian Computer Society, Inc.
3. Carrington, D., McEniery, B., & Johnston, D. (2001). PSPSM in the large class. In *Proceedings of the 14th Conference on Software Engineering Education and Training, In search of a software engineering profession* (Cat. No. PR01059) (pp. 81-88). IEEE. <https://doi.org/10.1109/CSEE.2001.913824>
4. Contreras-Vas, J.Á., Arias-Masa, J., Hidalgo-Izquierdo, V., Martín-Espada, R. (2021). Personal Software Process: A Study from an Academic Perspective. In: Costa, A.P., Reis, L.P., Moreira, A., Longo, L., Bryda, G. (eds) *Computer Supported Qualitative Research. WCQR 2021. Advances in Intelligent Systems and Computing*, vol 1345 (pp. 148-154). Springer. https://doi.org/10.1007/978-3-030-70187-1_11
5. Dweck, C. (2000). *Self-Theories: Their role in motivation, personality, and development* [Kindle edition]. Taylor & Francis.
6. Eckerdal, A., McCartney, R., Moström, J. E., Ratcliffe, M., & Zander, C. (2006). Can graduating students design software systems?. *ACM SIGCSE Bulletin*, 38(1), 403-407. <https://doi.org/10.1145/1124706.1121468>
7. Fagan, M. E. (1976). Design and code inspections to reduce errors in program development. *IBM Systems Journal*, 15(3), 182-211.
8. Grove, R. F. (1998). Using the personal software process to motivate programming practices. In *Proceedings of the 6th Annual Conference on the Teaching of Computing and the 3rd Annual Conference on Integrating Technology into Computer Science Education: Changing the Delivery of Computer Science Education (ITiCSE'98)* (pp. 98-101). Association for Computing Machinery. <https://doi.org/10.1145/282991.283046>
9. Hou, L., & Tomayko, J. (1998). Applying the personal software process in CS1: An experiment. In *Proceedings of the 29th SIGCSE technical symposium on Computer Science Education (SIGCSE'98)* (pp. 322-325). Association for Computing Machinery. <https://doi.org/10.1145/273133.274322>
10. Hu, C. (2016). Can students design software? The answer is more complex than you think. In *Proceedings of the 47th ACM Technical Symposium on Computing Science Education (SIGCSE'16)* (pp. 199-204). Association for Computing Machinery. <https://doi.org/10.1145/2839509.2844563>

11. Humphrey, W. S. (1994). Process feedback and learning. In *Proceedings of the 9th International Software Process Workshop* (pp. 104-106).
12. Humphrey, W. S. (1999). Why don't they practice what we preach? The Personal Software Process (PSP). *Annals of Software Engineering*, 6(1-4), 201-222.
13. Humphrey, W. S. (2000). *The personal software process*. Carnegie Mellon University.
14. Humphrey, W. S. (2005). *PSP: A Self-Improvement Process for Software Engineers*. Pearson Education Inc.
15. Kusakabe, S., Araki, S., Katamine, K., & Umeda, M. (2020). Analyzing motivation in personal software process education course with a qualitative approach. In *2020 9th International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 298-303). IEEE. <https://doi.org/10.1109/IIAI-AAI50415.2020.00066>
16. Loftus, C., Thomas, L., & Zander, C. (2011, March). Can graduating students design: revisited. In *Proceedings of the 42nd ACM technical symposium on Computer Science Education (SIGCSE'11)* (pp. 105-110). Association for Computing Machinery. <https://doi.org/10.1145/1953163.1953199>
17. McCracken, M., Almstrum, V., Diaz, D., Guzdial, M., Hagan, D., Kolikant, Y.B., Laxer, C., Thomas, L., Utting, I., & Wilusz, T. (2001). A multi-national, multi-institutional study of assessment of programming skills of first-year CS students. In *Working Group Reports from ITiCSE on Innovation and Technology in Computer Science Education (ITiCSE-WGR '01)* (pp. 125-180). ACM.
18. O'Dell, D.H. (2017, February). The debugging mindset. *Queue*, 15(1), 71-90. <https://doi.org/10.1145/3055301.3068754>
19. Pando Soto, B., & Rodríguez Rafael, G. (2020). Personal Software Process (PSP) skills for the software industry in Latin America. *Industrial Data*, 23(1), 237-244.
20. Plowright, D. (2011). *Using Mixed Methods: Frameworks for an Integrated Methodology*. SAGE Publications.
21. Prechelt, L. (2001). Accelerating learning from experience: avoiding defects faster. *IEEE Software*, 18(6), 56-61. <https://doi.org/10.1109/52.965803>
22. Quinn, N. (2023). Adjustment of Models and Procedures for Web Development. *Infotech Journal Scientific and Academic*, 4(2), 01-17.
23. Rong, G., Li, J., Xie, M., & Zheng, T. (2012, April). The effect of checklist in code review for inexperienced students: an empirical study. In *Proceedings of the 25th Conference on Software Engineering Education and Training* (pp. 120-124). IEEE. <https://doi.org/10.1109/CSEET.2012.22>
24. Rong, G., Zhang, H., Qi, S., & Shao, D. (2016, May). Can software engineering students program defect-free? An educational approach. In *Proceedings of the IEEE/ACM 38th International Conference on Software Engineering Companion (ICSE-C)* (pp. 364-373). IEEE. Retrieved from <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7883322&isnumber=7883261>
25. Schach, S. R. (2011). *Object-Oriented and Classical Software Engineering* (8th ed.). McGraw-Hill.
26. Thomas, L., Eckerdal, A., McCartney, R., Moström, J.E., Sanders, K., & Zander, C. (2014, July). Graduating students' designs: through a phenomenographic lens. In *Proceedings of the 10th annual conference on International Computing Education Research (ICER'14)* (pp. 91-98). Association for Computing Machinery. <https://doi.org/10.1145/2632320.2632353>.
27. Towhidnejad, M., & Salimi, A. (1996). Incorporating a disciplined software development process into introductory computer science programming courses: Initial results. In *Proceedings of the 26th Annual Frontiers in Education Conference (FIE '96)*, 2 (pp. 497-500).



An academic's personal perspective on the integration of educational technology in higher education for teaching and learning

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Abstract: COVID-19 brought a drastic shift in the education sector, influencing how T&L and assessment is done as EduTech became prominent. This saw many academics grappling with pressure to adopt new technologies as formal education was in a traditional f2f format for years. Despite these challenges, there is a significant shift from traditional to modern T&L practices such as e-learning and blended instruction as the adoption of EduTech in HE became a topic of interest recently. However, while studies have made contributions to the adoption of EduTech, none has focused on real-life academic experiences with the use of EduTech. Therefore, the study aims to provide an academic's personal perspective on the integration of EduTech for T&L. The objective is to encourage and promote the use of EduTech, by highlighting the benefits of these technologies for academics in various disciplines. A scholarly personal narrative methodology is used to reflect the academic's personal experiences regarding the use of EduTech. Reflection on the use of Blackboard Learn LMS, SAM Cengage, MS Excel, and Kahoot! is provided. The LMS was effective for managing subject content, providing students with a centralized place for accessing learning material on SAM Cengage and grades. All student grades are easily exported from the gradebook to Excel, which is also used for electronically taking and managing class attendance. Kahoot! was utilized to keep students engaged in the classroom, providing a competitive, yet fun and relaxing learning environment. These tools are good to supplement and improve the T&L experience of students.

Keywords: Blackboard Learn LMS, Educational Technology (EduTech), Higher Education, Kahoot!, Microsoft Excel, SAM Cengage, Scholarly Personal Narrative (SPN), Teaching and Learning (T&L)

Introduction

Professors in higher education presently face challenges associated with the need to captivate a population of students (Generation Z) who differ from previous generations (Martin-Somer, et al., 2024). The unique characteristics associated with Generation Z - who have grown up in a digitally connected world where instant access to information is the norm - created new challenges for academics and professors as they are required to change their teaching methods to effectively engage, teach, and encourage the current generation (Martin-Somer, et al., 2024; Hashish, et al., 2024). Furthermore, the COVID-19 pandemic brought about a drastic shift around the globe in the education sector, specifically on how teaching, learning and assessment is done, as educational technologies (EduTech) became essential tools for teaching and learning (Ochieng et al., 2023). In addition, the COVID-19 pandemic also accelerated the adoption and use of EduTech into teaching and learning practice. This saw several academics grappling with the pressure to adopt new EduTechs in a short space of time, as for many years, formal education depended on the classroom model, necessitating the actual

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presence of educators and pupils in a specified classroom (Chigbu et al., 2023). However, there is a significant transition from traditional teaching and learning practices to contemporary pedagogical models, such as e-learning, blended instruction, and various other educational methodologies (Chigbu et al., 2023).

Technology has evolved from a simple instrument for study and inquiry to a comprehensive strategy and integrated use in education (Tuma, 2021). Its adoption in higher education (HE) has been of interest recently, with numerous studies investigating various aspects of EduTech. In a study by Empaynado-Porto (2020), technology acceptance, organizational culture and attitudes were highlighted as influencing factors on the adoption of e-learning/EduTech at a university in the Philippines. A similar study on the adoption of e-learning by universities in Indonesia was conducted by Garaika (2020), who accentuates the importance internal factors have in influencing the adoption of e-learning. Furthermore, a study on the cultural context of Middle East higher educational institutions (HEI) by Khan and Qudrat-Ullah (2020) highlighted the importance of considering the influencing cultural factors when investigating the adoption of EduTech. Dangi (2021) highlighted the importance of institutional support towards influencing teachers' behaviour and acceptance of adopting EduTech. In addition, to predict students' intention to utilize technology enabled learning platforms such as the metaverse, Al-Adwan et al. (2023) emphasized adjustment of models to accommodate emerging technological advancements in education and suggested an extended Technology Acceptance Model (TAM).

The adoption of EduTech in HE is a complex phenomenon influenced by various factors such as organizational culture, technology acceptance, attitude, and cultural context. Studies have highlighted the importance of considering individual internal factors, institutional support, and theoretical frameworks in understanding and predicting the adoption of educational technology. While the above studies have made contributions on the adoption of educational technology and factors influencing the adoption in higher education, none of the studies has focused on real life experiences of academics on the use of EduTech and how they apply it. Thus, this study is unique in the sense that it provides real life examples and experiences of an academic. In light of this, the aim of the study is to provide an academic's personal perspective and real-life experiences on the integration of EduTech in T&L in HE. The rest of the paper is arranged as follows: methodology, context, reflection on the integration of educational technology, and conclusion.

Methodology

In this paper, the academic applies a scholarly personal narrative (SPN) research approach. This is a constructivist research methodology that acknowledges the researcher's personal experience as a viable subject of study (Heidelberger & Uecker, 2009). The inside-out methodology of SPN distinguishes it from other self-interrogation approaches, in that it begins with the scholar's narrative before shifting outward to help the writer and reader better understand the world outside of the scholar-storyteller (Camarao & Din, 2022). Swart (2018) defines SPNs as not only intellectual but also conveying the "storied lives" of professionals, presenting their own unique realities and provoking readers to question their own realities, and is thus a recognized research methodology that employs the author's experiences as a theoretical lens. Furthermore, Ng and Carney (2017) argue that including SPN could broaden the Scholarship of Teaching and Learning (SoTL) and deepen understanding of the complex circumstances and factors that shape educators, classrooms, and student experiences. It enables the academic as an information systems/technology (IS/IT) researcher to reach a larger audience and transcend the scientific language and purely objective perspective that all too often separate this research field from the rest of academia, practitioners, and the general public (Heidelberger & Uecker, 2009).

Context

As an academic in HE, especially in the IT field, I have been utilizing different EduTechs in my teaching, even before the COVID-19 pandemic. The integration of technology in my practice has provided me with an effective and efficient environment. Before I share with you my reflection on the technologies I use for T&L, let me provide you with a little bit of my context so you understand how everything ties together.

I worked in HE as a part-time lecturer in 2013, and 2015 – 2019. I became a permanent lecturer in 2020. As a part-time lecturer, I was responsible for teaching digital literacy subjects as a service subject to first-year students from other faculties within the university. The digital literacy content included Microsoft (MS) Word,

Excel, Outlook, and Computer Concepts. It provided students with the basics of MS applications, how they can utilize them, and how to navigate through the computer and the internet.

As a part-time lecturer, I was assigned a specific digital literacy subject to head and manage as each qualification in the university had a unique subject code and name referring to their digital literacy subject. For example, I was responsible for offering the subject (COM11AI which later changed to BDL11A) to all first-year students studying engineering qualifications (electrical, mechanical, and civil). This cohort of students was about 600 – 900+ per year. As a lecturer, part of my work still includes teaching digital literacy subjects to first-year students at the university.

Managing and teaching these massive classes required the use of EduTech, else I do not see how I would have managed to teach and assess these students effectively without integrating technology into my teaching. Despite having massive classes, the use of EduTech has made my work easier to manage and carry out. Below I provide my personal reflections on the technological tools I use for content management, T&L, and assessments for my digital literacy subjects.

Reflection on the integration of Educational Technology (EduTech)

This section of the paper provides the technological tools I utilize as an academic for managing subject content, T&L, and assessment for the digital literacy subjects I offer, which are: Blackboard Learn Learning Management System (LMS), Skills Assessment Manager (SAM Cengage), Microsoft Excel and Kahoot!. It outlines how I integrate each of these technologies into my practice, challenges, and feedback from students and peers providing a different yet relevant perspective on the use of these technologies.

Blackboard Learn LMS

Blackboard plays a major role in my practice as it provides a central platform for me to share content and engage with my students. My experience with Blackboard Learning Management System (LMS) has been multifaceted, blending both the advantages of digital teaching tools with the challenges of navigating technology in an educational context. At first when I started teaching, I only used Blackboard as an information repository and did not fully explore its features. However, as years went by, I started exploring more on the features I can use to help improve my subject. Blackboard has provided me with a comprehensive platform to manage my subject, engage with students, and integrate other third-party tools for teaching. I also restructured the content of the subject so that the students can easily flow with it. See Figure 1 below.

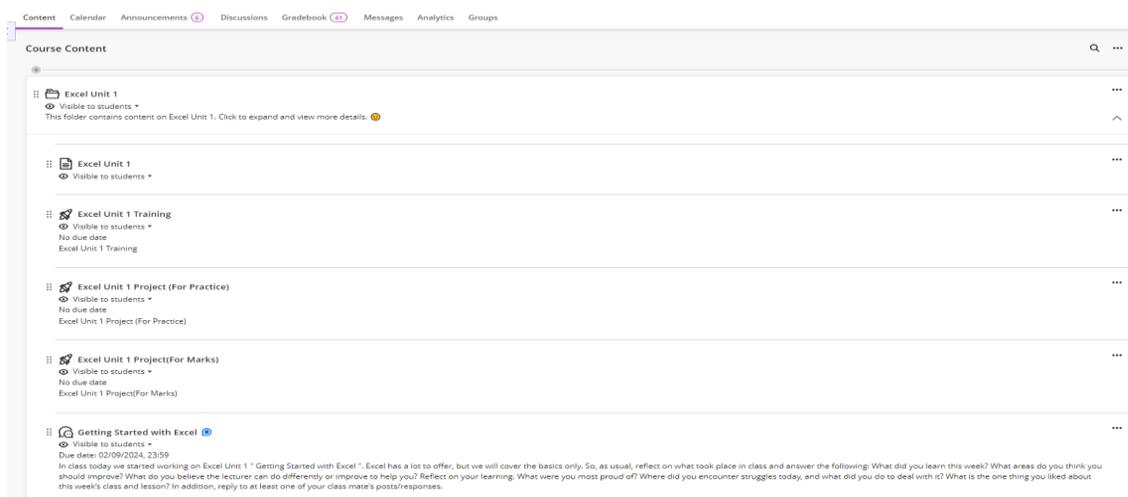


Figure 1: Blackboard LMS content

One of the key benefits I've appreciated about Blackboard is its ability to centralize all subject materials in a single, easily accessible location. This has allowed me to provide students with lecture notes, assignments, discussion forums, and grading feedback in one space (Toring et al., 2023). In higher education, where students often juggle multiple responsibilities, having everything in one place simplifies their learning experience. In addition, Blackboard's grade center feature has been helpful in providing timely feedback to students. The integration of SAM Cengage's Gradebook into the LMS has saved time and allowed for a quick

turnaround in grading. From an academic perspective, it also streamlines administrative tasks like grading and student activity tracking.

The availability of discussion boards and announcements within Blackboard has been useful for promoting a sense of community among students. I have used these tools to encourage dialogue beyond the classroom, allowing students to engage in peer discussions and share ideas. The discussions also provide a safe environment for my students to voice out any concerns they may have with regards to subject. Through this, I can improve my teaching through their critique, and they are also able to see which areas they need to improve as well on their side. Figure 2 below shows one of the discussions I provided to my students.

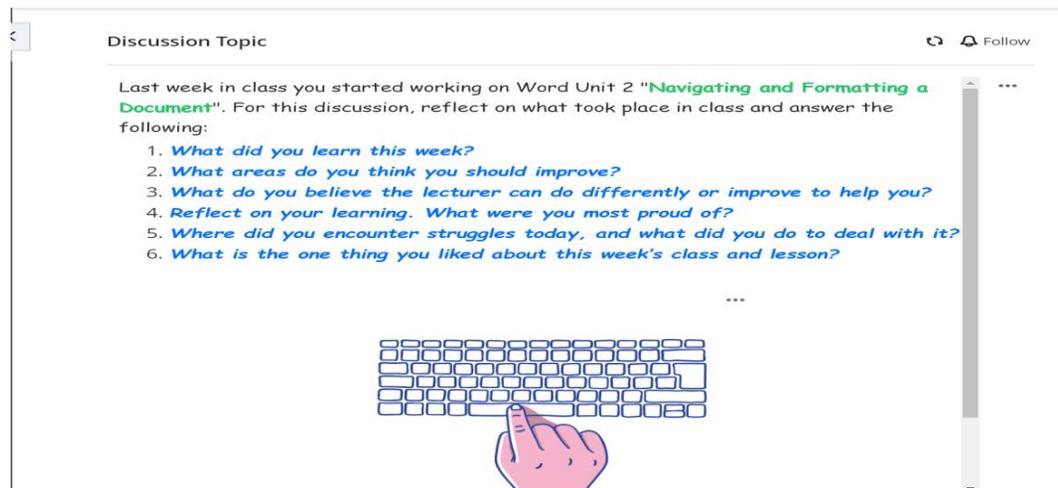


Figure 2: Discussion

However, Blackboard is not without its challenges. The previous version of Blackboard was its steep learning curve for both me and my students. Its interface came across as unfriendly and left students – especially those who are first time computer users – frustrated and overwhelmed. This challenge aligns with the findings of a study by Nguyen (2021), who perceived that users do not feel that it is too easy to use the LMS for the first time. Despite the challenges I faced with Blackboard, I have learnt to give myself time to understand how it operates. In addition, with the introduction of the new Blackboard Ultra, the new interface is easier to comprehend and navigate, making it easier to learn and work with the platform. In addition, the university (via the eLearning center under the Center for Innovation, Learning and Teaching) provides the eThuto101 and eThuto102 courses for academics to provide hands-on training on how to use the LMS. There are also weekly eThuto Talks held every week on Fridays to continuously engage with staff members on their experiences on the use of the LMS. The LMS has become a core part of my teaching toolkit and has fueled me to be intentional in my subject design and to continuously improve my teaching strategies. The eThuto101 & 102 courses, which I have completed successfully, have enriched my knowledge and improved my use of the LMS. I am incorporating the use of Blackboard Ultra not just as a storage repository as I did before, but as a tool to enhance T&L and student engagement.

In conclusion, the platform has empowered me to create a more organized and interactive learning experience, though there is still room for improvement, both in terms of the platform itself and my own practices as an academic. I look forward to continuing to explore its potential while also staying attuned to emerging EduTechs that may complement or enhance its use.

Skills Assessment Manager (SAM) Cengage

For my subjects, I do not utilize a textbook, I use SAM Cengage. It is an online learning environment (OLE) by Cengage, which provides us with content for my subjects and many other subjects. It provides simulated trainings and exams (assessments), and hands-on projects. Below I outline how the trainings, exam and projects work, then I provide my reflection on the use of SAM Cengage.

The trainings provide students with hands-on experience and interaction with MS applications. As shown in Figure 3, the trainings are structured in three modes (observe, practice and apply). During the observe mode, students learn from the simulation and observe how to carry out the task. The next mode is the practice mode. In this mode, students do the task with the guidance of the simulator. The last mode is the apply mode. In this

mode, students are provided with an instruction and must apply the steps to carry out the instruction on their own. These trainings are essential for students as they see how tasks are done, practice together with the simulation, and lastly, apply what they have learned.

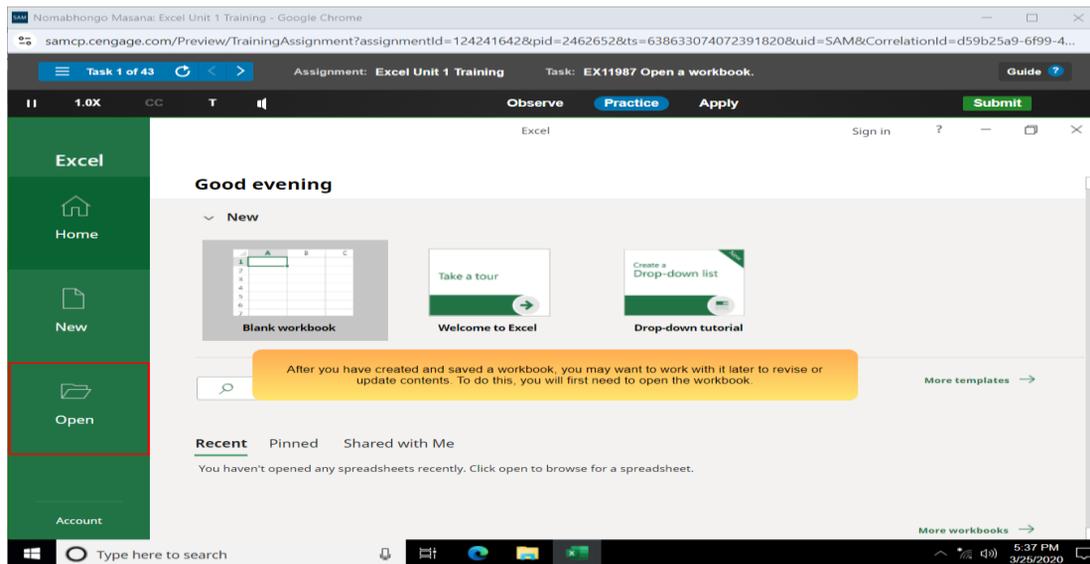


Figure 3: SAM Cengage Training

Regarding the SAM Cengage projects, I utilize them as part of continuously assessing students to ensure they are engaged with the content and for me to be able to see which areas they may be struggling with so I can assist them and have them better prepared for the assessments. The project is done in 3 steps: 1) Download Files; 2) Save Work to SAM; 3) Submit for Grade, as shown in Figure 4. The project files contain an instruction file, a start file and/or supporting files for units covered under MS Excel and Word. The instructions are on a Word document, the start file will either be a Word document for MS Word projects, or an Excel workbook for MS Excel projects. This is how I explain the project to my students, so they understand it better: “The instruction file is your question paper, and the start file is your answer sheet. You read the instructions on the instruction file and apply on the start file, the same way you would do with your question paper and answer sheet. Then when you are done, save, close the file and submit”.

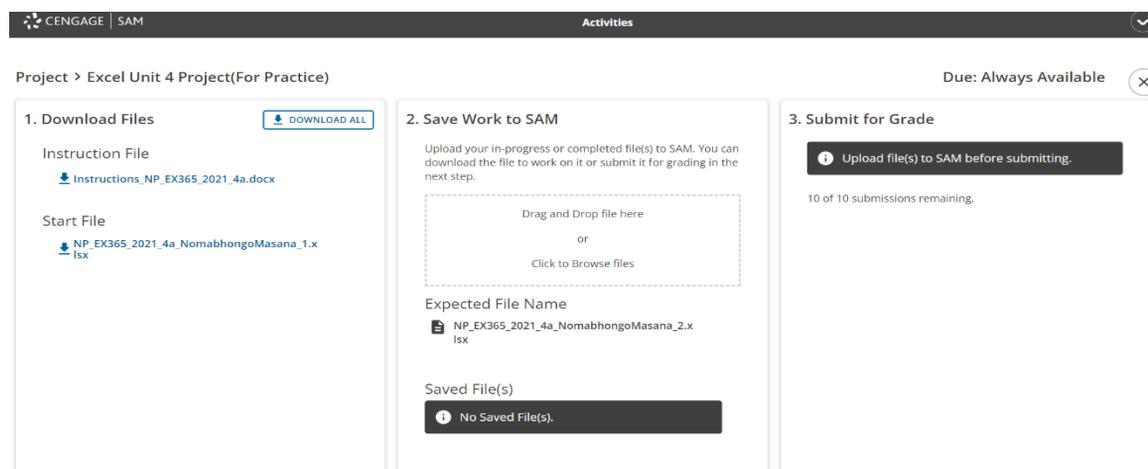


Figure 4: SAM Cengage Project

SAM Cengage assessments – referred to as Exams on the platform - are simulated. The students are provided with tasks they need to complete. For MS Word and Excel assessments, students are provided with 3 attempts to try out the task as shown on figure 5. Once the attempts are exhausted and the student did not get the task correct, they are marked incorrect for the task, and the simulation advances to the next task or tasks that still have attempts left. The assessment simulation is like the apply mode of the training simulation. Before the students take the assessment, I provide them with a Pre-Test, which shows them how the assessment

simulation works, more like providing students with previous question papers for them to see the style of the assessment.

My use of SAM (Skills Assessment Manager) Cengage as an integrated third-party tool in my subject has enriched both my teaching and learning experience. SAM's role in providing hands-on experience has been a valuable complement to the theoretical instruction provided in class. My experience with SAM has highlighted both its benefits in promoting student engagement and some of the challenges associated with integrating third-party tools.

One of the most notable benefits of SAM is its focus on practical, skill-based learning. The simulated environment provides real-world scenarios which enable students to engage with the content in a practical manner, allowing the learning to take place as students apply what they have learned.

One of the features I like, and I believe would be greatly appreciated, is SAM's automated marking/grading feature. Both the assessments and projects are automatically graded, saving me time, and providing students with instant feedback for improvement on their learning. This feature enhances student learning as it provides students with room to correct mistakes they made and to ask for assistance regarding concepts they may not comprehend. In addition, integrating SAM into Blackboard Ultra has proven to be an effective way of utilizing the LMS capabilities, as it provides a smooth transition between the two platforms, providing one central access to learning material and enhanced continuous use of the LMS. Furthermore, the integration enables me to effectively manage my subjects as grades from SAM can be synced automatically to Blackboard's gradebook, saving more time and reducing the risk of manual input errors.

However, with any other technology or platform, SAM is without challenges. Much as the platform offers training, some students who are new (especially first-year students) in using the platform, especially in the beginning of classes, tend to require more time to adapt to the system. Technical issues such as browser compatibility or system glitches can occasionally disrupt the learning experience. Despite these challenges, through the experience I have gained while using the system and technical support provided by Cengage, I have been able to overcome and resolve most of these challenges quickly.

The ability for students to repeatedly practice tasks until they achieve proficiency reinforces key concepts and caters to various learning styles. That said, the automated nature of SAM also means that, as an academic, I must balance it with more reflective and critical-thinking-based assessments.

While SAM is excellent for skill-building, it does not fully capture the nuances of analytical thinking or creativity that might emerge in open-ended projects or discussions. Thus, I utilize SAM as a supplement to my teaching rather than a replacement of traditional teaching methods, to ensure I engage with my students as they engage with the learning content.

In conclusion, SAM Cengage has been an effective and efficient tool for handling massive classes and providing my students with practical skills needed in this era we live in. Despite its challenges, its benefits such as its hands-on/real-live approach and automated grading and feedback highly outweigh these challenges.

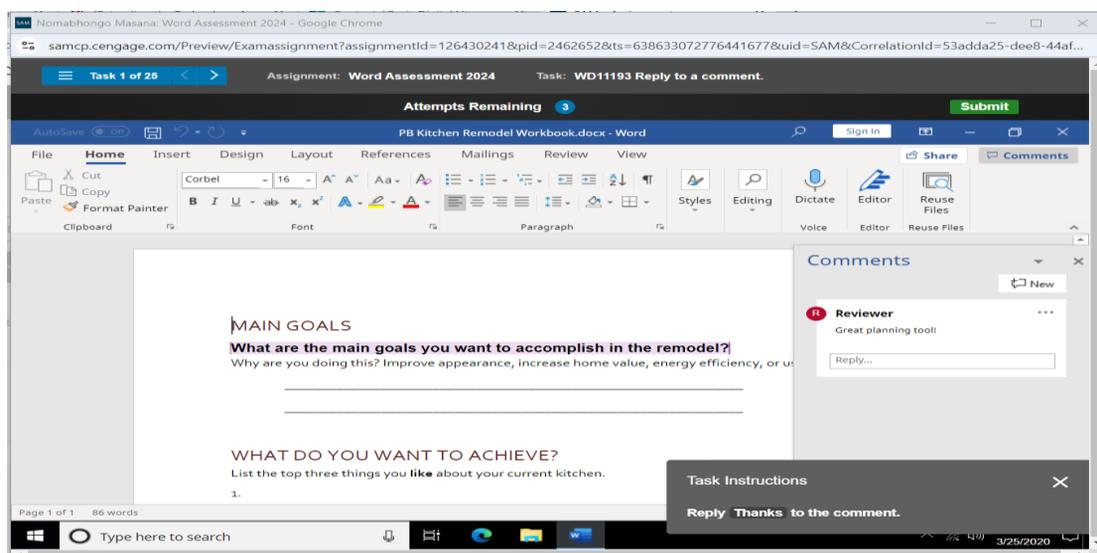


Figure 5: SAM Cengage Assessment

Microsoft Excel

Throughout my journey as an academic in HE, I have been using MS Excel as tool to store and manage my students' attendance and grades. I have found Excel to be easy to work with and customize to suit the needs of my subjects, such as setting my own formulas tailored specific to my subjects' diverse weights for discussions, projects, and assessments, which all contribute towards the final marks. Furthermore, collecting students' grades has been easier with the use of the Blackboard LMS, which provides me with an option to download all or some of the students' grades to a spreadsheet in seconds. By using Excel's conditional formatting, I can identify students who may be at risk of failure earlier in the semester, which helps me to apply intervention methods in time and makes students aware of the risk so they can improve to avoid failure.

As for the attendance, I use Excel to record attendance by scanning the students' student cards (which contains their student number) using a barcode scanner. Recording attendance this way minimizes the risk of having other students signing the attendance register on behalf of those who are absent. In addition, during assessments, I can correlate the attendance register with the number of students taking the assessment, to ensure the integrity of assessments and that no one who is not accounted for takes the assessment.

A feature I mostly appreciate about Excel is its ability to analyse data with ease. This feature has been useful to me when I have to provide an overall account of how students are performing, as well as to see how their attendance and participation affects their overall performance. This helps me to provide reports that are informed by data and informs my teaching practices and the students' learning. In addition, due to its flexibility and accessibility, I am able to share my spreadsheets with other colleagues who need to moderate the students' grades to ensure they are a true reflection of what took place. Despite all these benefits, the challenge with Microsoft's Excel Web version is that I am unable to scan student's attendance into the web spreadsheet, as it opens up a new tab every time I have to scan a student's student card. An alternative then to overcome this challenge and make use of the cloud, is to use Google Spreadsheet as it performs many functions which are not available in MS Excel web version, including managing student's grades and attendance online (Mansor, 2012). However, using Excel has enabled me to track and monitor my students' attendance and performance, and pick up trends and patterns I would otherwise have not been aware of if I was using paper.

Kahoot!

As mentioned in the introduction section of the paper, one of the challenges faced by professors and academics in HE is keeping students engaged in class and maintaining their attention. As an academic, I have faced this challenge previously during my classes, however, I approached this challenge by introducing elements of gamification in the classroom through Kahoot! to keep students engaged with the content and avoid them being bored in class. The gamified environment of Kahoot! provides students with an opportunity to engage in healthy competition with each other, while having fun and improving on their learning (Garza et al., 2023). The competitive element provides an inclusive, fun, relaxed, and engaging classroom environment (Martínez-Jiménez et al., 2021). In addition, I have observed that by introducing gamification in my classroom, students who are usually reserved and inactive in class become more active and interested in participating when using Kahoot!, as the platform gives students the confidence to engage in class without fear of being singled out.

During my classes, I have used Kahoot! to review and recap what I have covered in class, which also shows if students were paying attention in class or not. After each lecture, I allow students to answer a quiz on that challenges students to apply what they have just learned. I usually use this opportunity to allow them to work in groups to encourage teamwork among them. Working in teams gives them more confidence as they get to learn from each other as peers. The immediate feedback they receive, both in terms of correct answers and their standing on the leaderboard, motivates them to stay engaged and review any areas where they may be struggling. Kahoot's mobile accessibility has allowed my students to utilize their mobile devices (Martínez-Jiménez et al., 2021), and this lowers barriers to participation.

The platform's bright, colourful interface and use of music and visuals lighten the mood, turning learning into an experience that students genuinely look forward to. Figure 6 below provides the desktop view of Kahoot! I have found that this has a significant impact on classroom dynamics, see image below. Students are more likely to collaborate with their peers, share answers, and discuss the quiz topics afterward. This fosters a sense of community and shared learning that can often be missing in more rigid or formal academic settings.

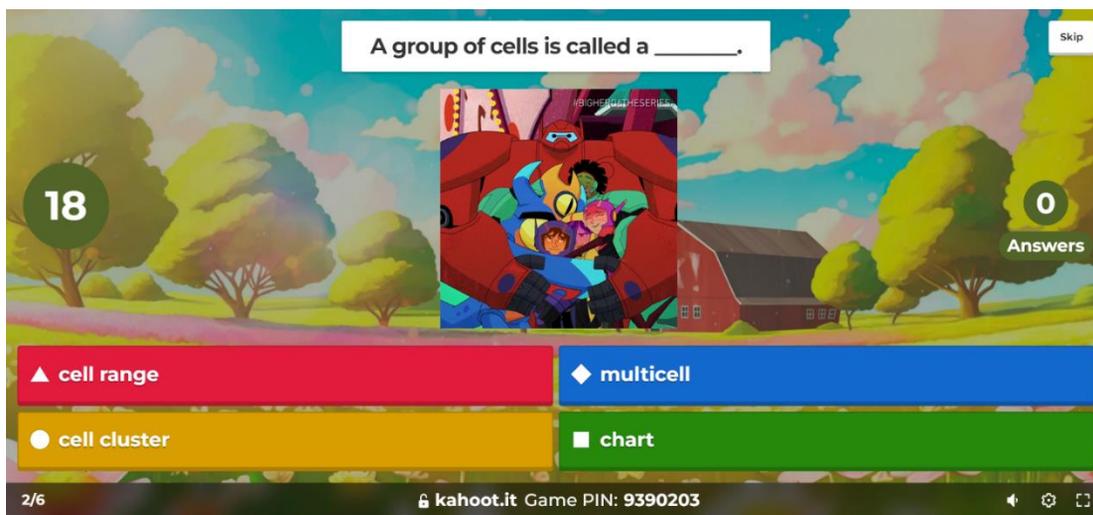


Figure 6: Kahoot! Quiz

Additionally, by introducing periodic Kahoot! quizzes throughout my lessons, I'm able to break up lengthy lectures and re-energize the classroom. Although Kahoot! is good for quick recall and close-ended questions, its fast-paced nature does not allow for assessing students' critical thinking and open-ended questions. In addition, Wang and Tahir (2020) outlined the inability to change answers after submission, less time to answer, and scores based on how fast students answer reduces student reflection resulting in some guessing answers without critically thinking, as some of the challenges linked with Kahoot!. Thus, in addressing this challenge, I make use of discussions and projects which assess students' critical thinking and require deeper understanding and application of key concepts.

Overall, Kahoot! has revived my classrooms turning them into a fun, engaging and inclusive environment. My classrooms are full of life, as the learning is enjoyable, leaving my students wanting to play more games in class.

Conclusion

Integrating educational technologies such as the Blackboard Ultra LMS, SAM Cengage, Microsoft Excel, and Kahoot! into my teaching practice has changed how I manage my subjects and engage with my students. Reflecting on my use of these technologies, I realized how each one has played a unique role in my teaching, and how they are all interconnected. Blackboard provided me with a central hub for content delivery, communication, and assessment, while SAM Cengage provides an interactive skills-based learning environment. The gamified environment provided by Kahoot! has revolutionized my classroom, providing a competitive, yet fun, relaxed, and engaging environment for my students. Moreover, with Microsoft Excel, managing student attendance and grades has never been this easy.

The EduTechs I have mentioned in this paper have fostered a learning environment that is dynamic, responsive, and tailored to the needs of today's students, who are increasingly accustomed to digital tools in their daily lives. Although technology enhances learning, it should be noted that its value is based much more on how it is applied, why it is applied, and where it is applied. We have heard the phrase, "Technology is only as good as the person using it." This is true in most cases, hence in my context, how I use technology may not necessarily be the same as how another person may use it. It is therefore up to you as an academic to explore and see which technology will best produce the results you desire in terms of improving your teaching, enhancing learning, and student engagement.

Despite the wonderful benefits outlined with the use of these EduTechs, the limitations associated with this study are that it provides my experiences alone as an academic, which may limit its generalizability to other contexts. In addition, the tools discussed in this study are only limited to the ones I use as an academic and do not explore other EduTechs. However, this provides an opportunity for research to be conducted on the perspectives of academics on the use of EduTech from various disciplines and contexts, the different innovative technologies and their application in HE by academics, feedback from students regarding the technologies used, as well as their impact on student learning and performance.

As I conclude this paper, these are my recommendations to other academics: 1) Embrace EduTech in your practice to transform the learning experience of your students, and to meet them where they are; 2) Although

learning something new may be daunting, we all started somewhere. I encourage you to start with just one tool that suits your classroom context, then expand your toolkit once you get the hang of it; 3) Lastly, keeping up to date with current trends in technology will keep us relevant to the evolving educational landscape, providing our students with the skills and knowledge they need to succeed in this modern world.

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References

1. Al-Adwan, A., Li, N., Al-Adwan, A., Abbasi, G., Albelbisi, N., & Habibi, A. (2023). Extending The Technology Acceptance Model (TAM) to Predict University Students' Intentions to Use Metaverse-Based Learning Platforms. *Education and Information Technologies*, 28, 15381-15413.
2. Camarao, J., & Din, C. (2022). Creating a Teaching community with Graduate Teaching Assistants: A Scholarly Personal Narrative. *International Journal for the Scholarship of Teaching and Learning*, 16(2), Article 3.
3. Chigbu, B. I., Ngwevu, V., & Jojo, A. (2023). The effectiveness of innovative pedagogy in the industry 4.0: Educational ecosystem perspective. *Social Science & Humanities Open*, 100419, 1-13.
4. Dangi, M. R., & Saat, M. M. (2021). "21st Century Educational Technology Adoption in Accounting Education: Does Institutional Support Moderates Accounting Educators Acceptance Behaviour and Conscientiousness Trait Towards Behavioural Intention? *The International Journal of Academic Research in Business and Social Sciences*, 11, 304-333.
5. Empaynado-Porto, A. (2020). Adopting e-learning technologies in higher educational institutions: The role of organizational culture, technology acceptance and attitude. *Review of Social Sciences*, 5, 1-11.
6. Garaika, H. M. (2020). Adoption of educational technology: study on higher education. *International Journal of Management (IJM)*, 11(1), 61-71.
7. Garza, M. et al., (2023). Performance in Kahoot! activities as predictive of exam performance. *BMC Medical Education*, 23(1), 1 - 8.
8. Hashish, E. A., Najjar, e. A., Alharbi, M., Alotaibi, M., & Alqahtany, M. (2024). Faculty and students perspectives towards game-based learning in health sciences higher education. *Heliyon*, e32898, 1-14.
9. Heidelberg, C. A., & Uecker, T. W. (2009). Scholarly Personal Narrative as Information Systems Research Methodology. In *MWAIS 2009 Proceedings*. Madison: AIS Electronic Library.
10. Khan, R. A., & Qudrat-Ullah, H. (2020). Adoption of LMS in Higher Educational Institutions of the Middle East (1 ed.). Cham: Springer Cham.
11. Mansor, A. Z., (2012). Managing Student's Grades and Attendance Records using Google Forms and Google Spreadsheets. *Procedia - Social and Behavioral Sciences*, 59, 420 - 428.
12. Martínez-Jiménez, R. et al., (2021). Kahoot! as a Tool to Improve Student Academic Performance in Business Management Subjects. *Sustainability*, 13(5).
13. Martin-Somer, M., Casado, C., & Gomez-Pozuelo, G. (2024). Utilising interactive applications as educational tools in higher education: Perspectives from teachers and students, and an analysisi of academic outcomes. *Education for Chemical Engineers*, 46, 1-9.
14. Ng, L., & Carney, M. (2017). Scholarly Personal Narrative in the SoTL Tent. *Teaching and Learning Inquiry*, 5(1), 133-145.
15. Nguyen, N.-T., (2021). A study on satisfaction of users towards learning management system at International University - Vietnam National University HCMC. *Asia Pacific Management Review*, 26, 189-196.
16. Ochieng, V. O., Asego, C. S., & Gyasi, R. M. (2023). The place of academia and industry in the adoption and adaptation of educational technologies for a post-COVID-19 recovery in Africa. *Scientific African*, 20, 1-27.

17. Swart, A. J. (2018). Developing a comprehensive teaching portfolio - A scholarly personal narrative. *In IEEE Global Engineering Education Conference (EDUCON)* (pp. 26 - 31). Santa Cruz de Tenerife: EDUCON.
18. Toring, H. et al., (2023). Evaluation of students' satisfaction toward an adopted learning management system at Indiana Aerospace University: A structural equation modelling approach. *Asia Pacific Management Review*, 336 - 346.
19. Tuma, F. (2021). The use of educational technology for interactive teaching in lectures. *Annals of Medicine and Surgery*, 62, 231-235.
20. Wang, A. I. & Tahir, R., (2020). The effect of using Kahoot! for learning - A literature review. *Computers & Education*, 149.



Technostress factors among students in the adoption of Generative Artificial Intelligence (GenAI) in higher education: A rapid review narrative

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Abstract: The usage of artificial intelligence (AI), particularly within higher education institutions (HEIs) is driving the increasing rate of technological stress known as technostress. This study seeks to look into the factors causing technostress among higher education students in the adoption of generative artificial intelligence (GenAI) and to propose mechanisms for mitigating the effects. To achieve this objective, a rapid literature review was used in exploring existing and recent research publications relevant to the research topic and objective. The study found factors such as techno-overload, techno-invasion, and many more as factors contributing to technostress among students of higher education. The results indicate the detrimental impact of technostress on students' academic achievement and general mental wellness, stressing the need for more research.

Keywords: AI, Artificial intelligence (AI), GenAI, Generative AI, Higher education institutions (HEIs), Mental stress, Psychological stress, Technostress

Introduction

Technostress among students is prevailing in the digital age which can be defined as psychological exhaustion and stress, associated with the use of technology. This psychological stress is a growing issue among students with regard to the adoption of artificial intelligence (AI) in higher education institutions (HEIs). This problem now attracts attention among scholars intending to investigate its impact, challenges, and many more, with a particular emphasis on higher education students. Also, HEIs are making substantial investments in educational-aided technology towards making teaching and learning better and easier. According to Wang, et al. (2020), technostress is a challenge for students due to the expected efforts and time demanded from the students to master the growing features of these educational tools and technologies.

This rapid literature review study provided the ground for further studies in synthesizing the existing body of academic literature studies on technostress with an emphasis on understanding its impact on higher education students' academic process, performance, and overall well-being. Pourahmad and Koc (2023) in a review paper outlined the academic literature gaps on the importance and benefits of technostress, highlighting the necessity for applying different scientific methods to understand the growing phenomenon. The above literature study shows that technostress is prevalent in today's technologically advanced world with a serious

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threat that affects many industries, including education. The growing concern calls for a deeper and more comprehensive study to provide proactive management to handle and lessen its consequences on users like students and organizations alike. Then, this study seeks to investigate the main technostress factors that affect students when utilizing GenAI tools in higher education.

Background of the study

Considering today's higher education, concerns about technostress have become more prevalent particularly as the application of AI increases. A person can feel technology stress in several ways, such as invasions of their private life, feelings of overload, or nervousness over their technology skills (Tarafdar et al., 2015; Upadhyaya, 2021). According to this study, people who experience stress due to their interaction with technologies like AI are said to be undergoing technostress. The rapid shift to remote and online learning spurred by the COVID-19 epidemic has exacerbated the issue of technostress by requesting students to balance their academic responsibilities with the new and emerging technological tools and platforms (Ali, 2020). Research suggests that a number of factors including techno-complexity, techno-overload, and more contribute to technostress, which has a substantial impact on students' academic progress and outcomes.

The techno-complexity focuses on challenges in using technology, while techno-overload looks into the unreasonable demands and expectations placed on technology users (Dragano & Lunau, 2020; La Torre et al., 2019). Additionally, limited knowledge of digital literacy and technical support also promotes technostress which has direct implications for the learning process and settings (Atanasoff & Venable, 2017). Although technostress is gaining attention across organizations, there is a dearth of research focusing on students and academics in Africa, and South Africa in particular. This study seeks to close the literature gap by examining how technostress impacts higher education students in South Africa and proposing coping strategies for managing the negative impacts on their productivity and academic performance. Understanding these factors equips higher education institutions in assisting students to be informed on better ways to use technology effectively in order to improve their academic progress, process, performance, and experience.

Literature review

Technostress an overview

Technostress can be seen as a form of psychological or mental stress characterized by negative impacts on people's attitudes, ideas, behaviors, and general mental health that result from using technology. This form of stress keeps increasing as more students in higher education and institutions turn to the use of modern technologies such as artificial intelligence (AI) and generative artificial intelligence (GenAI). Back in history, the term "technostress" was coined by clinical psychologist Craig Brod in the early 1980s to refer to a form of stress that shows confusion, anxiety, panic attacks, as well as physical signs and symptoms (Brod, 1984). According to Brod (1982) and Weil and Rosen (1997), anxiety is the main factor in relation to technostress that leads to the disruption of work routines and reduces one's ability to achieve and complete successful work. This is detrimental to a person's psychological and physiological well-being, stemming from the massive pressure and demands to use technology, as a result, anxiety, mental fatigue, and depression erupts (Pothuganti, 2024; Salanova, et al., 2013; Brod, 1984; Tarafdar, et al., 2015).

This technostress is characterized by worry, frustration, and feeling overwhelmed which can sprout from one trying to adjust to novel technological changes and innovation (Weil & Rosen, 1997; Tacy, 2016). This then triggers phobia, and depression, and can lead to other psychological disorders as users try to keep up with these technologies (Weil & Rosen, 1997; Tacy, 2016). However, according to Pothuganti (2024), Salanova, et al. (2013), Brod (1984), and Tarafdar et al., (2015), the major impacts of technostress are mental fatigue, anxiety, and fear.

Problem statement

Technostress is the term used to describe the stress that people suffer as a result of their dependence on technology or their inability to properly adapt or use technology in a way that is healthy and can bring great productivity. Some of the many causes of technostress are techno-invasion (the encroachment into private life), techno-overload (overbearing expectations from technology), techno-complexity (the problems of utilizing technologies), techno-insecurity (being afraid of losing a livelihood simply because of technology),

and techno-uncertainty (a lack of sense regarding using technologies) (Cook & Van Belle, 2022). The term technostress is mostly seen negatively, but there are some situations in which it might benefit students. For example, the pressure to adapt to new technologies can enhance the students' digital literacy, resilience, and problem-solving skills.

As students continue to navigate the growing technological complexity, flexibility then resilience is becoming important traits in the modern digital age (Kulikowski et al., 2022; Wang et al., 2020). Researchers believe that technostress can impede learning progress, perception, attitude, and motivation (Pourahmad & Koc, 2023). Technology advancements like GenAI can cause some feelings of stress, with some students seeing technology as helpful while others might envision this as stress. Technostress can also encourage students to become more involved in their educational pursuits. The ability and proactiveness of students to strategically manage the advancing nature of technology can be a source of acquiring knowledge, leading to more involvement in the learning process (Kulikowski et al., 2022; Zhao, Wang, Wu & Dong, 2021).

Whenever students successfully overcome the difficulties that are presented by technostress, it creates a sense of accomplishment in the students which further pushes them to improve their academic accomplishments (Abd Aziz et al., 2021; Kulikowski, et al., 2022). Although earlier research has shown that technostress has detrimental effects, few studies have examined students in higher education (Wang, et al., 2020). Furthermore, students look up to their peers for assistance in overcoming technological obstacles, as a result, the feeling of technostress can also foster teamwork among students, also, strengthening their social networks and collaborative skills (Kulikowski et al., 2022; Rayan et al., 2017).

Technostress, according to past scholars, can promote student collaboration, increase participation, and foster individual development to pose problems. Furthermore, technostress could have a major detrimental effect on higher education students' involvement, productivity, and academic achievement. Such stress levels could have risen as a result of several factors like the COVID-19 pandemic's promotion of ICT for distance learning, which required students to adjust to new learning environments and technologies. Along with symptoms like anger and low motivation, this can also cause physical symptoms like headache, gastrointestinal problems, insomnia, and high blood pressure (Cook & Van Belle, 2022). In order to promote students' success and well-being, higher education must address the detrimental effects of technostress on student's academic performance (Cook & Van Belle, 2022). Adding to existing literature, this study intends to investigate the main technostress factors that students encounter when utilizing AI tools like GenAI in higher education.

Research objective and question

Research objective: To investigate the key technostress factors experienced by higher education students in the adoption of GenAI tools.

Research question: What are the key technostress factors experienced by students in the adoption of GenAI tools in higher education?

Research methodology

The alternative to systematic literature review (SLR) is rapid reviews (RRs). As the name sounds, rapid review can be completed in a shorter time than SLR with a unique objective, and format, and used to synthesize evidence (Smela et al., 2023). Rapid reviews are primarily used in a situation with limited time to conduct the study. In the context of the research topic, the methodologies and principles of rapid reviews were effectively applied.

Rapid reviews were used to synthesize empirical evidence quickly while retaining high academic rigor that reduced bias in the study. Notably, rapid review methodology is mostly used in fast-evolving disciplines, fields, or subjects such as GenAI in education which requires a timely insight for stakeholders in decision-making. However, the effectiveness of rapid review demands a clear, comprehensive, unambiguous and concise research topic and question. For this study, a suitable question like: "What are the key technostress factors experienced by students in the adoption of Artificial Intelligence tools in higher education?" was used. According to Haby et al. (2023), a comprehensive, concise, and clear research question defines and guides the whole rapid review process ensuring that the search is organized, focused, and relevant.

Search process

Developing a search process is fundamental in research to ensure a systematic approach is followed. The process allows the researcher to search academic databases for resources. For instance, PubMed, Scopus, ERIC, and Google Scholar were searched with keywords like "technostress," "higher education institutions", "Artificial Intelligence," "higher education," and "students". The inclusion criteria for the study included studies published in the last Ten years, published in the English Language, with a focus on empirical research related to technostress in educational settings and the keywords. The exclusion criteria involve materials that were not published in the last ten years, are not published in the English language, and have no focus on the keywords and Technostress in general. The application of this search process and protocol enhances transparency and reduces duplication of efforts (Tricco et al., 2016).

Discussion of the findings

The key technostress factors experienced by students

The factors influencing technostress include an individual's experience with technology, age, perceived control over technology, and the organizational climate in which they operate (Brod, 1984). The literature suggests that technostress can lead to decreased performance and innovation, highlighting the need for strategies to enhance technology self-efficacy and information systems literacy among users (Tarafdar et al., 2015) especially higher education students.

The contributing factors of technostress include techno-complexity, which refers to the challenges posed by complex technologies; techno-invasion, characterized by the blurring of boundaries between work and personal life; techno-insecurity, stemming from fears of job loss due to technological advancements; techno-overload, resulting from excessive information and communication demands; and techno-uncertainty, which involves the unpredictability of technology changes (Ragu-Nathan et al., 2008; Khlaif et al., 2023).

Technostress among students

Technostress among students refers to the psychological and physiological stress that arises from using technology in educational contexts. This phenomenon has become increasingly relevant with the rise of online learning, where students often face challenges related to technology, which can lead to feelings of frustration, anxiety, and feeling overwhelmed. Saleem et al. (2024) defined technostress as the negative experience and consequence people encounter with new or unfamiliar technology, which may significantly impair their ability to learn.

According to the study, technostress may have a detrimental effect on students' cognitive skills (capacities), including their capacity for attention, understanding, memory, and learning in general. For instance, Upadhyaya and Vrinda (2021) found that students who were overwhelmed by educational technology in their online learning environments often experienced significant levels of technostress, which negatively impacted their academic journey and achievement. Students' intentions to participate in virtual education were adversely connected with technostress, suggesting that higher levels of technostress may reduce both academic motivation and fulfilment (Awang et al., 2022).

Additionally, the more screen time based on online learning, the greater the chance of physical and mental health issues associated with technostress. Vandendriessche et al. (2019) suggest that prolonged screen usage could result in eye strain, migraines, and insomnia. According to Vallone et al. (2023) and Torales, et al. (2022), isolation commonly occurs in online learning environments which are associated with mental health issues like anxiety, depressive disorders, and more. Technostress in higher education is a developing worry because it affects students' general well-being and academic performance. To help students mitigate the effects of technostress and enhance their virtual learning knowledge, lecturers and higher education institutions must implement efficient support systems in response to the problems presented by technology use in higher educational contexts (Saleem et al., 2024).

Summarised influencing factors of technostress

To this point, technostress is worrisome in the adoption of GenAI in higher education. The study pinpoints several important technostress that higher education students encounter while employing GenAI, which can

have a big influence on their academic process, performance, emotional development, and general well-being. Below is a thorough explanation of these factors:

- 1. Techno-overload:** This happens to students when they feel pressured to work longer and faster because of technological demands as they are not coping with the fast pace of its advancement and development. For example, students might encounter feelings of overwhelm and overload as they juggle multiple technological platforms in combination with their academic responsibilities. This constant pressure has been proven to cause mental fatigue, high levels of stress, and a decline in academic performance (Abd Aziz & Yazid, 2021; Ahmad & Amin, 2012). Also, ongoing stress might lead to student burnout (Li & Wang, 2020).
- 2. Techno-invasion:** This factor explains that technology impacts people's daily lives, making it more difficult to discern between commitments to one's studies and leisure activities. Students frequently struggle to set aside their coursework because online conversations and notifications disrupt their private lives. This intrusion may result in a conflict between the home and academics, which can make it hard for students to balance their personal and academic obligations and raise the risk of stress, depression, and anxiety (Abd Aziz & Yazid, 2021; Tarafdar et al., 2020).
- 3. Techno-complexity:** It arises from students' challenges in understanding and using various kinds of technological tools and platforms. Since technology is developing so quickly, students have to constantly adjust to new systems, which is frightening to them. For instance, the intricacy of learning management systems along with other learning technologies are causing students to become dissatisfied and perform less successfully academically (Abd Aziz & Yazid, 2021; Qi, 2019). Despite being digital natives, many students still lack the knowledge, skills, or experience necessary to use the continuously growing complex technological tools (Abd Aziz & Yazid, 2021).
- 4. Techno-insecurity:** Students' perceptions of their technical inadequacy are reflected in this factor. Students who believe they lack the skills necessary to succeed in a technologically driven world may experience performance anxiety. This lack of confidence may hinder their ability to engage with the learning technology and negatively impact their academic performance (Abd Aziz & Yazid, 2021; Ma & Turel, 2019). The fear of falling behind or not reaching objectives when utilizing technology may exacerbate stress levels even more.
- 5. Techno-uncertainty:** This alludes to the often unexpected character of technical advancements, including the frequent releases and changes made to technology and its infrastructure. Based on the continuous changes, students can feel anxious and unprepared to adapt and use the new technology and its features because of a lack of support from higher education. According to Abd Aziz and Yazid (2021), and Tarafdar et al. (2020), higher education is failing to provide the necessary support to assist students in navigating the current technology changes to avoid technostress and confusion.

The above critical technostress factors are to be addressed to enable students to use technology appropriately in promoting their academic expectations, experience, academic performance, and overall well-being (Abd Aziz & Yazid, 2021).

Mitigating technostress among students

Reducing technological stress is critical to facilitating effective usage of education-aided technology for online learning and non-academic situations, as well as overall mental well-being. Higher education institutions and educators should continue to provide effective measures to cut the negative impacts of technostress that causes feelings of fear, despair, anxiety, depression, discontent, and reduced academic engagement and performance. To mitigate the technostress:

One major tactic to reduce technostress is to establish strong and effective institutional support. This support will assist higher education in providing students with concise guidelines, instruction, and resources to equip students to manage online learning pressure (Saleem et al., 2024). For example, HEIs should provide a “teaching presence” that focuses on clear guidelines and instruction on the efficient use of online-aided technology (Awang Kader et al., 2022). These types of proposed interventions. guidelines and instructions

will eliminate the feeling of nervousness and increase confidence when adopting and using GenAI and other technology tools in higher education.

The demand is on higher education to reduce technostress through investment in technological infrastructure and support systems. The investment will present the opportunity to provide relevant training, workshops, and resources that promote students' proficiency in technical skills like troubleshooting which will enable them to use online learning platforms (Saleem et al., 2024). Additionally, the technical skills and abilities will enable students to develop a sense of belonging in the learning process that allows them to manage and mitigate the loneliness that is linked to online learning (Saleem et al., 2024).

A standard and supportive environment is essential for an effective online learning process towards reducing technostress. Establishing a standard environment and guidelines for online learning promotes collaboration among students and reduces technostress (Saleem et al., 2024). Lecturers and educators can provide continuous feedback, reflection, contact information, and guidance in the online learning environment to assist students in feeling valued and understood. Workshops and training can be organized by HEIs to assist students and lecturers in becoming more tech-savvy and stress-tolerant when adopting and using GenAI in higher education. According to Saleem et al. (2024), workshops and training can help students learn and understand proper ways to control their technology use and cope with any stress it may create.

Also, a multifaceted mechanism such as the provision of supportive online learning space, operative lecturer support, and resources towards reducing technostress on higher education students. Implementing these tactics by HEIs into practice, offering supportive and effective digital education policies empowers students with the skills and abilities to mitigate the challenges of technostress and improve their overall educational learning process and experiences (Saleem et al., 2024; Gabbiadini et al., 2023; Wang et al., 2023).

Recommendations and future study

- **Technostress management programs:** HEIs must develop and implement all-embracing programs to address students' technostress levels. These programs should empower students with coping skills to handle technological stress, challenges, and demands. Such programs include workshops, seminars, and training on computer literacy, time management, stress management, and a sense of fulfillment. Furthermore, HEIs can develop programs such as counseling, group therapy, and peer support groups to help students overcome the challenges of technostress. Also, HEIs might develop an effective educational space that promotes students' resilience, confidence, and overall well-being.
- **Improve digital literacy and training:** To overcome technostress, HEIs should improve students' digital literacy by designing dedicated education programs. The programs can introduce students to different educational-aided technology tools and platforms to enable them to reduce any form of GenAI challenges and complexity and increase their technology confidence and abilities. Also, preparing students to use GenAI tools and many other educational-aided technologies will assist students in effectively adopting GenAI, and their academics will be guaranteed to reduce the anxiety associated with GenAI adoption.
- **Longitudinal research on technostress:** Future research can focus on periodical or longitudinal research in exploring and understanding of the long-term effects of technostress on higher education students, their academic performance, and mental health. These studies can explore various ways students interact, their experiences with technostress, and its impacts on their academic journey. Furthermore, more research can examine the potential benefits associated with technostress like increased academic collaboration and participation. This will assist in bringing more light to the implications of technostress on student's academic and non-academic well-being. These kinds of research will assist higher education to fully comprehend the depth of the problem, and assist in discovering effective programs, processes, guidelines, and policy decisions to mitigate technostress.

Conclusions

Technostress in the adoption of GenAI is limited in the literature. This study has discovered the factors of technostress that impact students in higher education, especially in the adoption of GenAI. The identification of technostress contributing factors is crucial for developing a positive, reliable, supportive, and productive online learning environment, as GenAI continues to grow in adoption into the academic environment and

higher education institutions in particular. The results show that two major stresses that have a detrimental impact on pupils' academic performance and general well-being are technological overload and invasion.

HEIs can proactively reduce technostress by identifying the difficulties that these factors present, as well as implementing focused management programs, improved training in the use of technology (digital literacy), and the creation of helpful tools. The study further emphasizes the necessity of continuing research to investigate the long-term impacts of technostress and to pinpoint techniques that may promote students' success in learning environments that can be improved by technology.

Furthermore, tackling technostress is essential for fostering a more positive academic atmosphere at an age in which technology is heavily incorporated into higher education as well as for raising student satisfaction and performance. HEIs can build a more resilient and involved student population, and also, improve the overall educational experience by putting students' well-being first and giving them the resources they need to deal with technostress (technological difficulties).

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References

1. Abd Aziz, N. N., & Yazid, Z. N. A. (2021). Exploratory factor analysis of technostress among university students. *International Journal of Academic Research in Progressive Education and Development*, 10(3), 161-175.
2. Abd Aziz, N., Kader, M. A. R., & Ab Halim, R. (2021). The Impact of Technostress on Student Satisfaction and Performance Expectancy. *Asian Journal of University Education*, 17(4), 538-552. <https://doi.org/10.24191/ajue.v17i4.16466>.
3. Ahmad, U. N. U., & Amin, S. M. (2012). The dimensions of technostress among academic librarians. *Procedia-Social and Behavioral Sciences*, 65, 266-271.
4. Ali, W. (2020). Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic. *Higher Education Studies*, 10(3), 16. 10.5539/hes.v10n3p16
5. Atanasoff, L., & Venable, M. A. (2017). Technostress: Implications for Adults in the Workforce. National Career Development Association. 10.1002/cdq.12111
6. Awang Kader, M. A. R., Abd Aziz, N. N., Mohd Zaki, S., Ishak, M., & Hazudin, S. F. (2022). The effect of technostress on online learning behaviour among undergraduates. *Malaysian Journal of Learning and Instruction (MJLI)*, 19(1), 183-211.
7. Brod, C. (1982). Managing technostress: Optimizing the use of computer technology. *Personnel Journal*, 61(10), 753-757.
8. Brod, C. (1984). *Technostress: The human cost of the computer revolution*. Reading, Mass: Addison Wesley.
9. Cook, G., & Van Belle, J. P. (2022). Analysis of technostress experienced by students at the university of cape town, during the COVID-19 pandemic. *Issues in Information Systems*, 23(1).
10. Dragano, N., & Lunau, T. (2020). Technostress at work and mental health: concepts and research results. *Current Opinion in Psychiatry*, 33(4), 407-413.
11. Gabbiadini, A., Paganin, G., & Simbula, S. (2023). Teaching after the pandemic: The role of technostress and organizational support on intentions to adopt remote teaching technologies. *Acta Psychologica*, 236, 103936.
12. Haby, M. M., Chapman, E., Clark, R., Barreto, J., Reveiz, L., & Lavis, J. N. (2016). What are the best methodologies for rapid reviews of the research evidence for evidence-informed decision making in health policy and practice: a rapid review. *Health research policy and systems*, 14, 1-12.
13. Khlaif, Z. N., Khalili, F., Affouneh, S., & Tlili, A. (2023a). How remote leaning during crisis affect technostress levels experienced by academicians. *Education and Information Technologies*, 28(9), 11075–11100.

14. Kulikowski, K., Przytuła, S., Sułkowski, Ł., & Rašticová, M. (2022). Technostress of students during COVID-19-a sign of the time?. *Human Technology*, 18(3), 234-249.
15. La Torre, G., Esposito, A., Sciarra, I., & Chiappetta, M. (2019). Definition, symptoms and risk of technostress: a systematic review. *International Archives of Occupational and Environmental Health*, 92(1), 13-35. 10.1007/s00420-018-1352-1
16. Li, L., & Wang, X. (2021). Technostress inhibitors and creators and their impacts on university teachers' work performance in higher education. *Cognition, Technology & Work*, 23(2), 315-330.
17. Ma, Y., & Turel, O. (2019). Information technology use for work and technostress: effects of power distance and masculinity culture dimensions. *Cognition, Technology & Work*, 21(1), 145-157.
18. Pothuganti, S. (2024). Technostress: A comprehensive literature review on dimensions, impacts, and management strategies. *Computers in Human Behavior Reports*, 100475.
19. Pourahmad, Z., & Koc, H. (2023, November). Analyzing the Influence of Technostress on Students: A Systematic Literature Review. In *CS & IT Conference Proceedings* (Vol. 13, No. 21). CS & IT Conference Proceedings.
20. Qi, C. (2019). A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance. *Behaviour & Information Technology*, 38(12), 1337-1354.
21. Ragu-Nathan, T. S., Tarafdar, M., Ragu-Nathan, B. S., & Tu, Q. (2008). The consequences of technostress for end users in organizations: Conceptual development and validation. *Information Systems Research*, 19(4), 417-433. <https://doi.org/10.1287/>
22. Rayan, A., Dadoul, A. M., Jabareen, H., Sulieman, Z., Alzayyat, A., & Baker, O. (2017). Internet Use among University Students in South West Bank: Prevalence, Advantages and Disadvantages, and Association with Psychological Health. *International Journal of Mental Health and Addiction*, 15, 118-129.
23. Salanova, M., Llorens, S., & Cifre, E. (2013). The dark side of technologies: Technostress among users of information and communication technologies. *International Journal of Psychology*, 48(3), 422-436.
24. Saleem, F., Chikhaoui, E., & Malik, M. I. (2024, February). Technostress in students and quality of online learning: role of instructor and university support. In *Frontiers in Education* (Vol. 9, p. 1309642). Frontiers Media SA.
25. Smela, B., Toumi, M., Świerk, K., Francois, C., Biernikiewicz, M., Clay, E., & Boyer, L. (2023). Rapid literature review: definition and methodology. *Journal of market access & health policy*, 11(1), 2241234.
26. Tacy, J. W. (2016). Technostress: A concept analysis. *On-Line Journal of Nursing Informatics*, 20(2).
27. Tarafdar, M., Pullins, E., & Ragu-Nathan, T.S. (2015). Technostress: Negative effect on performance and possible mitigations. *Information Systems Journal*, 25(2), 103-132.
28. Tarafdar, M., Tu, Q., Ragu-Nathan, T. S., & Ragu-Nathan, B. S. (2011). Crossing to the dark side: examining creators, outcomes, and inhibitors of technostress. *Communications of the ACM*, 54(9), 113-120.
29. Torales, J., Torres-Romero, A. D., Di Giuseppe, M. F., Rolón-Méndez, E. R., Martínez-López, P. L., Heinichen-Mansfeld, K. V., ... & Ventriglio, A. (2022). Technostress, anxiety, and depression among university students: A report from Paraguay. *International Journal of Social Psychiatry*, 68(5), 1063-1070.
30. Tricco, A. C., Zarin, W., Antony, J., Hutton, B., Moher, D., Sherifali, D., & Straus, S. E. (2016). An international survey and modified Delphi approach revealed numerous rapid review methods. *Journal of clinical epidemiology*, 70, 61-67.
31. Upadhyaya, P., and Vrinda, (2021). Impact of technostress on academic productivity of university students. *Educ. Inf. Technol.* 26, 1647-1664. doi: 10.1007/s10639-020-10319-9
32. Vallone, F., Galvin, J., Cattaneo Della Volta, M. F., Akhtar, A., Chua, S., Ghio, E., ... & Zurlo, M. C. (2023). Technostress and academic motivation: direct and indirect effects on university students' psychological health. *Frontiers in psychology*, 14, 1211134.
33. Vandendriessche, A., Ghekiere, A., Van Cauwenberg, J., De Clercq, B., Dhondt, K., DeSmet, A., ... & Deforche, B. (2019). Does sleep mediate the association between school pressure, physical activity, screen

time, and psychological symptoms in early adolescents? A 12-country study. *International journal of environmental research and public health*, 16(6), 1072.

34. Wang, X., Tan, S. C., & Li, L. (2020). Technostress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit. *Computers in Human Behavior*, 105, 106208.
35. Wang, Z., Zhang, L., Wang, X., Liu, L., & Lv, C. (2023). Navigating Technostress in primary schools: a study on teacher experiences, school support, and health. *Frontiers in Psychology*, 14, 1267767.
36. Weil, M., & Rosen, L. (1997). *TechnoStress: Coping with technology @ work @ home @ play*. New York, NY: John Wiley & Sons.
37. Zhao, G., Wang, Q., Wu, L., Dong, Y. (2021). Exploring the Structural Relationship Between University Support, Students' Technostress, and Burnout in Technology-enhanced Learning. *The Asia-Pacific Education Researcher*. <https://doi.org/10.1007/s40299-021-00588-4>.



A model to integrate Generative Artificial Intelligence to improve student academic performance in South African universities

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Abstract: This paper explores the use of GenAI on university students in pursuit of academic excellence, with reference to South Africa. This study will embrace some of these salient issues: issues of high dropout rates occasioned by resource scarcity and meeting diverse learning needs by proposing a model that assists an individual learning experience using GenAI. This would be useful in highlighting recommendations toward effective adoption with reduced inequity in education and improvement of student achievement based on current literature and empirical investigations. Moreover, the paradigm proposed, named GAIA-SAU, would strongly focus on the development of personalized learning plans, continuous feedback mechanisms, and involvement of stakeholder engagement in delivering adaptive learning environments. This will lighten the burden for the country's path toward achieving high-quality and innovative learning, with further alignment to the goals of the National Education Strategy. Finally, the findings from this study will provide insight into educators, other stakeholders, and policymakers on ways in which best to capitalize on the use of GenAI in improving performance and equity in pursuing all students toward university education. This essay looks at how structurally advanced AI can solve these issues that stand in the way of realizing students' potential fully.

Keywords: Academic performance, Transformation, Generative artificial intelligence, South African universities

Introduction

With colleges facing high challenges, such as high dropout rates and underfunding, Generative Artificial Intelligence has immense potential for improving academic performance within educational frameworks. It supports learners at crucial junctures in highly individualized ways. This paper therefore attempts to conceptualize a model that will give in detail how GenAI would apply in the real world toward enhancing academic performance. The study addresses the call made by Cloete and Maassen (2019) for personalized learning strategies and increased access to learning materials. This model attempts to enhance the retention and academic performance of students by fostering adaptive learning environments. Against this background, the general research question that guided this study was thus: How does the integration of GenAI into academic performance create or enhance academic performance in South African universities? The form this paper shall take is that of a critical literature review, drawing on recent research concerning the use of GenAI in education, followed by a theorization of ideas informing this study. This section outlines information on

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research design and procedures for data collection in the methodology part, followed by the consequences and implications for education practice. In the end, practical recommendations of the usage of GenAI in Colleges of South Africa for consideration by educators and legislation to conclude the paper.

Literature review

Utilization of Generative Artificial Intelligence systems is one of the innovative approaches to improved student performance in the Universities of South Africa. The concept of genetic algorithms combined with artificial intelligence facilitates personalized and adaptive learning environments. Eden et al. (2024) agrees that high dropout rates and diversity in the needs of all students indeed call for innovative approaches to GenAI to bring improvement in academic achievement. The AI systems can create personalized learning content available, and curate personalized content based on metrics relevant to the success of each student. Whereas intelligent tutoring systems provide personalized feedback, congruent with the individual learning needs of learners, adaptive learning technologies continuously adjust on-the-fly content delivery to continuous assessments of students' performance. Other examples of such technologies that would fall into this category are things like specialized applications and personalized learning tools, which adapt instructional materials to diverse learning styles. While the learning management systems ease the administration, tracking, and reporting of educational courses, data analytics systems analyze performance data about students for trends and areas of improvement.

The integration of GenAI together with associated technologies has been used in a number of academic settings. For instance, in the study by Anis (2023), it is clear how much adaptive environments with personalized feedback have increased the rates at which students engage and complete their work. In a similar vein, Eden et al. (2024) pointed out that intelligent tutoring systems, while meeting the demands of each student, go a long way in improving academic results. These studies bring out the ways in which GenAI has the potential to reduce educational challenges and enable people to achieve their fullest potential. This work relies on the Diffusion of Innovation Theory, first proposed by Everett Rogers, which has been applied in describing the process of communication of innovative ideas or technological processes in social systems.

The relative advantage of the idea, its compatibility with prevailing practices, its intricateness, trial-ability, and observability are some of the critical characteristics that according to this concept ensure the forward motion of the adoption process. This framework stipulates ways in which Universities in South Africa would successfully integrate advanced technologies into their function to enhance academic achievement in the face of challenges of resource constraints and diverse student populations.

Methodology

This study adopts a qualitative systematic review approach, analyzing secondary data from academic publications, institutional reports, and relevant literature. The focus is on understanding how Generative Artificial Intelligence (GenAI) tools can improve academic performance in South African universities. Studies were selected based on relevance to personalized learning, adaptive assessments, and stakeholder engagement, ensuring alignment with educational challenges such as resource constraints and diverse learning needs. Thematic analysis was used to identify trends, critical factors for successful integration, and gaps in existing research. This approach ensures a comprehensive foundation for the proposed GAIA-SAU model, offering practical recommendations for GenAI adoption in higher education. This qualitative review of generative artificial intelligence in improving academic achievement amongst students in South African universities is based on secondary data emanating from the literature. It is against this background that qualitative approaches are better suited to explain the intricate relationships that exist between technology, teaching strategies, and the educational experiences of students. Thus, they are chosen. An interpretative methodology would indicate the proposed study reviewing subjective views, attitudes, and experiences of students, teachers, and administrative personnel regarding how GenAI affects the attained academic achievement. The backbone would be from Cloete and Maassen and Davis et al. (Cloete & Maassen, 2019; Davis et al., 2022). The secondary sources of data for this study are primarily extracted from various research papers, publications,

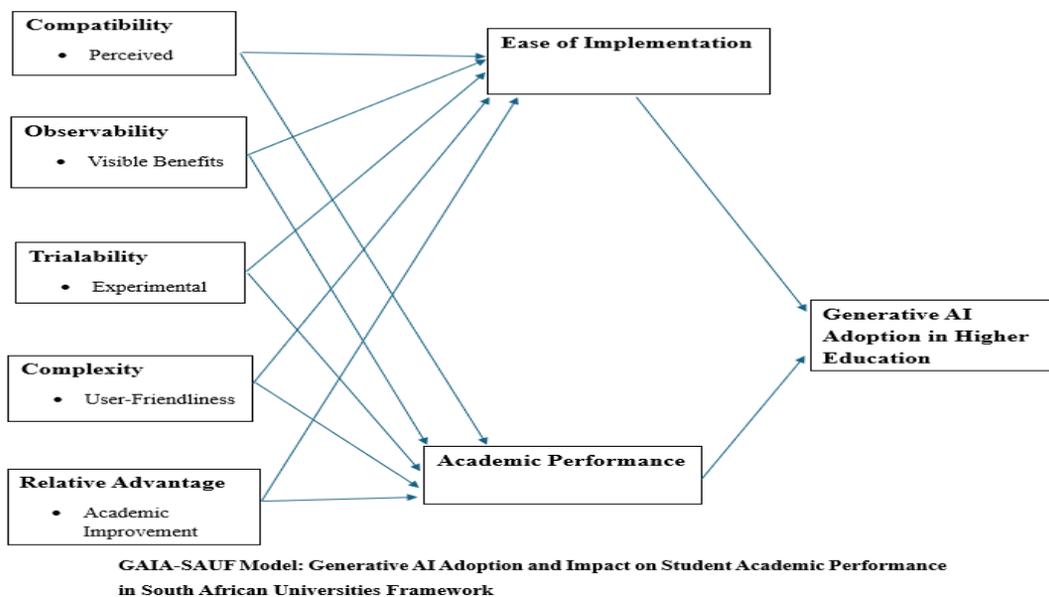
and scholarly literature. The data will highlight current practices and challenges that exist in the integration of GenAI. These findings offer empirical evidence of how effective GenAI is in ensuring improved student performance and recommend a model for successful implementation across South African universities based on some researchers (Makhanya & Zibane, 2020; Ismail, 2023). These findings form the basis for informing people about what he does and how GenAI can be used to enhance academic performance.

The GAIA-SAU Model: Revolutionizing Student Academic Performance through Generative AI Integration in South African Universities

The GAIA-SAU model proposed here thus addresses the most persistent challenges that students in South African universities face through the strategic integration of generative artificial intelligence into the education system. This will be achieved by improving students' academic performance through personalized learning experiences, adaptive assessments, and targeted support mechanisms. Using the power of GenAI, the framework would investigate data for each student, including academic tracking records, learning styles, and performance measures, to develop targeted learning plans that address the needs of each student. According to Eden et al. (2024), this will help instil a sense of ownership in each student. The research issue provides the rationale for the model underachieved by students, especially in South African universities. Contributory factors include inadequacy of resources, conventional approaches to teaching, and individualized application of an attitude towards learning. The GAIA-SAU model faces and oversees the same challenges since it is a structured framework through which Gen I is integrated. The model's core components are personalized learning plans, which include data-informed design to create learning experiences that cater effectively to the strengths and weaknesses of all students.

Adaptive learning environments: Through a real-time monitoring system of students' progress, learning materials would be adapted to ensure timely Support and intervention. Improved stakeholder engagement: Involving educators, administrators, and students in the process of GenAI adoption to align the technology with the mission and goals of the institution, promote more meaningful engagement with it, and foster broader adoption. This comprehensive approach addresses improvement in academic performance and helps build an inclusive environment to meet the diverse needs of the students. This is an excellent contribution that this study makes: its zeros in on integrating GenAI into the higher education context in South Africa, a perspective that only some studies have considered in the present literature. In this respect, the penchant of GenAI's model for personalized learning may fire up some discourses within the educational technology conference and spur further research on how advanced technologies could best be leveraged to overcome systemic educational challenges, especially in developing nations. These results stimulate further investments in the quest for technology-driven innovation to improve educational outcomes.

Introduction of Generative AI in South African Universities and Academic Performance of Students The model provides a template to solve the various academic problems faced by students in South African universities with the incorporation of generative artificial intelligence that works toward enhancing the performance of the students through personalized learning, adaptive assessments, and targeted support mechanisms. It analyses students' academic records, learning styles, and performance indicators to produce an individual learning plan best fitted to their needs and opportunities. The model underlines the involvement of stakeholders, organizational alignment, and an assurance of a hostile-free learning environment.



Perceived Educational Fit refers to the degree of congruence between the technology and prevailing teaching methods, curricula, and educational objectives, an issue that becomes crucial in adopting GenAI at South African universities. When GenAI could be perceived as an iterative development from existing practice, it would result in easy acceptance both by educators and students. The adoption of GenAI technologies will proceed more smoothly, for example, if they can be readily included in the workflow that lecturers have already created or used to augment conventional teaching methods without creating major disturbance. Furthermore, their acceptance hinges on how evident the benefits of GenAI are. Additionally, it supports successful results anytime they are demonstrated since using GenAI to support larger deployment across departments and courses can be linked to better skill development, increased student engagement, or higher grades. The focus on user-friendly experimental implementation is another important aspect of this methodology. Prior to widespread implementation, universities might assess the efficacy of small pilot projects in specific circumstances. In this way, some challenges can be foreseen, with the product being tinkered with best to meet the needs of educators and students alike.

Moreover, the success of GenAI depends a lot on how user-friendly it will be. The more user-friendly the technology is, the less significant the training or changes in current practice, and the more likely it will be accepted. Interest in adopting GenAI alone will be driven by the perceived potential to promote critical thinking skills and improve academic performance. When educators are convinced that GenAI can make a meaningful contribution to their teaching goals, they become more likely to adopt this kind of innovation; gradual yet sure integration of the technology within the educational landscape follows.

Policy and Educational Practices

Integration of GenAI in South African universities have important implications for educational policy and practice. The findings of this study may be helpful to policymakers in making pertinent steps towards innovative technologies that improve their education outcomes, a factor underlined in the National Development Plan 2030. According to the present research, GenAI can improve students' academic performance in schools; hence, policies supporting the integration of digital technologies in pedagogical uses should be promoted. This study helps to develop a framework for ways in which GenAI could be applied in educational contexts from an ethical perspective. Other ethical concerns in integrating technology into education involve data privacy and algorithmic bias.

Contribution to Personalized Learning and Adaptive Assessments

The proposed model can serve as a roadmap for universities to address those challenges while realizing the utmost benefits of GenAI. Personalized learning pathways and adaptive assessments have been highlighted in a model for integrating GenAI into South African universities. Through data analysis by GenAI, the model will infer students' unique needs, preferences, and learning styles to design customized learning experiences. Evidence has shown that GenAI can raise student engagement and motivation to continuously improve academic performance (Ellikkal & Rajamohan, 2024). Adaptive assessment features will, moreover, enable continuous monitoring of progress. GenAI algorithms can adapt learning materials and resources allocated to students regarding their performance, thus giving them the necessary support to pass through the challenges they have experienced in their academic endeavours. In this view, Zawacki-Richter et al. (2019) present that such adaptive approaches alleviate resource challenges facing universities in South Africa.

Bridging the Digital Divide

Adaptive learning platforms have customized learning materials and resources that GenAI can rely on while bridging existing digital gaps at universities. With the incorporation of technology, the learners would be guaranteed the necessary support and resources irrespective of their geographical and socio-economic status. This becomes important in helping those students who come from a very remote area or deprived region that has poor access to quality educational resources. This also mentions investment needs of computer labs and high-speed internet infrastructure that may integrate this new wave brought by GenAI. Continuous efforts have been made in support of infrastructural development processes at universities to ascertain equal opportunities of digital learning. The study now looks at the key drivers of access and availability of technology resources.

Ethical Implementation of GenAI

It therefore develops a framework in which GenAI could be implemented within the South African universities, with considerations toward the ethical implications that should precede such implementation. This therefore set up a policy framework and a set of ethical principles that became necessary in the construction of an actionable plan toward the mitigation of various risks and challenges associated with the GenAI applications touching on privacy, data security, and algorithmic biases. Results by Suliman et al. (2024) further bring out the issue of data security and privacy being paramount in every step of colleges in implementing such technologies of GenAI. Recommendations on standards for user consent procedures about data governance will ensure a well-protected collection of student data for moral use in the pursuit of improvement in academic achievement. It also deals with algorithmic bias viewed as algorithms, if left to themselves, exacerbate inequality. The study integrates methods or ways bias detection, and mitigation techniques can be established into processes supporting GenAI implementation to advance more equitable and inclusive educational environments.

Development and Support

Integration of GenAI in South African universities brings serious faculty development and Support considerations into focus. The model presented in the paper emphasizes that educators must be empowered to master the various technologies related to GenAI in teaching. The current research supports their professional advancement through comprehensive training programs and resources so that faculty can employ GenAI for pedagogies toward improvement in student learning. Indeed, Moodley et al. (2023) add that These findings suggest that GenAI can relieve some of the pressures on faculty by automating part of the learning process- for example, real-time feedback and guidance for learners using intelligent tutoring systems. Already, this speaks to the resource constraints of the universities in South Africa, which enables faculty to focus on what they are uniquely able to do: more individualized interactions and directed Support.

Future Research Directions

The results of this study and the model suggested to position GenAI within South African universities call for new research directions. The study contributes to the literature by documenting how GenAI can be leveraged within educational settings, thus laying a foundation for further research and refinement of the model. Future research can thus assess empirically the level at which the suggested model can effectively improve student academic performance in the South African university. Through longitudinal studies and data gatherings on student outcomes, it can be confirmed whether the model is efficient and can identify the areas where improvements need improvement. Further research may also establish that the model suits other educational environments within and outside the borders. The comparative study may provide insight into the model's flexibility within different educational systems and highlight best practices for successful implementation.

Application of Innovation Diffusion Theory in the Gaia-Sau Model for South African Universities

Innovation diffusion Theory applies to the very core of the GAIA-SAU Model since it provides a framework for understanding how the integration of GenAI into South African universities can be used to enhance student academic performance. The theory, first proposed by Everett Rogers, describes how innovative ideas, products, or practices diffuse over time within a given social system. The GAIA-SAU Model allows for identifying factors that influence the adoption of GenAI technologies in educational environments. It describes how adoption patterns go from innovator to laggard in a step-like manner. This structured approach can help in the strategic implementation of GenAI at universities. The stages listed herein will help the stakeholders devise strategies that enhance the speed at which GenAI technologies are accepted and used by teachers and students. The theory also investigates various influence factors, such as perceived relative advantages, compatibility with existing systems, complexity, trialability, and observability, which could support creating the most effective and efficient GAIA-SAU Model addressing such issues. An effective communication channel is always helpful in spreading the advantages and functionalities of GenAI technologies. The theory outlines that clear communications help to distribute information relating to innovations. Thus, the GAIA-SAU Model can apply different communication techniques to inform stakeholders how GenAI can help shape better educational practices.

Moreover, the theory identifies that social systems influence the rate at which innovation is adopted. The differentials that need to go into the GAIA-SAU Model should incorporate diverse students and technological readiness, amongst others, in South African universities. Understand social dynamics, allowing the model to meet specific needs in South African higher education. Based on this understanding of Innovation Diffusion Theory, appropriate strategies to encourage the adoption of GenAI by the GAIA-SAU Model can be suitably informed. These pilot programs make the trial of GenAI technologies possible for educators and students, observable, and compatible with current educational practices. But this is also a very valued framework from which to evaluate the impact of GenAI on academic performance output. It provides all stakeholders with critical choices for future investments in technology using the student's engagement and retention rate as key performance indicators. Innovation Diffusion Theory provides a strategic framework that allows the adoption and assessment to innovatively incorporate GenAI into the circumstances at South African institutions in the best possible manner to support the road of raising student academic achievement.

Findings

South African universities experience challenges that tremendously impact students' academic performance. Some of these are socioeconomic disparities, poor educational infrastructure, a shortage of technology, and a lack of sufficient academic support systems necessary for learning and development, as Mhlanga et al. (2020) addressed. It was stated in the study that disparities in accessing quality education, along with disparities in accessing resources, serve to exacerbate the already existing qualities in academic achievement among students emanating from poor backgrounds. On the other hand, integrating GenAI presents several advantages for tackling the challenges. GenAI can create personalized learning experiences tailored to individual students' needs, increasing engagement and motivation. This is because GenAI can process large volumes of data,

enabling better identification of at-risk students and providing interventions to enhance academics. Critical success factors for effective integration include institutional readiness, technological infrastructure, faculty training, and stakeholder involvement. This study again points out that universities' investments in improving their technological capabilities and providing educators with such training will lead to a capacity to maximize the full benefit of the functionality of GenAI-applied actions.

Conclusion

The introduction of Generative Artificial Intelligence is promoted in this research article to ensure academic improvement at South African universities. It seeks to answer one of the most important questions, "How does GenAI embed student academic performance at South African universities?" through the introduction of the GAIA-SAU Model. It addresses issues related to high dropout rates and different learning needs through a focus on personalized learning opportunities and flexible forms of assessments along with continuous feedback mechanisms. These findings are based on the use of GenAI in developing a more inclusive and productive learning platform to improve the student's academic performances. However, there are a couple of limitations. This investigation has focused on one South African university; thus, generalization on other places outside its context is highly limited. The latter, while drawing, to the extent that this relies on currently existing literature, only some developments concerning recent improvements in the development of GenAI technologies could be captured. Thirdly, other issues in the practical implementation of this model are likely to experience resource availability and readiness problems in the institutions. More empirical research should be done to establish the validity of this model for educational purposes. Integration Influence on Future Perspective The influence of integration on the long-term achievements of students is likely to fall within the limits of a number of disciplines and levels of education. It would also be essential to study further how the scalability of the GAIA-SAU Model works across different educational contexts. Indeed, considering the increasing digital transformation within educational institutions, continuous research is needed to develop strategies for embedding technologies such as GenAI into university systems.

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References

1. Anis, A. (2023). AI-driven personalized learning systems: Enhancing educational effectiveness. *Educational Administration: Theory and Practice*, 30(5), 11514–11524. <https://doi.org/10.53555/kuey.v30i5.4961>
2. Bateman, T. (2024). Teacher perspectives of ChatGPT as a pedagogical tool in the K-12 setting: A case study. *Quality Assurance in Education*.
3. Binhammad, M. H. Y., Othman, A., Abuljadayel, L., Al Mheiri, H., Alkaabi, M., & Almarri, M. (2024). Investigating how generative AI can create personalized learning materials tailored to individual student needs. *Creative Education*, 15(7), 1499-1523.
4. Chetty, K., Aneja, U., Mishra, V., Gcora, N., & Josie, J. (2018). Bridging the digital divide into the G20: Skills for the new age. *Economics*, 12(1), 20180024.
5. Clark-Wilson, A., Robutti, O., & Thomas, M. (2020). Teaching with digital technology. *Zdm*, 1-20.
6. Cloete, N., & Maassen, P. (2019). The effects of higher education policy on transformation in post-apartheid South Africa. *Journal of Higher Education Policy and Management*, 41(4), 391–406. <https://doi.org/10.1080/1360080X.2019.1592737>
7. Eden, C. A., Chisom, O. N., & Adeniyi, I. S. (2024). Integrating AI in education: Opportunities, challenges, and ethical considerations. *Magna Scientia Advanced Research and Reviews*, 10(2), 006-013.
8. Ellikkal, A., & Rajamohan, S. (2024). AI-enabled personalized learning: Empowering management students for improving engagement and academic performance. *Vilakshan-XIMB Journal of Management*.

9. Ismail, S. S. (2023). Barriers towards the implementation of e-portfolio in education based on the diffusion of innovation theory. *International Journal of Learning, Teaching and Educational Research*, 22(4), 512-540.
10. Khoza, S. B., & Mpungose, C. B. (2022). Digitalised curriculum to the rescue of a higher education institution. *African Identities*, 20(4), 310-330.
11. Makhanya, T., & Zibane, S. (2020). Students' voices on how indigenous languages are disfavoured in South African higher education. *Language Matters: Studies in the Languages of Southern Africa*, 51(1), 22-37.
12. Mhlanga, D., Denhere, V., & Moloi, T. (2022). COVID-19 and the key digital transformation lessons for higher education institutions in South Africa. *Education Sciences*, 12(7), 464.
13. Moodley, K., Van Wyk, M., Tive, D., Van Zyl, I., & Cronje, J. (2023). Student retention in fully online programmes at two South African universities.
14. McNaught, C., & Gravett, S. (Eds.). (2021). *Embedding social justice in teacher education and development in Africa*. Routledge.
15. Mzangwa, S. T. (2019). The effects of higher education policy on transformation in post-apartheid South Africa. *Cogent Education*, 6(1), 1592737.
16. Özkan, Y., & Kışla, T. (2024). A systematic review of AI-based mobile learning environments: Unveiling trends and future directions.
17. Ratten, V., & Jones, P. (2023). Generative artificial intelligence (ChatGPT): Implications for management educators. *The International Journal of Management Education*, 21(3), 100857.
18. Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *The Turkish Online Journal of Educational Technology*, 5(2), 14-23.
19. Suliman, Z., Mohale, N. E., Maphoto, K. B., & Sevnarayan, K. (2024). The interconnectedness between Ubuntu principles and generative artificial intelligence in distance higher education institutions. *Discover Education*, 3(1), 188.
20. Zawacki-Richter, O., Marzban, A., & Wulfert, H. (2019). The role of artificial intelligence in education: Current trends and future directions. *Computers & Education*, 140, 103605.
21. Zawacki-Richter, O., Marzban, A., & Wulfert, H. (2023). Generative AI and its implications for higher education: A systematic review and future research agenda. *Computers & Education*, 203, 104123.



Enhancing AI digital literacy among South African youth: A model for inclusive participation

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Abstract: With the rapid integration of AI now revolutionizing industries all over the world, AI and digital literacy are major skills identified with key future employability and creativity. The demand has never been higher for a digitally literate workforce as AI becomes an integral part of manufacturing, banking, health, education, and other industries. With these changes around the world, some of the major challenges that inhibit the participation of students in AI digital education in South Africa are socioeconomic inequality, inadequate infrastructure, and a shortage of teachers with appropriate training. These challenges narrow access to AI digital literacy, which is an enabler for social and economic inclusion. This paper applies the 1991 Icek Ajzen's TPB framework which provides an in-depth skeleton that is aimed at enhancing AI digital literacy among South Africa's youth. The paper discusses, identifies, and addresses various psychological and social elements of attitudes, subjective norms, and perceived control that influence the youth's involvement in AI digital education. It is a proposed framework that aims at an environment that would encourage AI digital literacy to thrive through definite interventions such as curricular integration, community involvement, teacher training, public-private partnerships, and government policy. Changes in the curriculum can ascertain the inclusion of AI from a tender age into the system, and public-private partnerships offer essential resources and technological access. While teacher training is meant to ensure the quality of AI and digital education, community engagement programs try to change social beliefs toward creating an enabling environment that fosters AI digital learning.

Keywords: AI digital literacy, South African youth, Theory of Planned Behavior

Introduction

Artificial Intelligence (AI) is changing how we interact, live, and work. By facilitating quicker and more precise decision-making through data processing and machine learning algorithms, AI is revolutionizing the healthcare, education, finance, and manufacturing industries (Bohr, 2020). Digital literacy in AI is becoming a crucial skill for people to engage in the global economy in an increasingly AI-driven environment. Significant economic and societal advantages await nations who make investments in AI education and incorporate these competencies into their curricula. However, those who fall behind in acquiring AI digital literacy run the risk of escalating already-existing disparities and becoming even more disadvantaged in the digital era (Funda & Piderit, 2024).

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One important group that could propel future economic growth in South Africa is the country's young population. However, several socioeconomic obstacles prevent many of the nation's youth from receiving AI education. The digital divide makes South Africa's youth unemployment rate, which is among the highest in the world, even worse (Alao, 2020). Youth in underprivileged and rural areas frequently do not have access to computers and the internet which are required for AI education (Moonasamy & Naidoo, 2022). Furthermore, incorporating AI into the national curriculum is difficult for the South African education system, and many schools lack the tools and qualified teachers needed to teach AI-related courses (Adam, 2022). The digital divide not only affects access to technology but also limits career prospects for the youth.

As a result, this inability of South African youth to acquire AI skills creates an extreme disadvantage in the global labor pool in a world fast making AI an integral part of nearly every multi-national business. Besides acting as a deterrent to innovation and technical improvement within their country, low AI and digital literacy tend to make it worse for South Africa to compete globally in AI-driven industries. Previous studies have shown that low AI and digital literacy is not only a barrier to innovation and technical improvement within their country but also makes it difficult to find a place in AI-driven industries. This article tries to address these issues by proffering a strategy that would improve AI digital literacy amongst the youth in South Africa. This study explores attitude, subjective norms, and perceived behavioral control as contributors to the participation of youths in AI digital literacy programs, drawing on Icek Ajzen's Theory of Planned Behavior (TPB). TPB is highly relevant when trying to figure out which obstacles deter youth from engaging in AI education; thus, it provides an implementable tool for the understanding of social and psychological elements of behavior. This framework seeks to foster a more inclusive and equitable AI education system in South Africa by focusing on interventions around curricular integration, community participation, teacher training, public-private partnerships, and government policy. This is required not only in terms of skills development but also as part of a more wide-ranging initiative with regard to socioeconomic differences. By providing its youth with AI skills, South Africa can enable its youth to seize digital economic opportunities and spur national innovation.

The paper presents an action plan, in summary, on how these barriers to AI digital literacy can be removed and recommends solutions at the level of community organizations, schools, legislators, and chief business executives.

Literature review

Understanding the theoretical and empirical backgrounds of the problem is important in the creation of a comprehensive framework for raising AI digital literacy among South African youth. This section looks at the state of research in AI digital literacy, and South African educational challenges, and applies relevant theories that can be used to surmount these challenges.

Empirical literature review

In recent years, interest in AI digital literacy has grown dramatically globally, with more countries integrating AI into their curriculum to keep pace with the digital future. For example, AI4K12 in the US makes sure early exposure to AI capabilities starts by introducing the concepts of AI to children in elementary up to high school level education. The Singapore AI Singapore program has a similar focus on Workforce Development and provides AI digital literacy via business partnerships. These examples demonstrate how important it is to have AI digital literacy become part of educational systems early enough. According to Alao and Brink (2023), there is great demand in South Africa for AI digital literacy, emphasizing that with AI, unemployment can be reduced and encourage creativity.

However, according to Molala (2021), the continuing difficulties faced by South African youth are reflected by a limited number of educated and tech-savvy people in rural areas. Digital gap condition interventions are further complicated by the total lack of AI-based curricula and socio-economic limitations which keep the greater majority of youth out of competition in a hi-tech, globalized environment. Empirical studies also support the idea of conducting AI digital literacy training for teachers. Ndung'u and Signe (2020) further reduce the possibility of students receiving quality AI education with evidence that educators lack the skills necessary to teach AI subjects. As AI digital literacy programs have found success in countries around the world, South Africa may be in a position to adapt strategies like these that are tailored toward its specific socio-economic context.

Theoretical literature review

This study applies the Theory of Planned Behavior (TPB). TPB is a psychic theory developed by Icek Ajzen. It explains the ways in which attitudes, subjective norms, and perceived behavioral control centrally influence an individual's behavior. As stipulated, the three elements are the predictors of behavioral intentions, which in turn predict actual behavior. TPB by Ajzen 1991, in this case, sheds light on AI digital literacy. It exposes the variables involved in youths' participation in the facilitation aspects of AI education programs. The attitude elements refer to the beliefs regarding AI digital literacy by the youth would place a lot of importance on how much value they attribute to the persisting with this education, regarding their future job and social importance. According to Alsheeti (2022), positive attitudes towards AI will lead to increased participation in its educational programs.

Subjective Norms: Social factors include friends, family, and teachers. They are extremely influential in the youth making a decision to participate or not participate in AI digital literacy initiatives. AI education is sure to be pursued when the communities surrounding them hold technology in high regard.

Perceived Behavioral Control: It concerns the degree to which persons perceive that they can enact AI digital literacy programs. In the context of student perceptions of their control of their outcomes concerning being successful in AI classes, this becomes affected by class instruction, AI class availability, and access to technology.

The TPB framework is intensely relevant to this study in the way it systematically presents how educational and socio-economic constraints influence youth engagement in AI digital literacy initiatives. It helps identify important points at which interventions could be offered to provide enhancements in AI digital literacy, focusing on attitudes, norms, and perceived control.

Methodology

This section describes the methods followed in developing the framework for raising AI digital literacy among the youth in South Africa. The study utilizes secondary data analysis by referencing previous studies, papers, and case studies on AI digital literacy, educational obstacles, and effective interventions in the domestic and international contexts respectively as noted by Johnston (Johnston, 2014).

Data collection

Reports obtained from global AI digital literacy campaigns, scholarly journals, and government publications were collected as secondary sources of information relied on the study to identify effective AI digital literacy initiatives around the world, with a focus on those implemented in developing countries. The relevance and applicability of these case studies to South Africa will be determined through analysis.

Data Analysis

Data were identified, examined, and summarized for patterns through analysis using thematic analysis, a qualitative technique of data analysis. Obstacles to AI digital literacy, effective international initiatives, and the role of public-private partnerships in promoting digital skills were the three dominant themes of interest under the theme analysis (Funda & Piderit, 2024). These themes have subsequently been applied to the elements of the Theory of Planned Behavior-that is, attitudes, subjective norms, and perceived behavioral control to develop an all-rounded framework for enhancing AI digital literacy (Ajzen, 1991).

Ethical Considerations

The research was compliant with the ethical standards for the analysis of secondary data, ensuring all sources of data were appropriately referenced and that the data was used in a manner that correlated with the aims of the original researchers. The manuscript only reviewed publicly available data; no new data were collected from individuals. The integrity of the original studies was not interfered with in the process of research. Further, during the process, necessary care was paid to avoid misutilization or wrong interpretation of data.

Discussion: Conceptual framework for enhancing AI digital literacy

The elements of TPB thus informed the conceptual framework developed in this work to address the challenges of AI digital literacy among South African youth. There are five major constituents of this

framework: public-private partnerships, integration into curriculum, community participation, teacher preparation, and government policy.

The framework

A proposed framework Theory of Planned Behavior includes strategic interventions aimed at creating an enabling environment for AI digital literacy. Each element maps to the TPB in either attitude, subjective norms, or perceived behavioral control and focuses on particular barriers highlighted within the study. The interventions include:

- **Public-Private Partnerships:** The most effective approach to tackle AI digital literacy involves active collaboration at multiple levels between the public and business sectors. For instance, companies such as Google and Microsoft have already embarked on initiatives like the Google Africa Developer Scholarship and the "AI for Good" program, respectively, providing free access to AI education and training (Clewlow, 2023). These collaborations make the resources more accessible and, therefore, increase the chances of youth interacting with AI technologies. The TPB posits that such partnerships act to enhance perceived behavior conduct through the provision of tools and training necessary for success in AI education (Roopaei et al., 2021).
- **Inclusion in the Curriculum:** The only way AI education will not lag behind in schools is through inclusion in the national curriculum. Just like programs such as AI4K12 initiated in the US, the concepts of AI need to be taught at an early age within schools (Touretzky & Seehorn, 2022). Schools can develop positive attitudes toward AI digital literacy by showing how integral it will be to the future of their careers by integrating it within computer science and mathematics disciplines.
- **Community Involvement:** Developing subjective standards surrounding AI education requires community involvement. Many people, particularly those in rural areas, may see technology as inaccessible or suspicious. Initiatives can increase awareness of the value of AI digital literacy by including schools, parents, and community leaders. Campaigns like Nal'ibali, which combine digital literacy with storytelling, are examples of how community-based approaches can create a positive environment for learning (Nal'ibali Campaign, 2023).
- **Teacher Training:** It is impossible to overestimate the importance of educators in advancing AI digital literacy. Students' access to high-quality AI education is restricted in South Africa since many teachers lack the abilities and expertise necessary to teach AI topics (Mnguni, 2024). Teachers perceived behavioral control can be enhanced by professional development and training, which will give them the courage to include AI into their lessons. In order to teach difficult AI topics in an approachable way, training programs should emphasize both technical proficiency and pedagogical approaches (Varadarajan, 2024).
- **Governmental Policy:** The effectiveness of AI digital literacy initiatives depends on government funding. Scaling AI digital literacy programs requires national policies that emphasize AI education, finance digital infrastructure, and assist teacher training (Pila, Madzivanyika, & Meso, 2024). The South African Government's National Digital and Future Skills Strategy is a step in the right direction, but more needs to be done to ensure that AI education is accessible to all students, particularly those in underserved areas (South African Department of Basic Education, 2022).

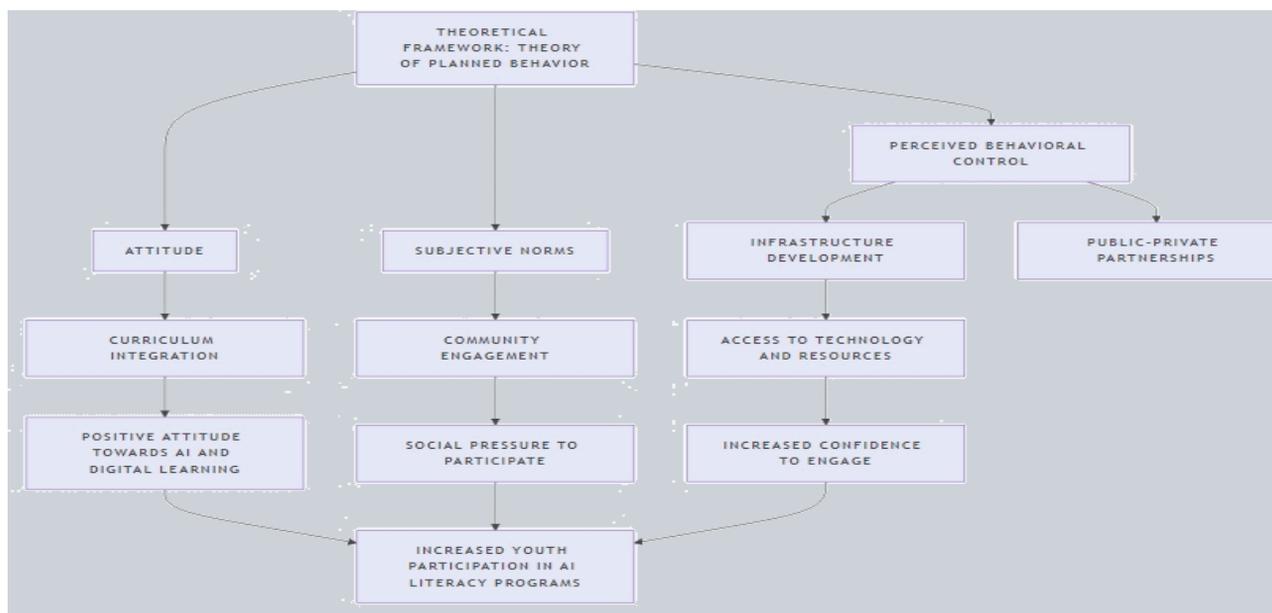


Figure 1: illustrates the AI Digital Literacy Framework, highlighting the strategic interventions aligned with the Theory of Planned Behavior (TPB) that address specific barriers to AI digital literacy among South African youth.).

Application of Theory

Each element of the framework is examined using the Theory of Planned Behavior to clarify how attitudes, subjective norms, and perceived behavioral control affect youth's involvement in AI digital literacy initiatives. **Attitudes:** Public-private partnerships and curriculum integration help shape positive attitudes toward AI digital literacy by demonstrating its practical benefits for future careers. Students are more willing to participate in AI instruction when they perceive how AI relates to their daily life (Alsheeti, 2022).

Subjective Norms: Social expectations regarding AI education are significantly shaped by community involvement. Subjective norms can be changed to foster an atmosphere that is more encouraging for the youth to pursue AI knowledge by enlisting parents, teachers, and community leaders in AI digital literacy programs (Hsieh, Rai, & Keil, 2008).

Perceived Behavioral Control: Public-private collaboration trains the teachers and provides access to technology, hence providing educators and students with a greater sense of control over their success in AI digital literacy initiatives. These strategies overcome challenges that prevent the youth from engaging in AI education because they provide them with the necessary tools and training (Roopaei et al., 2021).

Conclusion

For countries like South Africa, rapid technological developments—the majority of which are driven by AI—create an enabling environment; both opportunities and challenges go hand in hand. While AI has opened up hitherto unimaginable avenues with respect to job opportunities, economic growth, and innovation, it also threatens jobs because of increased automation. In the absence of proper AI digital literacy and other digital skills among South Africans, a large portion of the population will not be able to effectively access and participate in the digital economy, thus polarizing the already-present socioeconomic divide in the nation (Funda & Piderit, 2024). In addition to discussing the different barriers that keep the youth away from participating in AI education, this article has considered the other important role of AI digital literacy within the context of youth empowerment and social inclusion.

The current study, underpinning by Icek Ajzen's Theory of Planned Behaviour, has emphasized the need to address major internal and external factors that impact the behaviour of young people towards AI and digital education, such as attitude, subjective norms, and perceived control, in addition to external barriers like access to technology and educational resources (Ajzen, 1991). This proposed framework encompasses a comprehensive approach to improving AI digital literacy through curricular integration, community involvement, teacher preparation, public-private partnerships, and government policy serving as key change agents. Public-private partnerships, however, also play an important role in these cases, especially toward and within those poor and rural areas where access to AI technologies and education is minimal (Clewlow, 2023).

The partnerships ensure increased involvement of the youth with AI by mentoring and training the youngsters while providing the necessary resources.

Other critical components of the framework involve the integration of AI into the national curriculum. South Africa will be equipping the youth for competition in a technological globe by ensuring that the principles of AI are taught from a tender age within schools (Touretzky & Seehorn, 2022). It is also important that this be made available to cater to the needs of students within urban and rural areas inclusively with relevance. So, it first means intensive investment in teaching materials, teacher training, and digital infrastructure is costly (South African Department of Basic Education, 2022).

In order to influence social perceptions and expectations around AI education, community involvement is equally essential. AI digital literacy programs can foster a positive learning environment that inspires the youth to view AI as a useful and feasible skill set by enlisting the help of parents, teachers, community leaders, and neighbourhood organizations (Nal'ibali Campaign, 2023). Campaigns led by the community, like those that use storytelling to promote digital literacy, can increase youth engagement by humanizing AI education and making it more culturally relevant. One of the most pressing issues facing the South African educational system is perhaps teacher training. Even the strongest curriculum improvements would fail without adequate training, as many instructors lack the abilities needed to teach AI effectively. Professional development programs that focus on both technical skills and pedagogical strategies are essential for ensuring that educators can confidently deliver AI content in the classroom (Mnguni, 2024).

Lastly, government policy is crucial to the expansion of AI digital literacy programs. AI education must be given top priority in national policies, which should also provide the infrastructure, funds, and resources required to support educators, students, and schools. The National Digital and Future Skills Strategy, which outlines the South African government's commitment to digital literacy, is a positive move, but more needs to be done to guarantee that AI education reaches all children, especially those in underprivileged regions (Pila, Madzivanyika, & Meso, 2024). To develop a coherent and long-lasting AI education strategy, policymakers must collaborate closely with academic institutions, business executives, and neighbourhood associations.

Ultimately, improving AI digital literacy among South African youth necessitates altering attitudes, norms, and perceptions surrounding AI education in addition to removing technological and educational obstacles. With an emphasis on both systemic and individual-level treatments, the framework offered in this article provides a comprehensive strategy for overcoming these obstacles. South Africa can enable its youth to engage in the digital economy, stimulate creativity, and promote the nation's economic development by creating an atmosphere that is conducive to AI digital literacy. The ability of South Africa's youth to prosper in a rapidly evolving technological environment is crucial to their future, and AI digital literacy is the key to releasing that potential (Scott-Branch, Laws & Terzi, 2023).

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References

1. Alao, B. (2020). Impact of ICTs for Sustainable Development of Youth Employability. In *Promoting Inclusive Growth in the Fourth Industrial Revolution* (pp. 148-180). Johannesburg: ResearchGate.
2. Alao, B., & Brink, J. (2023). AI's potential for addressing unemployment and fostering creativity.
3. Adam, T. (2022). A study among peri-urban, marginalized, South African youth. Apollo - University of Cambridge Repository.
4. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
5. Alsheeti, S. (2022). Attitudes and Perceived Usefulness of AI in Youth Employment Opportunities.
6. Black, R. (2022). Exploring Digital Skills Development: The Role of Socio-Economic Backgrounds.
7. Corbin, J., & Strauss, A. (2015). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*.
8. Clewlow, R. (2023). Effective Models of Public-Private Partnerships in Digital Literacy: Case Studies in Africa.

9. Funda, V., & Piderit, R. (2024). Exploring Youth Participation in AI and the Barriers of Digital Inclusion in South Africa.
22. Hsieh, J. P., Rai, A., & Keil, M. (2008). Understanding Digital Literacy Engagement. *Computers & Education*.
23. Johnston, M. (2014). Secondary Data Analysis: A Method of Research for Analyzing Available Data. *Journal of Social Science*.
24. Mnguni, S. (2024). Assessing AI Literacy Training Gaps Among Teachers in South Africa.
25. Moonasamy, A. R., & Naidoo, G. M. (2022). Digital Learning: Challenges experienced by South African university students during the COVID-19 pandemic. *The Independent Journal of Teaching and Learning*.
26. Nicolae, B. (2024). The Role of Continuous Learning in Adapting to AI-Enhanced Business Paradigms.
27. Ndung'u, N., & Signe, L. (2020). The Fourth Industrial Revolution and digitization will transform Africa into a global powerhouse. *Brookings Institution*.
28. Pila, K., Madzivanyika, C., & Meso, C. (2024). Digital Literacy Policy Implementation and Youth Employment in South Africa.
29. Roopaei, M., Horst, P., Klaas, M., Foster, J., & Grunow, J. (2021). Developing AI Literacy Through Business Partnerships: The Case of AI Singapore.
30. Rosenthal, S. (2016). Qualitative Research Methodologies in Social Sciences.
31. Scott-Branch, L., Laws, A., & Terzi, S. (2023). AI Literacy as a Path to Sustainable Development: A Review of Policy Implications.
32. South African Department of Basic Education. (2022). Annual Performance Plan: Digital Literacy and AI in Schools.
33. Touretzky, D. S., & Seehorn, D. (2022). AI4K12: Bringing AI Literacy to the K-12 Classroom.
34. Varadarajan, R. (2024). The Impact of Professional Development in AI Education: Teacher Perspectives.



Theme 2:

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A teacher's plight to career progression: A narrative inquiry

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Abstract: This research is driven to capture the story of a high school teacher on the account of career progression. Specifically, this study uncovers the challenges related to promotion; give support for career advancement; and to illuminate insights or life lessons for other teachers or teachers to be on the account of promotion or career progression. Purposive sampling technic is employed. Data collection methods are through Semi-structured Interview, Writing Prompt through Timeline Completion and an Archival Record. Audio recorded face-to-face interviews with transcriptions provide in-depth participant insights. Data analysis procedure made using Braun & Clarke's six-phase framework: examining raw data; making initial codes; having repeated coding process; categorizing codes; developing themes and/or sub themes representing data in tables, figures; and lastly creating the final narrative. There are four (4) major themes that came to light namely: Priority, Determination, Complacency and, Support System, which give way to the sub-themes Stagnation, Disappointment / Regrets, and Encouraging others to pursue educational goals. Additionally, there are seven (7) epiphanies marking significant life realizations and turning points in the particular teacher respondent's career journey. These are the following: (1) Gratitude and Aspiration; (2) Unexpected Love for Filipino Subjects; (3) Sacrificing Career for Family; (4) Reawakening Professional Goals; (5) Realization of Career Stagnation; (6) Hope and Motivation from New Policy; (7) Lessons and Realizations. Lastly, this research emphasizes the value of lifelong learning, mentoring programs and training opportunities about career progression processes. Updated promotion policies must be announced properly to give equal and timely opportunities to all the teachers. There is a necessity of actualizing a career progression self-paced action plan for every teacher.

Keywords: Career progression, Complacency, Determination, Priority, Stagnation, Support system

Introduction

Domain number 7 of the Philippine Professional Standards for Teachers (PPST) significantly highlights "Personal Growth and Professional Development" of teachers and intensely magnifies the importance of personal professional reflection and learning to improve practice. The set of guidelines for teachers, which are based on the idea of lifelong learning, acknowledges the importance of PPST standards framework that

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describes the development of teachers as they develop, enhance their methods, and adapt to the complexity of educational reforms. Thus, the value and importance of teachers' responsibility for personal growth and professional development through continuous education or lifelong learning is a must. The career ladder or career progression emphasized the ascending standards and competencies expected from the teachers from Beginner Teacher, Proficient Teacher, Highly Proficient and Distinguished Teacher. However, it has never been easy for every teacher to continuously climb up the professional development ladder. Cahilog et al. (2023) mentioned several challenges that affected teachers' latency in career progression these involved (1) Uncontrollable Choices, (2) Contentment, and (3) Called to Serve. These are just a few expedients in highlighting and uncovering the realities of the teachers' world in the environment they are in.

According to Morales and Matriano (2023), teachers also experienced professional development challenges in terms of teacher-related factors to a great extent. These are the following: (a.) Having a busy schedule; (b.) Limited time to involve themselves in professional development; (c.) Lack of financial resources for their engagement in professional development; (d.) The perception that professional development activities may not effectively contribute to career advancement and professional growth; (d.) Sense of self-sufficiency, thereby eliminating any desire to participate in professional development activities; (e.) Instructional supervision and assistance, when teachers do not receive regular or timely constructive feedback about professional development practices. In addition to that, these were supported by Guira and Doctolero (2023) in a study which revealed that teachers who were never promoted, indeed encountered several obstacles and that served as frequently disregarded stories which needs to be heard and given a chance of attention and this emphasized the need for more inclusive and supportive teacher career advancement strategies.

In addition to instructional supervision and assistance, according to a survey on the Role of Principals in Teacher Promotion in the Philippines (Simbre et al., 2023), both teacher and principal participants agree that principals serve as effective models for teachers, with a positive attitude about work, providing technical assistance and opportunities for teachers to assume relevant tasks, according to recognition, developing soft skills of teachers, pursuing further study, and self-initiative as promotion requirements. These findings suggest that a career advancement system should include three key competencies: functional, core behavioral, and professionalism and ethics. These should continuously and systematically address concerns of teachers about promotion and better meet organizational needs.

There is not much of qualitative studies in the Philippines on teachers' stories of career progression. Thus, this research is driven to add and to contribute literature for in-depth exploration of behaviors, attitudes, and experiences within their real-life context in order to have a more comprehensive understanding of perspectives. This study aims to highlight recollection of events and circumstances behind a teacher's long delayed career progression. Specifically, this study uncovers the challenges related to promotion; give support for career advancement; and to illuminate insights or life lessons for other teachers or teachers to be on the account of promotion or career progression.

Rita Chen (A Pseudonym) was a previous adviser in high school and now a co-teacher of the researcher. Rita was known to be very passionate in delivering meaningful lessons to the students at the same time a loyal, caring and an epitome of camaraderie. This particular teacher had been awarded by the Local Government Unit for being one of the "Outstanding Employees" in the entire Jimalalud District 2 of the Division of Negros Oriental. In addition, this particular teacher had been in service for 21 years, with 16 years as T-1 in Junior High and now on her 7th year in Senior High School but still stuck as Teacher-II. In other words, Rita has very notable attributes and characteristics yet somehow failed to ascend in the professional ladder of development. Thus, this research seeks to answer the overarching essential question: How does the teacher describe her plight to career progression? Specifically, this research seeks to answer the following questions: (1) What challenges did the teacher encounter in connection to career growth or promotion during Junior and Senior High school as Technical Vocational Teacher? (2) What are the impacts to teacher's morale (sense of common purpose; the mental, emotional condition or enthusiasm and confidence) of not getting promoted? (3) What insights can be deduced from the teacher's experiences in connection to career growth? (4) What recommendations can be extended to the teacher to finally uphold the long-delayed promotion?

Literature review

Will (2024) in his study reiterated that when teachers first begin with employment, they are often upbeat and enthusiastic. However, after a few years, many begin to lose hope due to the difficulties of teaching and the stagnating pay or promotion in comparison to their colleagues in other fields. Maintaining teachers' morale after the initial excitement and hope wearing off is must be seriously countered by school administrators, so that teachers will be assisted and may move on to a more solid stage of their employment.

According to Macapagal and Ricafort (2023), it was found that teachers' aspirations for career advancement, along with their planned efforts, persistence, and professional development, were very important. There should be a balance of sound policies to be instituted in every school where teachers juggle providing quality education to the learners while helping them thrive in their careers. Tantawy (2020) reiterated that teachers who were highly engaged in professional development initiatives were found to have observed a positive impact on their career progression, promotion chances, retention, and commitment. However, due to some circumstances and the major life events of teachers, allocating time for professional development is almost impossible to achieve.

On the lighter part, teachers' development programs of the Department of Education are available to teachers with a support system, lifelong learning opportunities, awards and recognition, establishing linkages, and engaging them in challenging and fulfilling tasks. A teacher's capacity to manage their career routes is influenced by the availability of a faculty development program. The teachers' varied experiences with career management and faculty development are marked by their desire to pursue graduate studies, share knowledge, receive support from colleagues, and realizing their own potential. However, they encounter obstacles such as a lack of hope for advancement, pessimism, and unfair treatment at work due to certain authorities' selective preference for advancement. An extra component of the faculty development program is prepared for the first round of testing and approval (Labrada, 2020). In addition, some teachers use the idea of aiming for a higher leadership position as a motivation for career progression (Kalberg & Bezzina 2018). However, according to Harper (2018), many teachers find having a business venture more productive than receiving their fixed monthly salary. Bottomline is that teachers are always looking for ways to progress not only professionally but financially and promotion is not the only option.

According to Albert Bandura's social cognitive theory, behavioral patterns, contextual forces, and individual characteristics combine to produce human behavior. He suggested that people are both impacted by and actively shape their surroundings, emphasizing the roles of social experience, observational learning, and reciprocal determinism in human behavior. Also, people try to gain a sense of agency and exercise control over the significant events in their lives (Simply Psychology, 2024).

Teachers' professional advancement is not solely the product of individual efforts, but rather of a complex interplay between personal beliefs, social influences, observational learning, and the environment, as may be seen when seen through Albert Bandura's Social Cognitive Theory. Teachers are more likely to advance if they cultivate a high sense of self-efficacy, participate in ongoing professional development, and make use of encouraging professional networks. Teachers can be further empowered to take control of their careers, adjust to new obstacles, and eventually advance in their professions by creating an environment that values agency and feedback. This implies the significant roles of the school heads and the Department of Education heads in scaffolding teachers' career progression.

Methodology

Narrative inquiry

This study employed a qualitative narrative research inquiry design to collect or recount detailed stories or life experiences of an individual. It involved making meaning through collaboration between the researcher and the particular teacher respondent by chronologically ordering the meaning of experiences called life course stages in an individual's life or key events that become the focus for the biographer (Reissman 2008). In this particular research design, stories emerge from a story told to the researcher, a story that is co-constructed or co-created between the researcher and the participant. This is a story intended as a performance to convey some message or point (Reissman, 2008). It is said that there may be a strong collaborative feature of narrative research as the story emerges through the interaction or dialogue of the researcher and the participant.

Narrative stories tell of individual experiences, and they may shed light on the identities of individuals and how they see themselves. Narrative stories often are heard and shaped by the researchers into a chronology although they may not be told that way by the participant(s). (Clandinin & Connelly, 2000). Narrative stories are analyzed in varied ways. An analysis can be made about what was said, which is called "Thematic Analysis." Analysis can be based on the nature of the telling of the story which is called "Structural Analysis." Lastly, analysis can be laden on who the story is directed toward which is known as "Dialogic/ Performance" (Reissman, 2008). As to this research study, thematic analysis was employed.

Narrative researchers situate individual stories within participants' personal experiences within the job, home, culture, and historical contexts such as time and place, etc. It involves "Restorying" or the process of reorganizing the stories to a general type of framework. This framework may consist of gathering stories, analyzing them for key elements of the story like time, place, plot, and scene. Which is then followed by rewriting the stories within a chronological sequence (Ollerenshaw & Creswell, 2002).

Narrative researchers collect stories, negotiate relationships, smooth transitions, and provide ways to be useful to the participants. In narrative research, a key theme has been the turn toward the relationship between the researcher and the researched in which both parties will learn and change in the encounter (Pinnegar & Daynes, 2007). In this process, the parties negotiate the meaning of the stories, adding a validation check to the analysis (Creswell & Miller, 2000). Within the participant's story may also be an interwoven story of the researcher gaining insight into her or his own life (Huber & Whelan, 1999). Also, within the story may be epiphanies, turning points, or disruptions in which the storyline changes direction dramatically. In the end, the narrative study tells the story of individuals unfolding in a chronology of their experiences, set within their personal, social, and historical context, and including the important themes in those lived experiences. "Narrative inquiry is stories lived and told," (Clandinin & Connolly, 2000: 20).

Data gathering procedure

The researcher made use of the purposive sampling technique for the sole participant who was particularly chosen to answer the set of questions in the study. This means that the researcher selected the respondent for the study purposively to have an informed understanding of the research problem and the phenomenon in the study (Creswell, 2000). Within 7-8 weeks the data collection methods used were Semi-structured Interviews, Writing Prompts through Timeline Completion, and an Archival Record. Audio recorded data from face-to-face interviews lasted almost 2 hours with (14) fourteen pages of printed transcriptions. This was made manually using Microsoft Word with the aid of the Google Translator tool to provide an in-depth exploration of the participant's story.

Gaining informed consent was not quite complicated for the researcher since both the researcher and the respondent were teaching in the same school. In other words, "co-teachers". The permission letters were signed and approved by the school head and the particular teacher respondent. The researcher sought professional advice and technical assistance from more knowledgeable others of previous college instructors a research director in a university, a co-teacher, and a colleague who specializes in qualitative research studies. These experts provided aid in validating the tool for data collection. Lastly, from a university professor who specializes in Linguistics and Qualitative Research studies.

Data analysis procedure

The researcher used Braun & Clarke's six-phase framework for qualitative data analysis. This involved the following steps: (1) Become familiar with the data by reading, and re-reading the transcripts; (2) Generate initial codes by organizing the data in a meaningful and systematic way; (3) Search for themes by examining the codes to clearly see which fit together into a theme; (4) Review themes as themes should be coherent at the same time distinct from each other; (5) Define themes to identify the essence of what each theme is about. (6) Write-up the research report or narrative (Braun & Clarke, 2006).

The data analysis procedure included examining the gathered data, making initial codes, categorizing the codes or looking for patterns, and reducing codes to themes (Creswell, 2000). The study employed an Inductive coding approach to make sense of the data. It highlights creating a set of codes based on the data itself as the codes emerge from the data (Jansen, 2024). Specifically, the study used descriptive, in-vivo, and values coding. Descriptive coding aims to summarize extracts by using a single word or noun that encapsulates the general idea of the data. In-vivo Coding typically describes the data in a highly condensed manner, which allows the researcher to quickly refer to the content. It makes use of direct quotes from participants as codes. This is to avoid trying to infer meaning, rather staying as close to the original phrases and words as possible (Jansen, 2024). In vivo, coding is particularly useful when data are derived from participants who speak different languages or come from different cultures. In these cases, it's often difficult to accurately infer meaning due to linguistic or cultural differences. Values coding involves coding that relates to the participant's worldviews. Typically, this type of coding focuses on excerpts that reflect the values, attitudes, and beliefs of the participants. Values coding is therefore very useful for research exploring cultural values and intrapersonal and experiences and actions (Jansen, 2024).

After repeated coding processes, thematic analysis was employed. The thematic analysis focuses on themes and patterns. It looks at patterns and meanings in a data set. it takes bodies of data which are quite large and groups these data into according to similarities. It makes sense of context and derive meaning from it. Useful for finding out about people's experiences, views, opinions and perspectives. It is used for understanding people's experiences through an exploratory process (Creswell, 2000).

In analyzing narrative data, interpretation of faith was used. This is also known as the Hermeneutic of Faith where the stories told by the participants are true and meaningful based on their sense of personal experience. Researchers take the story at face value. It aims to explore or understand the subjective world of the

participants or the social and historical world they are living in (Josselson, 2004). The data analysis procedure specifically was composed of: examining raw data; making initial codes; having repeated coding process; categorizing codes; developing themes and/or sub-themes; representing data in tables, and figures; and lastly creating the final narrative.

Result and discussion

Table 1: Interview excerpt utilizing descriptive in-vivo coding for Question Number 1.

Question no. 1: Since when have you been teaching and connected with Department of Education?	
Significant Response	Descriptive Coding
2003, (January) nahimo ko sinulog dancer dayun tigpa snack my students were Greta and Mico...kahinumdum ko nila mo ingon sa kitchen, ayuha na niyu luto kay gigutom nko.	2003 Entered/Started w/DepEd

Rita recalled that her first year of actual service in school as Teacher-I was January, 2003. But her date of appointment was originally December 2002 which was still during Christmas vacation.

Table 2: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 2

Question no. 2: How many years of teaching experience did you have in Junior High School? Please describe those years in at least 3-5 adjectives.		
Significant Response	N-Vivo Coding	Descriptive Coding
Since 2003-2016, 14 years kuan ¹ I feel excited, inspired, motivated, kusog kaayu akong feeling gabaha jud. ² Dream nko nga dili ko kutob ug T-III. Mo hilak nalang ko ani day wala naman ko mahimo ani (joking and laughs)...	14 years. ¹ I FEEL EXCITED, INSPIRED, MOTIVATED, KUSOG KAAYU AKONG FEELING GABAHA JUD. ² DREAM NKO NGA DILI KO KUTOB UG T-III.	¹ HIGH-SPIRITED ² HOPEFUL

Rita had 14 years of teaching experience in Junior High School. Which she feels excited, inspired, motivated, and really high-spirited. She's full of hope and drive that she will not only be Teacher-I or Teacher-III but more. According to Will (2024) When teachers first begin with employment, teachers are often upbeat and enthusiastic.

Table3. Interview excerpt utilizing descriptive and n-vivo coding for Question Number 3.

Question no. 3: Did you apply for promotion or reclassification in Junior High School? How was it?		
Significant Response	N-Vivo Coding	Descriptive Coding
YES. katung naa koy 9 units. 2009-2010. Katung naa tu memo day nga teachers having the experience pwedi maka apply ug T-II dayun gi ing nan ko ni sir harry unya ni apply ko pero ang nka sulod taga JNHS. 9 me kabuuk diri ang nakasulod taga JNHS si mam P. ¹ Nalugi kaayu ko. Asa asa man sila, regional, national ako kutob ra division.	YES. WITH THE 9 UNITS. 2009-2010. ¹ NALUGI KAAYU KO. (BEHIND IN RANK)	¹ LAST IN RANK

The teacher respondent applied for promotion for Teacher-2 position once in junior high but failed to get promoted because promotion was given to teachers who are more qualified and more accomplished. DepEd Order No. 42, s. 2007, DepEd Order No. 66, s. 2007, and MEC Order No. 10, s. 1979, served as bases in identifying criteria and indicators for professional development practices. All these highlighted the specific points for scoring from performance rating, experience, outstanding accomplishments, education emphasizing on further education, trainings, authorship, etc. the teacher would really have to keep abreast with all these, especially continuing professional education to be competitive in the ranking for promotion and in order not to be left behind.

Table 4: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 4.

Question no. 4: How long have you been serving in Senior High School? Please describe these years in at least 3-5 adjectives.		
Significant Response	N-Vivo Coding	Descriptive Coding
<p>Since 2017 till present turning 8 years. Finally promoted to T-II.</p> <p>¹Happy na kay teacher 2 ahw ug mo ingon nga sa trabaho sa mga bata,</p> <p>²kontento ko, ok ra, nalipay ko. sa environment... wala koy problema sa senior high.</p> <p>³Ma-stress rako ana ing-non ko “T-II paka ron mam?” Mura ka’g ma down sa kaugalingon dayun of course mura kag ma-stress kay imung mga junior high students na T-III na.</p> <p>Kuan day ⁴Nagmahay (SHS) ...</p>	<p>¹HAPPY WITH WORK & STUDENTS.</p> <p>²CONTENTED WITH ENVIRONMENT.</p> <p>³STRESSED WHEN ASKED OF RANK: “T-II PA KA RON MAM?”</p> <p>⁴NAGMAHAY</p>	<p>¹HAPPY</p> <p>²CONTENTED</p> <p>³STRESSED</p> <p>⁴REGRETFUL</p>

In 7 years of teaching in Senior High, Rita said she’s happy with work, environment and students but stressed when asked about her position or rank, “*Teacher-II pa ka ron ma’am?*” in addition, Rita expresses regret “*Nagmahay*” for not being able to ascend in the professional career ladder in a long period of time.

Table 5: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 5.

Question no. 5: Do you see yourself finishing your Master’s degree in the future or proceeding with your TM-2 in Dressmaking? Why or why not?		
Significant Response	N-Vivo Coding	Descriptive Coding
<p>Wala na. Akong gihuna huna ron day wala na na inline sa profession. ¹Negosyo akong ganahan. Mao jud na siya day wala nako ga huna huna nga mo school pa ko day. Negosyo na.</p> <p>Not dali ang kwarta. Sa akong ²pangidaron ba, kuan na kaayu (too late).</p> <p>kung mo proceed ko ug master’s degree.. dayun unsa ma promote kog T-III?</p> <p>professional ³growth ra na. dili gyud ko gihapon ma master teacher day kay ngano naa si mam J. Blurred kaayu na jud. Di na pwedi. dili nko day. Dili nko mag kuan ug instructor kay wala na jud sa akong huna huna ng instructor. Ang ako nga ma ⁴promote nalang kog T-III malipay nako ana dayun ⁵focus kog Negosyo. labina naa nakoy ⁶college, need kog laing extra income.</p> <p>Assessor pwedi, pwedi. Pero daghan n apud assessor naas guihulngan. Wala na jud mao ra na akoo, promoted to T-III. Dayun mag Negosyo lamang na.</p>	<p>NO</p> <p>¹ I WANT TO DO BUSINESS</p> <p>² CONSIDERING MY AGE NOW IT SEEMS TOO LATE.</p> <p>³IT’S JUST PROFESSIONAL GROWTH, I WON’T BECOME MASTER TEACHER.</p> <p>⁴ I JUST WANT TO GET PROMOTED TO T-III. I WILL BE HAPPY.</p> <p>⁵I’LL FOCUS ON BUSINESS.</p> <p>⁶ ESPECIALLY NOW I HAVE COLLEGE, I NEED EXTRA INCOME.</p>	<p>NO</p> <p>¹ BUSINESS</p> <p>² AGE</p> <p>³ JUST PROFESSIONAL GROWTH</p> <p>⁴ GET PROMOTED</p> <p>⁵FOCUS BUSINESS</p> <p>⁶COLLEGE</p>

Rita’s responses in question number eight presented disinterest in continuing her further study for master’s degree. She expresses her interest in doing business for extra income for her soon to be college son. Thus, she wants to get promoted to Teacher-III. As she says “*It’s just professional growth, I won’t become master teacher. I just want to get promoted to T-III.*”

According to Harper (2018), many teachers find having business venture more productive than receiving their fixed monthly salary. This is certainly true with Rita as well when she said “*I’ll focus on business.*”

Especially now I have college, I need extra income”. For Rita, having more source of income is more necessary than pursuing further study or professional development.

Table 6: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 6.

Question no. 6: If the road to becoming a Master Teacher is blurry, how about being a school head or a teacher-in-charged as a stepping stone to P1, would you consider it? Why or why not?		
Significant Response	N-Vivo Coding	Descriptive Coding
<p>¹kalima ko gi-approach ma-TIC sa school but said NO. sa time ni mam R, dayun paghawa ni mam N. dayun ka sir C, dayun sunod ka sir H. Dayun ka sir R. Mailhan najud ko day ug unsa jud ko day..ahahah. Tapulan ko ana nalang day.</p> <p>Aning time pagawas ni mam R²buntis ko ana. Ingon c mam “day mu hawa nako day. Ikaw akong ibilin kay ikaw taga diri. Ikaw najud aning eskwelahana day” nya daghang ³bugoy. Magdad-anay man ug sundang. Dayun gidad-an kog sundang day. Gidad-an kog sundang.</p> <p>Si A diha katung langlang..ang iyang manghud, nutrition month man, unya akoy adviser. Naay cooking cooking, Nawala man day (knife) nasuko siya. Nya akong mga estudyante atu kay 122 inside the classroom. Unsaon nako pag-monitor. Ug wala ⁴giing-nan ko ani day (TIC is road to P1), murag utongon nako. Wala ko kabalo gud nga ing ana. Kay ni ingon man pud sila day kay ug ma TIC ka ⁵same ra japon kag sweldo.</p> <p>OO, naligsan lagi ko anang kuana. Pero ng eskwela ko ana(2003-2004) dayun kaning sa time ni sir C. MO ana gyud na siya na lami jud na siya kay motivated kaayu na siya “Teach, lamia nimo sa, 29 pa imong edad nya kuan naka TIC.” Dayun ana pud c mam R, kay ug dili jud ka day ako ning ihatag ni sir cabag. Nya ako atu murag ahead man ko ni sir C ug duha ka tuig, nya laki man si sir naay motor..mao akong ihatag niya. Ganahan pud siya ma TIC.</p> <p>OO, laki man gud siya day nya buntis ko ani nga time ni mam R. Nya pagka human nkog panganak ni sakay bayag barko si husband.</p> <p>oo, ang paghawa ni sir C, ako napud iyang gi-ingon. Nya ⁶nursing mother baya ko day. Si second child. nya lisud nag ⁷dalan (18-19 km). Basta lisud kaayung dalan day. Dayun walay suga (walay korente) wala computer type writer ra. Mao sir H na.</p> <p>akoy gi-ingon ani ni sir H unya wala na sa akong ⁸huna-huna, kuan, si e (buntis/³rd child) ang pagka check-up, ang ⁹risk, kanag sige-ag padala ug seminar ng mga school head, sa district nya katu man tung tyma nga bisag sabado padulhugon. Kabantay ka sauna nga daghan bagul-bol?</p> <p>¹⁰Negosyo na akong ganahan (magbaboyan, maninda)</p> <p>no.</p>	<p>¹FIVE TIMES APPROACHED TO BE TIC BUT DECLINED.</p> <p>²PREGNANT WITH FIRST CHILD</p> <p>³VIOLENT INDECENT PEOPLE BRING BOLO TO SCHOOL. I WAS A VICTIM.</p> <p>IF I WAS ⁴TOLD (TIC IS ROAD TO P1), I MIGHT ACCEPT IT. I REALLY DON'T KNOW THAT. THEY TOLD ME THAT IF I BECOME TIC, I WILL STILL HAVE THE ⁵SAME SALARY. WHY BOTHER?</p> <p>⁶I WAS A NURSING MOTHER. THIS TIME WITH (2ND CHILD).</p> <p>⁷TRANSPORTATION FROM WAS REALLY DIFFICULT.</p> <p>⁸OUT OF MY MIND, I HAD MY 3RD CHILD THEN.</p> <p>⁹RISK WHEN YOU'RE SENT TO SEMINARS, DISTRICT, ETC.</p> <p>¹⁰ I PREFER BUSINESS/MERCHANDIZING OR PIGGERY.</p>	<p>¹ NOT INTERESTED</p> <p>²PRIORITIZED MOTHERHOOD/ PARENTHOOD</p> <p>³VIOLENT PARENTS/PEOPLE</p> <p>⁴ UNWARE OF BENEFITS</p> <p>⁵SAME SALARY.</p> <p>⁶ 2ND CHILD NURSING MOM</p> <p>⁷DIFFICULT TRANSPORTATION</p> <p>⁸ 3RD CHILD NURSING MOM</p> <p>⁹RISK</p> <p>¹⁰DO BUSINESS</p>

Some teachers use the idea of aiming for a higher leadership position as a motivation for career progression (Kalberg & Bezzina 2018). But Rita was not one of them. She expressed disinterest several times to be a school leader/TIC due to many reasons like due to prioritizing motherhood, violent parents/people, transportation or travelling, risks, etc. Rita rather prefers to do business or have piggery.

Table 7: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 7.

Question no. 7: What challenges did you encounter in connection to career growth or promotion during junior high school?		
Example: Challenge in terms of finances while finishing Master's Degree for promotion; Challenge in terms of time, I was too busy, etc.		
Significant Response	N-Vivo Coding	Descriptive Coding
kana ¹ time. No more time sapag eskwela wala na kay naa naman ² anak. Dayun kuan mga ³ dalan. Lisud kaayung dalan dili pa kabalo mo drive. Habal habal lang. talagsa ra habal-habal mu dulhug. Wala paman lain habal habal dinhi sauna. Walay motor kaayu 2003-2006..pila ra kabuok, dili ka kasakay dayun. Need pa nimo ihatud sila, maghulat ka ug byahe. Mga tawo usually maglaw pa, guba kaayu ang karsada day from Jimalalud. Lisud jud ang dalan day. Kuan baya kana pag pauli. Ganahan ko mo eskwela pero ⁴ mabira rako ky wla sila pud ng eskwela..ang uban until now.. ang uban ng TIC na principal, ang uban ni balhin ug elementary nagpa transfer. Kuan rajud na ⁵ zigzag akong dalan day.	¹ TIME NO MORE TIME SAPAG ESKWELA WALA NA KAY NAA NAMAN ² ANAK. LISUD KAAYUNG ³ DALAN DILI PA KABALO MO DRIVE. GANAHAN KO MO ESKWELA PERO ⁴ MABIRA RAKO KY WLA SILA PUD NG ESKWELA ⁵ NA ZIGZAG AKONG DALAN DAY. (my path is zigzag)	¹ TIME ² MOTHERHOOD/PARENTHOOD ³ TRANSPORTATION ⁴ LACK OF INTEREST ⁵ RUNNING IN CIRCLES

Rita named several challenges she encountered in connection to career growth or promotion during junior high school. Namely, time, prioritized mothering or parenthood over taking MA classes, transportation, lost interest, and many more. Certainly, these are unquestionable reasons why the teacher respondent stopped pursuing a Master's Degree and only earned 9 units. Years later it turned out to be an on-and-off plight for further education. MA 9 units from 2003 dissolved. In 2017 re-started MA journey, re-enrolled MAV & earned CAR. Which later lead to my getting accepted into SHS as Teacher-II. Rita described this as “*Na zigzag akong dalan*” or “*My path is zigzag*” indicating her path to career progression.

According to Morales and Matriano (2023), teachers experienced professional development challenges in terms of teacher-related factors to a great extent. These are the following: (a) Having a busy schedule; (b) Limited time to involve themselves in professional development; (c) Lack of financial resources for their engagement in professional development; (d) The perception that professional development activities may not effectively contribute to career advancement and professional growth; (d) Sense of self-sufficiency, thereby eliminating any desire to participate in professional development activities; (e) Instructional supervision and assistance when teachers do not receive regular or timely constructive feedback about professional development practices.

Table 8: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 8.

Question no. 8: What challenges do you encounter in connection to career growth or promotion as a Technical Vocational Teacher?		
Example: Challenge in terms of finances while finishing Master's Degree for promotion; Challenge in terms of time, I was too busy, etc.		
Significant Response	N-Vivo Coding	Descriptive Coding
¹ Wala ko gi-assignan ug TLE subjects(specialization). Wala pud ko nangayo kay dili man sila mo tudlo ug Filipino. Ang Filipino gihatag jud nila nko kay lisud konu na nila. Mao na wala ko nahatagan ug TLE. pagsulod jud nako, ako jud na tanang Filipino. First year-4 th year (High school). Ang ako nga ² nalipay na ko nahimo ko'ng teacher, ug unsaon nko pagtudlo ug Filipino nya sila.	I WAS ¹ NOT ASSIGNED TO TEACH TLE SUBJECTS. I DIDN'T ASK BECAUSE THEY DON'T WANT TO TEACH FILIPINO. THEY GAVE ME FILIPINO BECAUSE IT WAS DIFFICULT FOR THEM. THAT'S WHY I WASN'T GIVEN TLE (SPECIALIZATION).	¹ NOT GIVEN TEACHING LOAD IN TLE (SPECIALIZATION)

<p>Perting toon day, maong c M Nakita na. kita ka aning akong mata kani? Mao na naka ingon day. Naka coach, nagka judge sa district ug cluster even represented division level FILIPINO. Learned to ³love Filipino develop love for Filipino; coaches and judges Filipino related competitions; but grew up apart from specialization. Suga(lamparelya) dayun matulog ko ug 12-1 am. Upat ka subjects baya akong tun-an. Ako man Filipino paghawa ni mam kuan, nya maulaw baya ko day. Wow fresh graduate, dapat dako kaayu expectation ang mga bata nimo. Mao to abot kog ala-una magtoon. Mata ko alas-kwatro. Kay maglakaw pako gikan sa amoa padulong sa school. mu labang suba...</p> <p>I've never been ⁴sent to TLE training...</p> <p>ang akong TLE training kani ra sa senior high teacher. First time na train kog TLE.</p> <p>Nya pag-abot nko senior high ⁵wala gihapon ko naka tudlo ug TLE...</p> <p>wala ko nila giapil day. Actually day si sir H giapil ko. Pero inug pasa didtu sa mga pangalan, wala ko.</p> <p>wala ko kabalo. I am not ⁶known to be a TLE teacher. Wala ko nailhan sa pagka TLE teacher day, nailhan man gud ko sa pagka FILIPINO. Kana gung naay training (district) adtu kog TLE, boring kaayu akong life day kay wala koy mga kaila. Adtu kog FILIPINO daghan kaayu kog kuan katabi.</p> <p>syempre ang senior dili gyud na niya ihatag ng iyang kuan. TLE si mam N.</p> <p>OO. Open minded naman ta gud ron day. Sauna ug unsay dili niya ganahan. Mao tuy iyang ihatag nimo. Nya ug ikaw...OO, aning ng eskwela kog dress making naa nay TMC-I scholarships. Si sir R gani ani. Wla ma na siya naka gastu sa iyang agritural NC-2. OO, wala na siya ka gasto.wala man ko gud nailhan. Kani aning tyma day. ⁷Nasuya gud ko ani nila tinud-anay wala ko na apil sa scholarship.</p> <p>Kaning 2015-2016 scholar...sa Siquijor man gani si sir R ani day. Agriculture NC2</p> <p>Pagka dawat ni sir R sa iyang scholarship nga NC2 in Agriculture, nasuya ko day. ⁸Mao nga gi-enrol nko akong kaugalingon diha sa Guihulngan for NC-2 in Dress-making. Scholar sa Guihulngan kang G. ⁹Pero kaning TMC-1 dress making nako akoang kaugalingon gasto.</p> <p>busdak mana. 18 thousand busdak man. Lahi bayad ang assessment. dayun magbayad pajud ka atung kuan day katung libro.</p> <p>¹⁰Lami ba gud na Day maka ulaw kaayu. Natulog ko, nagtagad kog bata,</p> <p>2022-2023 mka apas pa unta ko atu ninyu January/February? ug pa promote ug naa pay assessment for TMC-I. ending until now ¹¹walay guidelines for promotion for Techvoc. Plus complete papers na na, received na greenfolder sa division march 17, 2023. Ang akong kakuyawan ani day kabalo kag unsa napud, pag abot ani reclass man tu imong gi-ingon day sa?</p> <p>naa silay kuan ron day, karon gani naa silay meeting/conference ron pero si payang moy gipadalang robacs. Wala man gud koy TLE karon 2nd sem. Hatagan ko niya ug TLE second sem kay wala na si pyang. Adtu mana xa immersion magdala mga bata.</p>	<p>SINCE I WAS HIRED, MY SUBJECTS ARE ALL FILIPINO FROM FIRST YEAR-4TH YEAR HIGH SCHOOL.</p> <p>ANG AKO NGA ²NALIPAY NA KO NAHIMO KO'NG TEACHER, UG UNSAON NKO PAGTUDLO UG FILIPINO NYA SILA.</p> <p>MAO NA NAKA INGON DAY. NAGKA COACH, NAKA JUDGE SA DISTRICT UG CLUSTER EVEN REPRESENTED DIVISION LEVEL FILIPINO (LEARNED TO ³LOVE FILIPINO DEVELOP LOVE FOR FILIPINO; COACHES AND JUDGES FILIPINO RELATED COMPETITIONS; BUT GREW UP APART FROM SPECIALIZATION)</p> <p>⁴I'VE NEVER BEEN SENT TO TLE TRAINING...</p> <p>⁵WHEN I GOT TO SENIOR HIGH, I STILL DIDN'T TEACH TLE...</p> <p>⁶I AM NOT KNOWN TO BE A TLE TEACHER.</p> <p>⁷I WAS REALLY JEALOUS OF THEM I WAS NOT INCLUDED IN THE SCHOLARSHIP.</p> <p>⁸ I ENROLLED MYSELF FOR NC-2, GIBO'S SCHOLAR.</p> <p>⁹ SPENT FROM MY OWN POCKET FOR TMC-1 DRESSMAKING.</p> <p>¹⁰I FEEL ASHAMED, IT SEEMED I SLEPT, I TOOK CARE OF THE (MY) BABIES.</p> <p>¹¹ 'TIL NOW NO GUIDELINES FOR PROMOTION.</p>	<p>² ALREADY HAPPY BECOMING A TEACHER/ Complacency</p> <p>³LOVE FILIPINO</p> <p>⁴NOT SENT TO TLE TRAINING</p> <p>⁵STILL DIDN'T TEACH TLE IN SHS</p> <p>⁶ NOT KNOWN AS TLE TEACHER.</p> <p>⁷ SCHOLARSHIP NO</p> <p>⁸DIY/SELF HELP</p> <p>⁹SPENT OWN MONEY</p>
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		¹⁰ SLEPT FOR YEARS ¹¹ NO PROMOTION
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The teacher respondent faced notable challenges in connection to career growth or promotion as a Technical Vocational Teacher. Namely, (a) Not given teaching loads based on specialization; (b) Developed deeper love for Filipino subjects; (c) Not sent to Technical Vocational trainings; (d) Did not receive scholarship for NC-2 & TMC-I from DepEd; (e) Spent for TMC-I in dressmaking since the name was not enlisted to receive scholarship grants as this particular teacher has been known more as Filipino teacher than being a Technical Vocational Teacher in years; (f) Slept for years(stagnant career) (g) No guidelines for promotion. Amidst all these, the teacher expresses sort of restlessness waiting for the new guidelines in promotion for SHS.

DepEd Order no. 005, s. 2024 encourages that teachers must be given workloads and teaching loads based on the area of specialization. The first challenge mentioned by Rita was not parallel to this order. Teacher's flexibility and versatility is encouraged in the actual field of teaching. Such is done by teaching various subject areas but not to the point of completely depriving the teacher from his/her original specialization. According to Macapagal and Ricafort (2023) it was found that teachers' aspirations for career advancement, along with their planned efforts, persistence, and professional development, were very important. There should be a balance of sound policies to be instituted in every school where teachers juggle for providing quality education to the learners while helping them thrive in their career.

Table 9: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 9.

<p>Question no. 9: What impact did it bring you as a person for not getting promoted? (sense of common purpose; the mental, emotional condition or enthusiasm, confidence).</p> <p>You may answer this way:</p> <p>I feel _____</p> <p>I think _____</p> <p>I will _____</p>	
Significant Response	Values Coding
<p>I feel... ¹naguol ko.</p> <p>Na ²discourage nako. Na discourage nko kay wala na'y guidelines.</p> <p>³Nagmahay, dugay na unta kong na T-III ani.</p> <p>⁴I think I will...mubalik ko ug Junior..(laughs) I think I will transfer to Junior.</p> <p>Mao jud na siya. Mao na ni akong gibuhar (preparing folder for transfer). Himua jud ko ana ug application letter. Ang promotion hanap.</p>	<p>I FEEL ¹SAD.</p> <p>² I AM DISCOURAGED. THERES' NO MORE GUIDELINES.</p> <p>³ I AM REGRETFUL. I SHOULD HAVE BEEN T-III FOR A LONG TIME NOW.</p> <p>⁴I THINK I WILL GO BACK TO JUNIOR HIGH.</p>

The impacts on teacher's morale (sense of common purpose; the mental, emotional condition or enthusiasm, confidence) of not getting promoted are evident the following: (a.) *I feel sad*; (b.) *I am discouraged there's no more guidelines*; (c) *I am regretful. I should have been Teacher-III by now*; and (d.) *I think I will go back to Junior High*. According to Will (2024) When teachers first begin with employment, teachers are often upbeat and enthusiastic. However, after a few years, many begin to lose hope due to the difficulties of teaching and the stagnating pay or promotion in comparison to their colleagues in other fields. Maintaining teachers' morale after the initial excitement and hope wearing off is must be seriously countered by school administrators, so that teachers will be assisted and may move on to a more solid stage of their employment.

Table 10: Interview excerpt utilizing descriptive and n-vivo coding for Question Number 10.

Question no.10: What life insights as a teacher do you wish to impart to other teachers and “teachers to be” on the account of promotion based on the following:		
<p>a. PPST Career Progression</p> <p>b. Lifelong learning/ Further Study</p> <p>c. Mentorship and Collaboration</p> <p>d. Self-Motivation</p>		
Significant Response	N-Vivo Coding	Descriptive Coding
<p>¹Study while they are still young. Kung ma hire sila, padayun ug eskwela. Mao ra gyud n akong ika kuan kana mga batan-on karon. ²Padayun ug eskwela ayaw undang handtod mahuman. Dayun kanang mga ³opportunity nga maabot nila ayaw i-waste..(ahahaha) ⁴walay ni mentor/nitudlo nako karon ra.. akong ika advice padayun jud ug eskwela kay ikaw maoy mo tulod sa mga tawong tapulan sama nako. Kamo mag motivate. Pareha nimo ba..parehas karon, nimo day mahuman ka ug doctorate, ikaw jud mo ⁵tulod sa mga bag o karon nga nahisama ba ko nga sitwasyon.Gamay ra mi higayon nga nag-uban ni sir cabs kay na promote man siya. Daghan baya exit si sir cabag day..bilib kong sir C pud iyang mga teachers sa sibulan, canlaon iya jud gipang push.</p> <p>Wala man gud pud sila day. Kinsa man mo kuan unless siguro ug tua kos ubos. Tan awa gud kaming sir H. Ug si sir H ug wala gi-ari diri..nga “sir, nganong wala ka gapa promote? Ana rapud siya day “ay ok rako ani mam” katung diha’y mga taga division day gibisita na si sir..”How many years nga nag school head naka sir? Nakatawa ra si sir harry “dugay dugay najud mam. Wala rapud sa akong huna huna mam.Kuan jud to day na blessing jud to xa. Walay laing reason unsa gud to nganong ni ari ra sila mao rajud to ang tuyo atu nga time. Mao to akong gi-ingnan si sir..”Naa man diay ra na sir. Sige na sir pag kuan na.” dayun ana raman siya “ay unya ra ko, mag hinay hinay ragud ko”. Atu nga time TIC pa siya dayun karon HT-III na. dayun karon ng push na gyud na si sir harry. That time, nag hesitate pud si sir harry nga mu dawad sa pagka TIC una. Bali namong tulod tulod... maayu man pud kaayu pag exit ni sir cabs, kay kami iyang gipatawag “_unsang himoan tikag endorsement letter.” Ingon ko sir C ayaw jud, malooy ka..si sir H sir kay laki unya habal habal driver pud si sir harry, plus konsehal pud na siya sa una, politikanhon, maka penetrate sa LGU, mao tu. Nya unsa may potential nko ug mo sulod. Ug dili ko mo dawad ana day nga dili maka benefit ang tanan kay unsa may mabuhay nko..?</p> <p>Feeling nako murag ana pero maka kaya man ko. Adu nalang nako sa akong anak day.. dako kaayu ko’g panan-aw niya.<i>Answer Continuation</i>... padayun ug eskwela ayaw ⁶stop hantud mahimong doctor</p>	<p>¹STUDY WHILE THEY ARE STILL YOUNG.</p> <p>²CONTINUE TO STUDY UNTIL FINISH.</p> <p>³ DON’T WASTE ANY OPPORTUNITY. ⁴NO ONE REALLY WAS THERE TO MENTOR ME. CONTINUE TO STUDY THEN YOU WILL ENCOURAGE OTHERS LIKE ME TO STUDY AS WELL.</p> <p>⁵ PUSH OTHERS UP</p> <p>⁶DON’T STOP UNTIL YOU BECOME A DOCTOR.</p>	<p>¹STUDY</p> <p>²CONTINUE</p> <p>³OPPORTUNITY</p> <p>⁴MENTOR</p> <p>⁵HELP</p> <p>⁶DON’T STOP</p>

The teacher respondent wishes to impart to other teachers and “teachers to be” on the account of promotion by saying “*Study while still young; Continue until finish*... “as professional development is at par with career progression. The teacher respondent encourages other teachers to encourage other teachers as well in taking serious steps towards professional development as this will have a lasting effect on their careers in the future. Tantawy (2020) reiterated that teachers who were highly engaged in professional development initiatives were found to have observed a positive impact on their career progression, promotion chances, retention, and commitment.

Teachers’ development programs of the Department of Education are available to teachers support system, lifelong learning opportunities, awards and recognition, establishing linkages, and engaging them in challenging and fulfilling tasks. A teacher's capacity to manage their career routes is influenced by the availability of a faculty development program. The teachers' varied experiences with career management and faculty development are marked by their desire to pursue graduate studies, share knowledge, receive support from colleagues, and realizing their own potential. However, they encounter obstacles such as a lack of hope for advancement, pessimism, and unfair treatment at work due to certain authorities' selective preference for

advancement. An extra component for the faculty development program is prepared for the first round of testing and approval (Labrada, 2020).

Table 11: Outline of categories that support each code.

<p>Challenges to Career Progression or Promotion</p> <p>TIME</p> <p>MOTHERHOOD/PARENTHOOD</p> <p>TRANSPORTATION</p> <p>LACK OF INTEREST</p> <p>RUNNING IN CIRCLES</p> <p>NOT GIVEN TEACHING LOAD IN TLE (SPECIALIZATION)</p> <p>LOVE FILIPINO</p> <p>NOT SENT TO TLE TRAINING</p> <p>STILL DIDN'T TEACH TLE IN SHS</p> <p>NOT KNOWN AS TLE TEACHER.</p> <p>NO SCHOLARSHIP</p> <p>SELF HELP</p> <p>SPENT OWN MONEY</p> <p>SLEPT FOR YEARS</p> <p>NO PROMOTION</p> <p>VIOLENT PARENTS/PEOPLE</p> <p style="text-align: center;">Insights from the teacher's experiences in connection to career growth.</p>	<p>Impacts to teacher of not getting promoted</p> <p>I FEEL SAD.</p> <p>I AM DISCOURAGED. THERES' NO MORE GUIDELINES.</p> <p>I AM REGRETFUL. I SHOULD HAVE BEEN T-III FOR A LONG TIME NOW.</p> <p>I THINK I WILL GO BACK TO JUNIOR HIGH. I'LL FOCUS ON BUSINESS.</p>
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STUDY WHILE THEY ARE STILL YOUNG.

CONTINUE TO STUDY UNTIL FINISH.

DON'T WASTE ANY OPPORTUNITY. NO ONE REALLY WAS THERE TO MENTOR ME. CONTINUE TO STUDY ENCOURAGE OTHERS LIKE ME TO STUDY AS WELL.

PUSH OTHERS UP

DON'T STOP UNTIL YOU BECOME A DOCTOR

Table 12. Part 1 of Extracted Themes

EXTRACTED THEMES			
PRIORITY	DETERMINATION	COMPLACENCY	STAGNATION
<p>Codes:</p> <ul style="list-style-type: none"> • Pregnant with 1st child. • No more time sa pag-eskwela wala na kay naa naman anak. • Was a nursing mother. This time with (2nd child). • Out of my mind, I had my 3rd child then. • I slept, I took care of the (my) babies. • I prefer business/merchandizing or piggery. • I'll focus on business. • Especially now I have college, I need extra income. • Five times approached to be TIC(Teacher-in-charge) but declined. 	<p>Codes:</p> <ul style="list-style-type: none"> • Transportation was really difficult. • Risk when you're sent to seminars, district, etc. • Ganahan ko mo eskwela pero mabira rako ky wla sila pud ng eskwela • Violent indecent parents/people bring bolo to school. I was a victim. • Five times approached to be TIC but declined. 	<p>Codes:</p> <ul style="list-style-type: none"> • It's just professional growth, I won't become master teacher. • Already happy becoming a teacher. • I was not assigned to teach TLE subjects. I didn't ask because they don't want to teach Filipino. 	<p>Codes:</p> <ul style="list-style-type: none"> • Since I was hired, my subjects are all Filipino from first year-4th year high school. • I've never been sent to TLE training... • When I got to senior high, I still didn't teach TLE... • 'Til now no guidelines for promotion. • <i>Na zigzag akong dalan day.</i> (my path is zigzag)

SUPPORT SYSTEM	DISAPPOINTMENT & REGRETS	ENCOURAGING OTHERS TO PURSUE EDUCATIONAL GOALS	A RAY OF LIGHT
<p>Codes:</p> <ul style="list-style-type: none"> • I was not assigned to teach TLE subjects. I didn't ask because they don't want to teach Filipino. • They gave me Filipino because it was difficult for them. That's why I wasn't given TLE (specialization). • I've never been sent to TLE training... • When I got to senior high, I still didn't teach TLE... • I was really jealous of them I WAS NOT INCLUDED IN THE SCHOLARSHIP. • If I was told (TIC is road to P1), I might accept it. I really don't know that. They told me that if I become TIC, I will still have the same salary. Why bother? • No one really was there to mentor me. 	<p>Codes:</p> <ul style="list-style-type: none"> • Stressed when asked of rank: "T-II pa ka ron mam?" • Considering my age now it seems too late. • I feel ashamed, it seemed I slept, I took care of the (my) babies. • I feel sad. • I am discouraged. There's no more guidelines. • I am regretful. I should have been T-III for a long time now. • I think i will go back to junior high. • 'Til now no guidelines for promotion. • Nagmahay/REGRETFUL 	<p>Codes:</p> <ul style="list-style-type: none"> • Continue to study then you will encourage others like me to study as well. • Study while they are still young. • Continue to study until finish. • Don't waste any opportunity. • Push others up • Don't stop until you BECOME A DOCTOR. 	<p>Codes:</p> <ul style="list-style-type: none"> • EO 174 • Standardization Law • Folder is ready and intact.

Themes

The following are the extracted themes from the gathered raw data after the data analysis procedures.

Prioritizing parenthood over professional development

Rita's decision to prioritize parenthood over professional development was influenced by her valuing process to put her family first. The fulfillment of raising her children and being actively involved in their upbringing was heavier for her than some potential career sacrifices. Family responsibilities often win over professional development. This is particularly true for parents like Rita, who prioritizes the needs of their children over career advancement. Stone and Hernandez (2013) discuss the concept of "opting out," where individuals, often women, temporarily or permanently disregard plights for professional and career developments to focus on family care. This decision can be influenced by the desire to provide better care and support for children, but it can also result in slowed career progression and reduced long-term earning. This is what exactly happened to Rita in her statement *"I slept; I took care of the (my) babies."*

Determination

Determination is an attribute that significantly impacts personal and professional success. It involves setting clear goals, maintaining resilience, leveraging social support, and employing adaptive strategies to overcome obstacles. If Rita had developed enough determination as with confidence and perseverance earlier in her career, she might have enhanced her ability to achieve her goals of ascending in the professional ladder from Teacher I to Teacher-III and more. But Rita somehow missed to portray determination in her earlier stage of professional development due to circumstances like difficult transportation, risks, presence of violent people, lack of interest, and many more.

In the context of professional development, determination is crucial for career advancement and skill acquisition. Individuals who demonstrate determination are more likely to seek out opportunities for learning and growth, even in the face of challenges. Greenhaus and Powell (2006) note that work-family enrichment, where fulfilling roles in both work and family life, can positively influence determination by providing a sense of accomplishment and support from multiple areas of life. Determined individuals employ various strategies to overcome obstacles, such as problem-solving, seeking help, and maintaining a positive attitude. Honig (2006) emphasizes that complex challenges require adaptive strategies and a determined mindset to navigate effectively. By remaining flexible and open to new approaches, determined individuals can find innovative solutions to problems and continue progressing toward their goals.

Complacency

Complacency in career progression and professional development is a state where individuals become self-satisfied and fail to pursue further growth or advancement. This was evident when Rita said *“It’s just professional growth, I won’t become master teacher.”* And *“Already happy becoming a teacher.”*

Complacency in career progression often stems from a variety of factors. One significant cause is a sense of contentment with current achievements and positions. When individuals achieve certain milestones, they might feel a sense of fulfillment that discourages further efforts for advancement. According to London (1983), a lack of challenging goals can lead to a state of comfort where individuals no longer strive for improvement. This attitude can lead to stagnation and missed opportunities, negatively impacting both the individual and the organization they work for. Understanding the causes, consequences, and strategies to combat complacency is essential for fostering continuous improvement and career success.

Stagnation

One of the primary causes of career stagnation is the lack of opportunities for advancement within an organization. This can happen when promotional opportunities are limited. When employees perceive that there are no clear paths for progression, they may feel stuck in their current roles (Greenhaus & Powell, 2006). Exactly the reason why Rita said *“‘til now no guidelines for promotion.”* And *“Na zigzag akong dalan.”* (*My path is zigzag*).

Support system

It is immensely noteworthy to make sense of the following phrases *“If I was told (TIC is road to PI), I might accept it. I really don't know that. They told me that if I become TIC, I will still have the same salary. Why bother? “No one really was there to mentor me.”* These statements are just few of Rita’s declaration of having a weak or underdeveloped support system. The essence of “Synergy” or “Collaboration” are driving forces of an epic support system. The idea of having a system or pool of people who are imbued with notable and unique attributes to back you up, nurture you to be welcoming to opportunities would have been very substantial in for Rita’s earlier career growth. According Stone and Hernandez (2013), strong support system is crucial for career and professional development, providing emotional, informational, and instrumental assistance that can significantly impact an individual’s career trajectory. Such support can come from various sources, including family, friends, mentors, colleagues, and professional networks. Understanding the role of these support systems can help individuals ascend in careers more effectively and achieve professional goals. Providing a supportive environment that fosters continuous learning and growth is can be the key to overcome challenges, make informed career decisions, and achieve professional goals.

Disappointment and regret

“I feel sad, I am discouraged. There’re no more guidelines. I am regretful. I should have been T-III for a long time now.” These set of words are just few of how Rita expressed feelings of sadness, discouragement, and regret over past decisions or situations, coupled with a sense of wanting to change direction or refocus on new goals, such as going back to junior high or focusing on business. These means unfulfilled professional aspirations and challenges in career development. The phrases reflect frustrations and obstacles faced in pursuing a specialization in teaching TLE (Technology and Livelihood Education), including lack of support, recognition, training, and promotion, alongside personal sacrifices and a sense of stagnation.

Encouraging others

“Study while they are still young. Continue to study until finish. Don’t waste any opportunity.”

The words or phrases under this theme emphasize the value of studying, seizing opportunities, continuous learning, and encouraging others to pursue their educational goals persistently until achieving the highest levels of success.

A Ray of Light

On July 26, 2024 with the news on Expanded Career Progression for Teachers, Rita found a “Ray of light” that she will certainly be promoted soon. She decides to eventually wait for the new guidelines and no longer interested to transfer or return to Junior High but stay in Senior High. Executive Order No. 174 represents a significant policy initiative aimed at enhancing career progression and professional development in the Philippines. By promoting continuous learning, equal opportunities, and performance-based advancements, the order seeks to create a more dynamic and competitive workforce. Successful implementation of this order

can lead to increased job satisfaction, productivity, and organizational growth, benefiting both employees and the broader economy.

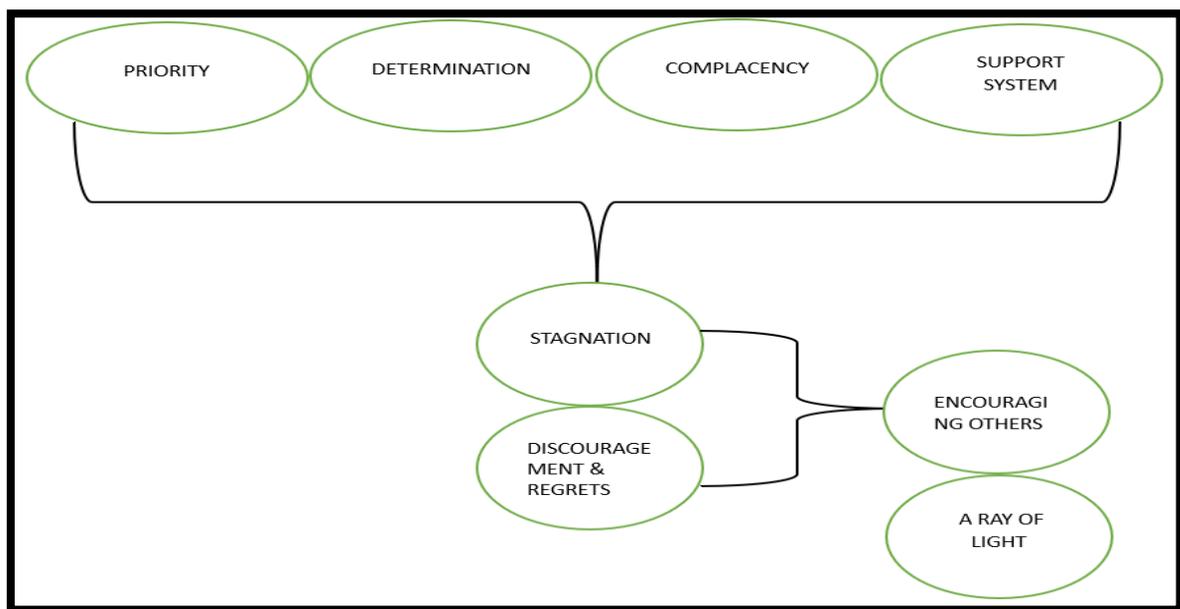


Figure no. 1 Illustration of Major Themes and Sub-themes

The major themes of the study are “Priorities, Determination, Complacency, and Support System.” Rita’s priorities, underdeveloped determination, complacency in her earlier plight for career progression and her weak support system paved the way to career stagnation and discouragements. In the end, Rita realizes the value lifelong learning and professional development, thus encourages other teachers to keep pursuing professional development to uphold positive future career progression. In order not to end up in the same story. “A Ray of Light” signifies Rita’s hope and brighter vision of the future after learning about “Executive Order no. 174” signed by President Ferdinand Marcos last July 26, 2024 which is the Expanded Career Progression System for Public School Teachers.” This is a sophisticated and promising system to promote the professional development and career advancement for public school teachers.

Timeline

Rita, the teacher respondent was asked to fill-in a timeline as a writing prompt of her experiences or life as a teacher aligning with the Department of Education’s guidelines for career progression. This enabled plotting her background, and outlining the experiences that led her present state or situation, having delayed promotion. This was followed by narrative that gave detail of the teacher respondent’s story of life experiences as a teacher in connection to her plights for career growth or promotion.

Rita’s timeline teaching experiences or life as a teacher aligning with DepEd guidelines of career progression. (This served as a writing prompt.)

Guidelines of Promotion	Main Events in Life as a Teacher <i>(State here what notable things or actions did you do that affected or contributed to your plight for career progression.)</i> Example: 2003-2004 Employed as T-1 in DepEd; Started Master’s Degree...
MEC Order no. 10, s. 1979 Implementing Rules and Regulations for the System of Career Progression for Public Schools Teachers. (Established the framework for the career progression of public-school teachers in the country. It outlined the requirements, procedures, and criteria for promotion from Teacher I to Master Teacher, the highest rank for public school teachers at the time). • Promotion	2003-2004 <ul style="list-style-type: none"> • Got employed as Teacher 1 • Took MAEM at NORSU Guihulngan City (Isem)
	2004-2005 <ul style="list-style-type: none"> • Got married

<p>Refers to advancement from one position to another with an increase in duties and responsibilities and usually accompanied by an increase in salary; Promotion may only be resorted if there is a vacant item due to retirement, promotion, transfer, etc.; There is a resulting vacancy of an item once a promotion occurred; Needs three (3) rating period from the last appointment.</p> <ul style="list-style-type: none"> • Reclassification <p>Refers to the change in the position title requiring the issuance of an appointment with a corresponding increase in rank and salary; Shall apply only to filled regular position in the national government (NBC 2005-5); There is no vacant item once the item is reclassified; Reclassification may only be allowed after three (3) consecutive years of at least VS or two (2) consecutive years of Outstanding Performance from the effectivity of the latest appointment</p> <p>Teacher II / Teacher III BSEE/BSE or Bachelor's Degree w/ 18 Professional Educ. Units</p> <ul style="list-style-type: none"> • Reclassification <p>Teacher II BSEE/BSE or Bachelor's Degree w/ 18 Professional Educ. Units + 20 MA units</p> <p>Teacher III/HT BSEE/BSE + MA Equivalent</p> <ul style="list-style-type: none"> • Master Teacher 	<ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study • Difficult Transportation from house to school • Late to enroll
	<p>2005-2006</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study <p><i>"Wala na ko ngpa enrol kay feeling nko mo enrol ko, I am encouraging katung mga una nko nga mga maestra... mam mang eskwela ta, mang eskwela ta..Ikaw ra day kay bata pa ka. Nya wala man gyud silay eskwela eskwela jud. oo dayun nag eskwela ko, dayun pagka human mura man ug walay klaro akong pag-eskwela, ngano man ni, nga dili man pud sila ganahan nga gauna na sila nako..."</i></p>
	<p>2006-2007</p> <ul style="list-style-type: none"> • Had 1st baby • Did not enroll MAEM; stopped schooling/further study <p><i>"Kay walay ni ingon..wala pud ko kabalo unsay value anang mo eskwela, asa padulong.. ana ba wala ra gyud day. Ambot na lamang. Sala lagi nko kay dili man ko mangutana pud. Murag maka ingon kong sala nko day di ko mag sukut sukut..."</i></p>
	<p>2007-2008</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2008-2009</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2009-2010</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study • Had 2nd baby • Applied for Teacher-II with 9 units MAEM • Did not get promoted; behind in rank
	<p>2010-2011</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2011-2012</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2012-2013</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2013-2014</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2014-2015</p> <ul style="list-style-type: none"> • Did not get scholarship for TLE teachers from DepEd • Enrolled for NC II Dressmaking at Guihulngan City
	<p>2015-2016</p> <ul style="list-style-type: none"> • Did not enroll MAEM; stopped schooling/further study
	<p>2016-2017</p> <ul style="list-style-type: none"> • Attempted to enroll MAEM at NORSU BAIS only to find out that the 9 units from NORSU Guihulngan had been obsolete and dissolved.

	<ul style="list-style-type: none"> Started/enrolled MAVE at Norsu Bais instead.
<p>2017-2018</p> <p>No guidelines for Promotion for SHS</p>	<p>2017-2018</p> <ul style="list-style-type: none"> Applied for SHS; accepted as Teacher II Continue MAVE at NORSU Bais Submitted folder for T-III but lacks years of experience (no guidelines)
	<p>2018-2019</p> <ul style="list-style-type: none"> Continue MAVE at NORSU Bais
	<p>2019-2020</p> <ul style="list-style-type: none"> Achieved Complete Academic Requirements (CAR) for MAVE at NORSU Bais Not given scholarship for TMC-I (not in the list of TLE teachers) for the longtime teaching Filipino not TLE or Technical Vocational Subjects. Decided to spend from own pocket for TMC I in Dress Making. Enrolled at RAMS ART; Decided to spend from own pocket for TMC I in Dress Making
	<p>2020-2021</p> <ul style="list-style-type: none"> No Assessment for TMC-1 Dressmaking due to pandemic
	<p>2021-2022</p> <ul style="list-style-type: none"> No Assessment for TMC-1 Dressmaking
<p>DM No. 235 s. 2022 Acceptance of Application for Reclassification Through Equivalent Record Form (ERF) of Senior High School for SY ,2022</p> <p>Technical Vocational Livelihood (TVL) Track</p> <p>Teacher II</p> <ul style="list-style-type: none"> 3 years in service+ NCII+ TMC I+ (appropriate to the specialization) + Bachelor's degree + 20 MA units <p>Teacher III</p> <ul style="list-style-type: none"> 3 years I service+ NCII+ TMC I (appropriate to the specialization) + MA Graduate or Bachelor's degree+CAR) 	<p>2022-2023</p> <ul style="list-style-type: none"> Attempted to apply for promotion but do not have TMC-I yet since Assessment was delayed.
<p>February 2023</p> <p>No guidelines for Promotion for SHS</p>	<p>February 2023</p> <ul style="list-style-type: none"> Earned TMC-I in Dressmaking Submitted folder for Teacher-III but there were no guidelines for promotion.
<p>July 2024</p> <ul style="list-style-type: none"> Division Memorandum No. 0467 Submission of Rank List for Teacher II, Teacher III and Transferees for Elementary and Secondary Level for the SY 2024-2025 in the Division of Negros Oriental Division Memorandum No. 0468 Acceptance of Applications for Master Teacher Positions for the SY 2024-2025 in the Division of Negros Oriental Based on MEC Order NO. 10, s. 1979 "Establishing the Expanded Career Progression System for Public School Teachers." <p>President Ferdinand R. Marcos Jr. on Friday (7/26/24) signed the IRR of EO No. 174 S. 2022 or the "Establishing the Expanded Career Progression System for Public School Teachers."</p>	<p>July 2024</p> <ul style="list-style-type: none"> Attempts to apply for transfer from SHS to JHS Or Apply for Teacher-III in JHS. Turn between the idea whether to stay in Senior High ang wait for new guidelines of promotion or reclassification; or transfer and go back to Junior High in order to apply for T-III after 6 months. Certain about focusing on Business. Rita said (holding the notes of the timeline) "Ikaw, ug wla ka ani nag tulog-tulog ug wala ka nag tinapulan aning dapita. Tagam." (Addressing to herself.)

<p>EO 174 was issued to establish the Expanded Career Progression (ECP) system to promote the professional development and career advancement of public-school teachers.</p> <p>This system will offer two distinct career paths for teachers to pursue: the Classroom Teaching (CT) Career Line or the School Administration (SA) Career Line, without prejudice to a teacher's choice in switching career lines during their professional career.</p> <p>Under the CT track, teachers can advance through multiple stages: Teacher I to Teacher VII, and then Master Teacher I to Master Teacher V.</p> <p>For the SA track, teachers holding Master Teacher I positions can advance from School Principal I to School Principal V. This track will help teachers transition into leadership and management roles.</p> <p>"The expanded career progression ensures that teacher progression to higher position is developmental, merit-based, and in accordance with standards <i>"hindi po credential based na existing system sa ngayon in terms of position. We, the Department of Education, envisions that with this new career progression system, walang teacher na magre-retire na Teacher 1 (no teacher will retire as Teacher 1),"</i> Cabral said. —KBK, GMA Integrated News</p>	<p>Note:</p> <p>From 2003-2017 the teacher was offered or approached to be TIC (Teacher-in-charge) of the school for 5 separate times but declined all these due to: MOTHERHOOD/PARENTHOOD, VIOLENT PEOPLE, UNAWARE OF THE BENEFITS, SAME SALARY, DIFFICULT TRANSPORTATION, & RISK.</p> <ul style="list-style-type: none"> • With the news on Expanded Career Progression for Teachers, the teacher respondent, Rita found a "Ray of light" that she will certainly be promoted soon. She decides to eventually wait for the new guidelines and no longer interested to transfer or return to Junior High but stay in Senior High. • <i>"Dia ra. Oo. Ready na akong folder sa promotion. (shows her last green folder received from division.)"</i> She exclaimed.
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Rita (a pseudonym) is known to be a very passionate teacher. She's always delivering meaningful lessons to the students embodying loyalty, caring attitude and camaraderie. She's also known as a nurturing and hands-on coach who selflessly extends her own resources to students and others whenever necessary. No wonder she was awarded by the Local Government Unit for being one of the "Outstanding Employees" in the entire Jimalalud District 2 of the Division of Negros Oriental. She had been in service for 21 years, with 14 years as T-1 in Junior High and now on her 7th year in Senior High School but still stuck as Teacher-II. Rita clearly has very notable attributes and characteristics yet somehow failed to ascend continuously in the professional ladder of development. Below is the story of Rita's plight for career progression based on the completed timeline and the data gathered from the interview.

Rita's Plight for Career Progression Commencing the Journey

I got connected with the Department of Education as Teacher-I on December 26, 2002, as printed in my appointment. I was really happy back then because the years before that were tough, as I experienced working as a nanny and a housemaid. I also had several jobs as a saleswoman in three different stores. That time I earned PHP 1500-2,000 in a month, and I was okay with it. That's why, when I got hold of my appointment, I was really grateful. Finally, "Maestra na jud ko." I was in my 20s, full of energy, excitement, and enthusiasm to teach. I was really inspired and motivated to dream of being more than just Teacher I or Teacher III. That dream was so powerful and strong that I got myself enrolled in 2003 at Negros Oriental State University (NORSU) Guihulngan for a Master of Arts in Educational Management, despite the rough road, distance, and limited resources.

A Square Peg in a Round Hole

It was in January of 2003 that I first reported on my station. I accepted whatever subjects my co-teacher would give up since they had the privilege to choose what subject to teach since they were way ahead of me. We were called to serve in the first place, and being flexible or versatile is necessary in the actual field of teaching. I never thought this would have a lasting effect on my career, though.

Since the school year 2003–2004, I taught all Filipino subjects from the first year to fourth year. This was not easy for me because Filipino is not my specialization. I finished my Bachelor of Secondary Education with a major in Home Economics. I remembered burning the midnight candle to study the four Filipino I-IV (4) subjects for the next day. I would sleep from 12 to 1 AM already, but I endured because I wanted to effectively teach the lessons to the students, so I learned the subjects by heart every night. As days turned into months and months into years, I became very fond of Filipino subjects. I seemed to master the topics and the competencies over the years. I started coaching students in competitions like Tula, Balagtas, Panitikan, etc. I experienced being a winning coach several times too. I was sent to more trainings in Filipino and served as a cluster judge for Filipino competitions as well, and I was happy. Little did I know, I was slowly drifting away from my specialization, which is a Bachelor of Secondary Education Major in Home Economics. I was known to be more like a Filipino teacher than a TLE, or Technical Vocational Education teacher.

Got Asleep for a Long Time

It was 2004 when I got married. From then on, I became a homemaker. I make sure that I keep all things in order and that all concerns are well attended to. When I had my first baby in 2005, I was determined to be a hands-on mother since my husband could hardly go home because he was a local marine engineer. I decided not to continue my plight for further study or education to focus on taking care of my baby. My co-teachers were not interested in pursuing a master's degree either. All the while, I became so engrossed with Filipino subjects that I was breathing them in, loving them, and living like a real Filipino teacher. I didn't remember complaining or asking about teaching my own specialization (BSED-Home Economics). I was okay with it. How could I get so careless about it?

Then came my second baby in 2009. I became even more determined to better provide for my babies by having a piggery with my husband, who decided to finally leave work and stay at home with our family. I applied for Teacher II using my 9 units of professional education, but I was left behind in rank. I did not get promoted. This made me really sad and downhearted.

Waking Up from the long Sleep

I never pursued continuing professional education, not until 2017, after I gave birth to my third baby. The same year, I qualified and got accepted to Teacher II as a Technical Vocational Senior High Teacher. It seemed I was asleep for a long time (2003–2016); that's 13 years to be exact. Since my first nine units of professional education (MAEM) were found obsolete and dissolved, I pursued a Master of Arts in Vocational Education instead and finally achieved Complete Academic Requirements (CAR) in 2020 at Negros Oriental State University, Bais City. I thought I was really blessed and privileged at first after 14 years in service. Yet in the long run, I regret being in the senior high school because there's been no promotion guidelines for a long time. I should have qualified for Teacher III if I stayed in junior high, or maybe I would have been a school head now if I had not rejected the opportunity of becoming a Teacher-in-Charge (TIC) years ago. I was asked five (5) separate times, but I also declined five (5) separate times.

Scholarships for Technical and Vocational teachers flourished from the Department of Education. An opportunity to earn TMC-I and a chance to get an edge for promotion in the near future. But I was not on the list for the second time (1st time was a scholarship for NC-2) because I was not known or recognized as a TLE, or technical vocational teacher. Although I was hired as one, I still don't teach TLE or Technical Vocational subjects in senior high, and I am not sent to related trainings either. In this connection, I decided to spend from my own pocket for TMC-I in Dress Making and enroll at RAMS ART, Bais City, to keep going. The after-effect of developing love for Filipino subject was that I grew up apart and away from my true specialization, which is technical vocational education. I admit that I would need to take refresher subjects or courses so that I could effectively teach dressmaking to students if I were to teach.

Got Immobilized

From 2020 to 2022, there was no assessment for TMC-I dressmaking. Then DM No. 235 s. The acceptance of the application for reclassification through the Equivalent Record Form (ERF) of the senior high school for SY 2022 flourished. Just when I was so powered up to climb up the career ladder, things didn't seem to cooperate. My co-teachers in senior high already got promoted to Teacher-III just a few months before I finally earned my TMC-I in dressmaking or after the assessment. As of July 2024, I am still waiting for new guidelines for promotion or reclassification. My folder is intact and ready to be submitted and endorsed. But there's a part of me that somehow tells me to go back or transfer to junior high so that I can get promoted to teacher III after 6 months. I am still torn between the idea of waiting for guidelines or going back to junior high. Nonetheless, I no longer think of finishing my master's degree (MAVE). I think I can get more productive by focusing on business instead.

A Ray of Light

On July 26, 2024, Executive Order No. 174, entitled Expanded Career Progression System for Public School Teachers, was signed by President Ferdinand R. Marcos Jr. It was a very promising initiative for both the professional and career development of teachers. This system offers two distinct career paths for teachers to pursue: the Classroom Teaching (CT) Career Line or the School Administration (SA) Career Line, without prejudice to a teacher's choice in switching career lines during their professional career.

Under the CT track, teachers can advance through multiple stages: Teacher I to Teacher VII, and then Master Teacher I to Master Teacher V. For the SA track, teachers holding Master Teacher I positions can advance from School Principal I to School Principal V. This track will help teachers transition into leadership and management roles. Surely, I will have my spot in the coming days here. What a good motivation for other

teachers to seriously pursue professional education and lifelong learning! As to my career progression journey, it was not really an easy straight path. It's more like a "Zigzag path" due to my previous decisions, collective circumstances, etc. Nonetheless, I'd like to impart to other teachers and teachers to be my significant realizations regarding career progression: (a) Study while still young; (b) Continue to study until you finish; (c) Don't waste any given opportunity along the way; (d) No one was really there to mentor me. Continue to study and encourage others to study as well. After all, we teachers are the epitome of lifelong learning.

Discussion of Epiphanies

Rita's "Plight for Career Progression" have several epiphanies marking significant realizations and turning points in her career journey these are the following:

Gratitude and aspiration: Rita realizes the immense gratitude and pride in becoming a teacher after years of working various low-paying jobs. This realization fuels her enthusiasm and determination to pursue further education and career advancement. But this feeling was just short-lived. It was changed later on when Rita got married and had her first baby.

Unexpected Love for Filipino Subjects: Despite not specializing in Filipino, Rita becomes passionate and proficient in teaching it, leading to various successes. This shift from her original specialization causes a deviation in career trajectory, which has long-term consequences. Rita's situation highlighted the importance of flexibility and adaptability in the teaching profession (Smith & Ingersoll, 2004). However, it also led to risk of misalignment between skills and job roles, which in her case caused limitations of advancement opportunities in her original field of specialization (Kane & Orsini, 2005).

Sacrificing Career for Family: Rita decides to prioritize family over continuing education and career progression when the first child is born. This decision results in a significant pause in Rita's professional development and educational pursuits. The struggle to balance work and family life is a common issue, particularly for women (Hochschild & Machung, 2012). This pause can lead to long-term career stagnation and challenges in regaining professional momentum (Stone & Hernandez, 2013). However, prioritizing family can also lead to greater personal fulfillment and well-being (Greenhaus & Powell, 2006).

Regret Over Missed Opportunities: Rita reflects on her past decision declining opportunities to become a Teacher-in-Charge and the impact of not pursuing professional education sooner. These reflections lead to a sense of regret and a recognition of the missed potential for career advancement. Reflecting on missed opportunities can serve as a powerful motivator for future action (Zeelenberg & Pieters, 2007). This awareness can encourage proactive career planning and continuous professional development (Locke & Latham, 2002). It also highlights the importance of mentorship in guiding career decisions (Ragins & Kram, 2007).

Reawakening Professional Goals: After a long pause or break Rita decides to resume professional education and career advancement efforts. This marks a renewed commitment to personal and professional growth, leading to the pursuit of a Master of Arts in Vocational Education and achieving Complete Academic Requirements. Reawakening of professional goals illustrates the concept of career resilience and the potential for growth at any stage of life (London, 1983). Lifelong learning and continuous education are crucial for adapting to changing job markets and advancing in one's career (Field, 2006).

Realization of Career Stagnation: Despite achieving new qualifications, Rita faces career stagnation due to the lack of promotion guidelines in senior high school. This realization prompts contemplation about transferring back to junior high for better promotion possibilities. This highlights the need for clear and transparent career progression policies within educational institutions (Ingersoll, 2001). It may also prompt individuals to seek alternative pathways for advancement, such as lateral moves or additional certifications (DeLong & Vijayaraghavan, 2003).

Hope and Motivation from New Policy: The signing of Executive Order No. 174 brings hope and motivation for career progression through the new Expanded Career Progression System for Public School Teachers provides a renewed sense of optimism and motivation for the author to continue pursuing professional development and career advancement. Systemic changes, such as new policies, can significantly impact individual career trajectories by providing clearer paths for advancement (Honig, 2006). Supportive policies are essential for motivating and retaining skilled educators (Darling-Hammond, 2000).

Lessons and Realizations: Rita realizes the importance of continuous education, seizing opportunities, and mentoring others in their career journey. These insights shape her perspective on career progression and lifelong learning, which she wishes to impart to fellow teachers. Emphasizing continuous education and seizing opportunities are key strategies for career success (Noe, 2010). Mentorship is crucial for fostering professional growth and creating a supportive work environment (Allen, Eby, Poteet, Lentz & Lima, 2004). Promoting a culture of lifelong learning and mutual support can enhance the overall quality of education and professional satisfaction (Knight, 2002).

Implications

The epiphanies collectively highlight Rita's journey of self-discovery, professional growth, and the challenges faced along the path of career progression. Additionally, these epiphanies emphasize the importance of adaptability, lifelong learning, and seizing opportunities in career progression. These highlight the challenges and rewards of balancing personal and professional life, the impact of systemic policies on individual careers, and the value of mentorship and continuous self-improvement. Rita's story serves as both a cautionary tale and an inspirational guide for educators navigating their career paths. Mentoring programs, training opportunities and amplification of

Conclusion

The aim of the study was to capture the story of a high school teacher on the account of career progression. Specifically, this study uncovers the challenges related to promotion; give support for career advancement; and to illuminate insights or life lessons for other teachers or teachers to be on the account of promotion or career progression. This research specifically seeks to answer the following questions: (1) What challenges did the teacher encounter in connection to career growth/promotion during Junior and Senior high school? (2) What are the impacts to teacher's morale (sense of common purpose; the mental, emotional condition or enthusiasm and confidence) of not getting promoted? (3) What insights can be deduced from the teacher's story in connection to career growth? (4) What recommendations can be extended to the teacher to finally uphold the long-delayed promotion or career progression?

This study has shown that Rita Chen, the particular research respondent encountered the following challenges in connection to career growth or promotion in junior and senior high school: (a)Not enough Time; (b) Motherhood/parenthood; (c) Transportation; (d) Lack of interest; (e) Running in circles; (f)Not given teaching load in TLE (specialization); (g) Love Filipino subject; (h) Not sent to TLE training; (i) Still didn't teach TLE in SHS; (j)Not known as TLE teacher; (k)No scholarship; (l)Self-help/Spent own money; (m)Slept for years; (n)No promotion; and (o)Violent parents/people. All these challenges fall under the specific themes: (1) Priority, (2) Determination, (3) Complacency, and (4) Support System. Which further emanated the sub-themes (1) Discouragement / Regrets and (2) Encouraging Others.

These made several impacts to the teacher's morale (sense of common purpose; the mental, emotional condition or enthusiasm and confidence) of not getting promoted are the implied in the following statements: (a)*I feel sad*; (b)*I am discouraged*(c) *Theres' no more guidelines*(d)*I am regretful*. (e) *I should have been t-iii for a long time now*; (f)*I think I will go back to junior high*; (g) *I'll focus on business*.

The insights that can be deduced from the teacher's story in connection to career growth are captured in the following statements: (a)*Study while they are still young*. (b) *Continue to study until finish*, (c) *Don't waste any opportunity* (d) *No one really was there to mentor me* (e) *Continue to study encourage others like me to study as well* (f) *Push others up*; and (g) *Don't stop until you become a doctor*.

In general, the findings of the study suggest and underscore the benefits and challenges of striking a balance between personal and professional life, the influence of systemic policies on individual careers, the significance of mentorship and ongoing self-improvement, and the value of ability to adapt, lifelong learning, and seizing opportunities in career progression.

Additionally, the study contributes to the understanding of the importance of professional development in the context of career progression and the importance of flexibility and adaptability in the teaching profession (Smith & Ingersoll, 2004). It is necessary not to forget about our area of specialization. it's typically an edge to be versatile and flexible ready to teach other subjects but not to the point of forgetting and completely disregarding our own area of specialization. This might cause a lasting effect in our career progression in the future that could possibly hinder opportunities or privileges like scholarship grants, skill-based trainings, etc. just like what happened to Rita having misalignment between skills and job roles, caused limitations of advancement opportunities in her original field of specialization (Kane & Orsini, 2005).

A major limitation of this study is time constraints. Narrative research certainly needs comprehensive and extensive amount of information about the participant to have a clear understanding of the context of the individual's life. But due time constraints collection of extensive this research was a short-lived one. It lasted for about 7-8 weeks only. Much as it takes a keen eye to capture the individual's experiences. Uncovering "figure under the carpet" that explains the multilayered context of a life needs ample amount of time (Edel1984).

Active collaboration between the researcher and the participant was evident although very limited. There were (3) three off the record interviews including dry run and (1) one audio recorded and transcribed. Thus, the researcher tried to simultaneously discuss the respondent's stories while being reflective about personal and political background, which shapes the "restorying" the account.

The researcher does not have direct access to the realm of meaning of the respondent. Therefore, researcher is dependent on the storyteller's recollection or introspection. The analysis of narrative data makes use of hermeneutic or interpretative reasoning; thus, the analysis methods are not as precise as quantitative tools (Riessman, 2008).

Narrative inquiry relies heavily on the personal stories and subjective experiences of participants, which can introduce bias. The researcher's interpretations are also subjective, potentially leading to partiality. According to Connelly and Clandinin (1990) the stories told and the retelling of those stories are influenced by the personal biases of both the participant and the researcher, which can affect the credibility of the findings. Due to its focus on individual experiences, the findings of narrative inquiry are often not generalizable to larger populations. Riessman (2008) points out narrative research focuses on particularities and may not produce findings that are widely applicable or generalizable. Ensuring reliability and validity in narrative inquiry can be challenging because the data are not easily replicable, and different researchers may interpret the same narrative differently. Polkinghorne (2007) highlights the interpretive nature of narrative inquiry means that establishing reliability and validity is complex and often subjective. Ethical issues can arise in narrative inquiry, particularly concerning confidentiality and the potential impact on participants when sharing personal and potentially sensitive stories. Chase (2005) states that researchers must navigate ethical dilemmas related to confidentiality and the potential emotional impact on participants when their personal stories are shared.

Albert Bandura's Social Cognitive Theory (SCT) offers a powerful lens for understanding teachers' career progression, highlighting the dynamic interplay between personal beliefs, social interactions, and environmental factors. At its core, SCT shows that teachers grow not in isolation but through engaging with their environment and the people around them (Simply Psychology, 2024). This perspective emphasizes that development is not just a result of individual effort but a shared, interactive process that shapes how teachers learn, adapt, and advance in their careers. Thus, the following aspects are necessary and must be given attention:

- (1) Mentorship and Collaborative Learning.** Professional growth for teachers often stems from meaningful interactions with more experienced colleagues, participation in teaching communities, and attending workshops or conferences. This kind of learning, which Bandura would call observational learning, allows teachers to pick up new pedagogical strategies, classroom management skills, and methods to engage students effectively. Mentorship programs illustrate this concept perfectly, enabling teachers to both learn from role models and become role models themselves. Such programs create a cycle of learning and growth, where experienced teachers pass on their knowledge while also being inspired to reflect on their own practices, fostering a culture of continuous improvement.
- (2) Reflective Practice and Adaptability.** Teachers who engage in reflective practice—examining their teaching methods and learning from both successes and challenges—are better equipped to identify their strengths and areas for development. This self-assessment process leads to more targeted professional growth as teachers seek out training and resources that align with their career goals. Adaptability, a key quality supported by SCT, allows teachers to stay relevant in a constantly evolving field. It enables them to embrace new challenges, explore different teaching methodologies, and pursue leadership roles when opportunities arise. When teachers are flexible and open to change, they not only grow as educators but also pave the way for more substantial career progression.
- (3) The Role of Environment and Supportive Culture.** Teachers' career growth is significantly shaped by the environment in which they work. SCT teaches that behavior is influenced by personal beliefs, actions, and the surrounding social context. Schools that provide a supportive culture with strong leadership, opportunities for collaboration, and access to professional development resources create an environment where teachers can thrive. When teachers feel valued and supported by their schools, they are more motivated to take initiative, experiment with new ideas, and pursue advanced professional roles. This environment reinforces their belief in their own capabilities and propels them toward career advancement.
- (4) The Influence of Role Models and Peer Networks.** Teachers often look up to colleagues or educational leaders who inspire them and set a high standard for what is possible. These role models play a pivotal role in shaping teachers' career aspirations and influencing their paths. Observing how others handle challenges and succeed in various teaching and leadership roles helps teachers envision their own potential. This social learning creates a ripple effect, motivating teachers to seek out similar growth opportunities and model positive behaviors they've witnessed in others.
- (5) The Power of Feedback and Recognition.** Feedback, from the school heads or Master Teachers whether positive or constructive, plays a crucial role in a teacher's professional development. SCT posits that reinforcement shapes behavior, and in teaching, positive feedback from students, colleagues, and school

leaders strengthens effective practices and encourages teachers to continue refining their skills. Recognition in the form of awards, promotions, or public acknowledgment acts as a motivator, inspiring teachers to push forward and expand their capabilities. Constructive criticism, even if it's difficult to hear, becomes an opportunity for growth, enabling teachers to learn from challenges and improve their approach. Teachers who see challenges as stepping stones rather than obstacles are more likely to rise to leadership roles and make a lasting impact in their field.

(6) Building Professional Communities. Teachers often seek out professional learning communities, peer networks, and educational forums where they can share experiences and ideas. SCT supports this notion by demonstrating how social interaction fosters an environment of collaboration and shared learning. In these spaces, teachers can refine their practices, gain insights from different perspectives, and develop essential leadership skills. Such interactions introduce teachers to new educational trends, methodologies, and technologies, broadening their professional horizons and preparing them for more significant roles in their careers.

(7) The Importance of Self-Efficacy. Central to SCT is the idea of self-efficacy an individual's belief in their own capacity to achieve their goals. For teachers, strong self-efficacy leads to resilience in the face of challenges and a willingness to take on new teaching strategies or leadership roles. When teachers believe in their ability to learn and grow, they're more likely to engage in continuous professional development, pursue additional certifications, and seek opportunities to lead within their schools or districts. This belief doesn't just motivate teachers; it drives them to take proactive steps that align with their career aspirations.

By viewing teachers' career progression through the lens of Social Constructivist Theory, success is not just about individual skills but about a complex interplay of personal confidence, supportive relationships, feedback, and a nurturing environment. Teachers who actively engage with their colleagues, reflect on their practices, and build strong networks are better positioned to grow and advance in their careers. Schools and educational systems that support these interactions create fertile ground for teachers to thrive, fostering an atmosphere where educators feel empowered to reach new heights and take on roles that shape the future of education. Teachers who are supported through mentorship, constructive feedback, collaborative networks, and leadership will be more confident, adaptable, and motivated to pursue growth. Schools that prioritize these strategies foster an environment where teachers not only survive but thrive, continually shaping the future of education and creating a cycle of learning that benefits students, educators, and the broader educational community.

The findings further suggest several courses of action for creating a self-paced action plan for career progression. This self-paced action plan is anchored on John Wooden's Pyramid of Success (Wooden, 2019). John Wooden defines success as a peace of mind which is a direct result of self-satisfaction in knowing you did your best to become the best that you are capable of becoming. It emphasizes the importance of two cornerstones such as "Industriousness" and "Enthusiasm." In the context of education, teachers must constantly and consistently do their best from the start and maintain or even increase the same enthusiasm as years progress. In addition, it is recommended that the school heads or school leaders must: Develop Comprehensive Mentorship Program; Create a Supportive and Collaborative Environment; Help Teachers Leverage the Influence of Role Models; Implement Systems for Constructive Feedback and Recognition; Promote Professional Learning Communities; Empower Teachers to Build Their Self-Efficacy; and Foster Adaptability Through Innovative Practices.

Especially now that the IRR of EO No. 174 S. 2022 known as "Establishing the Expanded Career Progression System for Public School Teachers" has been signed and approved by President Ferdinand R. Marcos Jr. on the 26th of July. It was issued to establish the Expanded Career Progression (ECP) system to promote the professional development and career advancement of public-school teachers (GMA, 2024). This system is said to offer two distinct career paths for teachers to pursue: the Classroom Teaching (CT) Career Line or the School Administration (SA) Career Line, without prejudice to a teacher's choice in switching career lines during their professional career. Under the CT track, teachers can advance through multiple stages: Key Features and Innovations of the Expanded Career Progression System introduces several innovative features designed to address the longstanding issues in teacher career advancement: (1.) **Additional Teaching Positions** such as Teacher IV (SG 14), Teacher V (SG 15), Teacher VI (SG 16), Teacher VII (SG 17), and Master Teacher V (SG 22). These additions create a more granular and dynamic career ladder within the teaching track. (2.) **Dual Career Paths.**

The system establishes two distinct career lines such as Classroom Teaching and School Administration. This structure allows teachers to choose between remaining in the classroom or pursuing leadership roles in school management. The Classroom Teaching path includes positions from Teacher I to Master Teacher V.

The School Administration path includes positions such as School Principal I, II, III, and IV. (3.) **Equivalence of Positions.** The system establishes equivalence between positions in the Classroom Teaching and School Administration career lines for example, Master Teacher V is equivalent to School Principal IV, ensuring parity between the two tracks. This equivalence promotes respect for both career paths and allows for potential lateral movements. (4.) **Flexibility in Career Choices:** such as teachers who qualify for Master Teacher, I can choose to continue in classroom teaching or transition to school administration. This flexibility enables educators to align their career paths with their skills, interests, and aspirations. The system allows for potential movement between tracks at various points in a teacher's career. (5.) **Merit-Based Progression.** The new system emphasizes merit and competence in the promotion process, moving away from the previous reliance on available positions. This approach aims to reward high-performing teachers and encourage continuous professional development. (6.) **Streamlined Administrative Positions.** The School Administration career path features streamlined positions: School Principal I, II, III, and IV. This simplification aims to create a clearer pathway for those interested in educational leadership roles. (7.) **Enhanced Reclassification Processes.** (8.) The Department of Education, in collaboration with the Department of Budget and Management, will reinforce reclassification processes. This allows teachers to progress based on merit and competence rather than waiting for teaching positions to become available.

Thus, this research recommends that teachers must consistently value lifelong learning. It certainly has favorable effect in terms of career progression and professional development in the future (Rocero, 2023). In case the teachers lose interest and hope of ascending in the professional ladder of promotion, the school head must right away be available as mentor to provide motivation, guidance or assistance (Will, 2024). As happy and positive teachers have a domino effect on students' academic performances. In addition, the school head must see to it that every teacher must be given loads related to area of specialization (DO no. 005, s. 2024) to support alignment for future career growth. This will not only solidify the teacher's love for teaching in the area of specialization but also open more possibilities, opportunities and privileges to be recognized, trained and granted with scholarships based on the area of specialization. Furthermore, mentoring programs and training opportunities about career progression processes or steps and requirements must be given and discussed to teachers during In-service Trainings or Learning Action Cell sessions in order to provide comprehensive guide for every beginning, proficient, highly proficient and distinguish teachers. Updated policies and memorandum about promotion must be announced properly to give equal timely opportunities to all the teachers.

Most importantly, this research emphasizes the necessity of actualizing a career progression self-paced action plan (Longcob, 2022) aimed at giving hands-on guide or help for teachers' career progression. The self-paced action plan must be based on the professional career development ladder provided by the Philippine Professional Standards for Teachers (PPST) in order to clearly and smoothly enliven professional orientation, development and empowerment of each teacher. Below are the steps and the sample format and template of the self-paced action plan.

Steps for Self-Paced Action Plan for Career Progression

1. **Goal Setting.** As a proficient teacher identify your SMART goals. Ask yourself, "What do I want to achieve? How will I attain it?"
2. **Do constant self-reflection.** As a proficient teacher you should continue to check yourself and your actions if you still align with your goals and to what is expected of you. Be ready to flip or re-align and re-adjust to keep attuned.
3. **Keep Going for lifelong learning-** lifelong learning is proven to have numerous advantages in career advancement. Enrolling for short term courses, Masteral or Doctoral degree will not only give a boost in credentials but also build up skills, knowledge and competencies as educator. Make sure that you always align with your area of specialization or whatever goals you have for the future.
4. **Widen professional network-** seek for more connections. After owning a degree or finishing a course, its about time you go out and seek for part-time job as a college instructor, fresh graduates review lecturer, motivational speaker, etc.
5. **Synergy –** collaborate and work with co-teachers who share the same interest and goals with you. Each one is uniquely imbued with skills and inclinations so might as well make and build connections. Be welcoming of the idea that you might need help in some aspects and having a colleague would be nice.
6. **Mentorship & Footprints-** admit that you do not know everything. Ask for guidance and mentorship from school head, master teachers, etc. they have way more ideas and inputs than you can ever imagine that could help you in your plight for career progression.

7. Be Productive- start writing, polishing and publishing your crafts. Commence your contributions to the pool of knowledge. Share your best practices with others too.
8. Repeat entire process. Avoid stagnation and being complacent. Keep going and growing by doing what you love to do to be constantly productive.

Sample Self-Paced Action Plan for Career Progression						
Name of Teacher: _____		Current Position: _____				
Educational Attainment: _____		Area of Specialization: _____				
Activity	Description	Objectives	Time	Own Means	Needed Persons	Desired End
1. Goal Setting	<i>As a proficient teacher identify your SMART goals. Ask yourself, "What do I want to achieve? How will I attain it?"</i>	To get promoted from T-III to Master Teacher-I; or T-III to P1; or get a part-time job as a College/ Graduate school Instructor; get a spot as Review Lecturer for LPT aspirants, etc.	2-3 years or shorter	Finish doctorate degree. Keep learning. Keep abreast on memos, guidelines from DepEd NegOr.net & documents intact.	Self, colleagues and mentors	MT-1; or P1; or College part-time instructor; or Review Lecturer for LPT aspirants, etc.
2. Self-reflection	<i>As a proficient teacher you should continue to check yourself and your actions if you still align with your goals & to what is expected of you. Be ready to flip or re-align and re-adjust to keep attuned.</i>	To do constant reflection on knowledge, skills, goals and practices.	Quarterly	PRAY; Journal Writing; or Poem Writing; or; Taking a well-deserved 1-2 hrs. of lone quiet time; or gardening, etc.	Self, colleagues and mentors	Reflective, Transparent, Welcoming of change and corrections.
3. Keep going for Lifelong learning	<i>Go for further education as lifelong learning is proven to have numerous advantages in career advancement. Enrolling for short term courses, Master's or Doctorate degree will not only give a boost in credentials but also build up skills, knowledge & competencies as educator. Make sure that you always align with your area of specialization or whatever goals you have for the future. Lookout for seminar workshops and trainings related to your area of specialization. if you get lucky you might receive scholarship grants too.</i>	To enroll on the 1 st semester of S.Y. 2024-2025 at NORSU Graduate school for EDD-EM.	August, 2024	Permission to study; agree with family; seek some funds	Husband; family, colleagues and mentors	Finish 9 units this semester

<p>4. Widen professional network</p>	<p><i>Seek for more connections. After owning a degree or finishing a course, it's about time you go out and seek for more growth ex. part-time job as a college instructor, fresh graduates review lecturer, motivational speaker, writer, researcher etc.</i></p>	<p>To go out and build strong professional network.</p>	<p>Quarterly</p>	<p>Talk to friends/ People that align with your purpose and frequency; follow & join educational channels, groups and FB pages; get involved.</p>	<p>Self, colleagues and mentors; new acquaintances</p>	<p>Built wider & productive professional network.</p>
<p>5. Synergy</p>	<p><i>Collaborate and work with co-teachers who share the same interest and goals with you. Each one is uniquely imbued with skills and inclinations so might as well make and build connections. Be welcoming of the idea that you might need help in some aspects and having a colleague would be nice.</i></p>	<p>To collaborate with co-teachers in seeking means for career progression.</p>	<p>July 8, 2024; or second quarter of 2024</p>	<p>Reach-out to co-teachers who also want to ascend in the professional ladder.</p>	<p>Self, colleagues and mentors; new acquaintances</p>	<p>Easy collaboration with co-teachers</p>
<p>6. Mentorship & Footprints</p>	<p><i>Admit that you do not know everything. Ask for guidance and mentorship from school head, master teachers, etc. They have way more ideas and inputs than you can ever imagine that could help you in your plight for career progression. Lookout for best practices of MOL's, see what suits you.</i></p>	<p>To seek mentorship from more knowledgeable others (School head, MT's, Professors, etc.) for guidance, tips and inputs.</p>	<p>Quarterly or as needed.</p>	<p>Reach-out to more knowledgeable others (School head, MT's, Professors, etc.) for guidance, tips and inputs</p>	<p>Self, colleagues and mentors; new acquaintances</p>	<p>Thankful, Welcoming of change and corrections.</p>

<p>7. Be productive</p>	<p><i>Start writing, polishing and publishing your crafts. Commence your contributions to the pool of knowledge. Share your best practices with others too.</i></p>	<p>To write, polish and publish work as contribution to the pool of knowledge.</p>	<p>Once a year; or before the end of 2024.</p>	<p>Ask MOL for tips; Use AI for polishing grammar, choice of words, etc. Hunt legit publishing organizations; Allocate funds or sponsorship; or Build up FB page and YouTube Channel for publications,</p>	<p>Self, colleagues and mentors; new acquaintances</p>	<p>Published works with ISBN</p>
<p>8. Repeat entire Process</p>	<p><i>Avoid stagnation and being complacent. Keep going and growing by doing what you love to do to be constantly productive.</i></p>	<p>To iterate the steps in the self-paced action plan for career progression.</p>	<p>yearly</p>	<p>Post the self-paced action plan in a VISION BOARD</p>	<p>Self-check, consistency, persistence and hard-work</p>	<p>STAY ATTUNED</p>

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References

1. Baras, R. (2018). Contentment and Gratitude: How Green is Your Grass? | Family Matters. *Family Matters*. Retrieved from <https://www.ronitbaras.com/emotional-intelligence/personal-development/contentment-and-gratitude-how-green-is-your-grass/>
2. Bennett, D. & Hennekam, S. (2018). Self-authorship and creative industries workers' career decision-making. *Human Relations*, 71(11), 1454-1477.
3. Cahilog, D. T., Sarong, J. S., & Arcila, F. E. (2023). Exploring the motivations and challenges of teachers leaving DePed for overseas opportunities. *Randwick International of Education and Linguistics Science Journal*, 4(3), 516–534. <https://doi.org/10.47175/rielsj.v4i3.754>
4. Chase, S. E. (2005). Narrative Inquiry: Multiple Lenses, Approaches, Voices. In N. K. Denzin & Y. S.
5. Chin, M., Ching, S., et al. (2022). Perspectives on the Barriers to and Needs of Teachers' Professional Development in the Philippines during COVID-19. *Sustainability*, 14(1), 470. <https://doi.org/10.3390/su14010470>
6. Clandinin, D. J., & Connelly, F. M. (2000). Narrative Inquiry: Experience and Story in qualitative Research. Jossey-Bass.
7. Clandinin (Ed.), Handbook of Narrative Inquiry: Mapping a Methodology (pp. 537-566). Sage Publications.
8. Connelly, F. M., & Clandinin, D. J. (1990). Stories of Experience and Narrative Inquiry. *Educational Researcher*, 19(5), 2-14.
9. Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. Education Policy Analysis Archives, 8, 1.
10. Deci, E. & Ryan M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.
11. DeLong, T. J., & Vijayaraghavan, V. (2003). Let's hear it for B players. *Harvard Business Review*, 81(6), 96-102.
12. Field, J. (2006). Lifelong Learning and the New Educational Order. Trentham Books.
13. Gagné, M. & Deci, L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, 26(4), 331-362.
14. Guira, G., & Doctolero, A. (2023, December 29). *Experiences of Teachers who were never Promoted until Retirement*. Retrieved from <https://ajehd.unp.edu.ph/index.php/ajehd/article/view/72>
15. Harper, C. (2018, March 8). *Why every teacher should own a business*. Retrieved from <https://www.linkedin.com/pulse/why-every-teacher-should-own-business-carrie-harper/>
16. Hochschild, A. R., & Machung, A. (2012). *The Second Shift: Working Families and the Revolution at Home*. Penguin Books.
17. Honig, M. I. (2006). Complexity and policy implementation: Challenges and opportunities for the field. *New Directions in Education Policy Implementation*, 109-128.
18. Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal*, 38(3), 499-534.
19. Jansen, D. (2024, May 30). *Qualitative Data Coding 101: Everything you need to know*. Grad Coach. Retrieved from <https://gradcoach.com/qualitative-data-coding-101/>
20. Josselson, R. (2007). The Ethical Attitude in Narrative Research: Principles and Practicalities. In D. J.
21. Kane, T. J., & Orsini, M. M. (2005). The impact of after-school programs: Interpreting the results of four recent evaluations. Working Paper.
22. Kemp, R. (2021). *Why gratitude gives rise to contentment, empathy, and humility*. Retrieved from <https://www.linkedin.com/pulse/why-gratitude-gives-rise-contentment-empathy-humility-ryan-kemp>
23. Kilag, Bariquit, et al., (2023). Implication of Individual Plan for Professional Development (IPPD) on teachers' professional development and career advancement. *Basic and Applied Education Research Journal*, 4(1), 12–18. <https://doi.org/10.11594/baerj.04.01.02>
24. Knight, P. (2002). *Small-Scale Research: Pragmatic Inquiry in Social Science and the Caring Professions*. Sage Publications.
25. Llego, M. A. (2020). *Senior High School (SHS) ranking for promotion to Teacher II and Teacher III requirements*. TeacherPH. Retrieved from <https://www.teacherph.com/shs-ranking-for-promotion-to-teacher-ii-and-teacher-iii-requirements/>

26. Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist*, 57(9), 705-717.
27. London, M. (1983). Toward a theory of career motivation. *Academy of Management Review*, 8(4), 620-630.
28. Longcob, J. B., Salatandre, J. a. B., Tatang, B. K. G., Escubido, E. C. J., Taneo, J. D., & Cabello, C. A. (2022). Stuck Up in the Middle of Nowhere: The Lived Experiences of Teachers' Latency
29. Macapagal, C. B., & Ricafort, D. J. (2023). Teachers' aspirations toward career advancement. *American Research Journal of Humanities Social Sciences*, 6(5), 2378702. Retrieved from <https://www.arjhss.com>
30. Morales, M. J. Q., & Matriano, E. A. (2023). Practices, Challenges and Perceived Impact of Professional Development Activities among Senior High School Teachers in their Career Progression. *Zenodo (CERN European Organization for Nuclear Research)*, 2822–4353. <https://doi.org/10.5281/zenodo.7170505>
31. Noe, R. A. (2010). *Employee Training and Development*. McGraw-Hill Education.
32. Allen, T. D., Eby, L. T., Poteet, M. L., Lentz, E., & Lima, L. (2004). Career benefits associated with mentoring for protégés: A meta-analysis. *Journal of Applied Psychology*, 89(1), 127.
33. Polkinghorne, D. E. (2007). Validity Issues in Narrative Research. *Qualitative Inquiry*, 13(4), 471-486.
34. *Pyramid of Success - Coach John Wooden*. (2019). Coach John Wooden. <https://www.thewoodeneffect.com/pyramid-of-success/>
35. Ragsin, B. R., & Kram, K. E. (Eds.). (2007). *The Handbook of Mentoring at Work: Theory, Research, and Practice*. Sage Publications.
36. Riessman, C. K. (2008). *Narrative Methods for the Human Sciences*. Sage Publications.
37. Rocero, A. (2023, January 26). *PPST.pptx* [Slide show]. SlideShare. <https://www.slideshare.net/slideshow/ppstpptx/255537210>
38. Simbre, A., Aquino, J. M., & Palad, I. (2023). A Survey on the Role of Principals in Teacher Promotion in the Philippines. *Thai Journal of East Asian Studies*, 27(2), 21–45. Retrieved from <https://so02.tci-thaijo.org/index.php/easttu/article/view/260317>
39. Simply Psychology. (2024). *Albert Bandura's Social Cognitive Theory*. Retrieved from <https://www.simplypsychology.org/social-cognitive-theory.html>
40. Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal*, 41(3), 681-714.
41. Stone, P., & Hernandez, L. A. (2013). The rhetoric and reality of "opting out". *Contexts*, 12(1), 62-67.
42. Greenhaus, J. H., & Powell, G. N. (2006). When work and family are allies: A theory of work-family enrichment. *Academy of Management Review*, 31(1), 72-92.
43. Tantawy, N. (2020). Investigating teachers' perceptions of the influence of professional development on teachers' performance and career progression. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3582306>
44. *What positive impact do teachers have on students?* (2023). Quora. Retrieved from <https://www.quora.com/What-positive-impact-do-teachers-have-on-students>
45. Will, M. (2024). This is the surprising career stage when teachers are unhappiest. *Education Week*. Retrieved from <https://www.edweek.org/teaching-learning/this-is-the-surprising-career-stage-when-teachers-are-unhappiest/2024/04>
46. Yardley, E. (2024). *Braun and Clarke Thematic Analysis - How to do the six-step process in your qualitative research project — Degree Doctor®*. Degree Doctor®. Retrieved from <https://www.thedegreedoctor.com/blog/braun-and-clarke-thematic-analysis-how-to-do-the-six-step-process-in-your-qualitative-research-project>
47. Zeelenberg, M. & Pieters, R. (2007). A theory of regret regulation 1.0. *Journal of Consumer Psychology*, 17(1), 3-18



Critical research thinking: A recipe for academic writing success and publications

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Abstract: This short study explores the critical benefits and opportunities of applying research thinking in conducting a successful academic writing process and publication. Research thinking is critical because it enables an academic (scholar) or student to conceptualize, create, analyze, evaluate, and synthesize existing ideas in building effective academic writing and publications. This concise paper evaluates the role of critical thinking in enabling a scholar or student's ability to analyze existing information, build an argument, construct own opinion, provide academic support through citations, and contribute to broader academic knowledge. The study evaluated different factors like idea conceptualization, critical analysis, creativity, problem-solving, information synthesis, presentative and communication skills, and ethical considerations as a bedrock for building critical thinking in the academic research process. The researcher further highlights the necessity for scholars and students to develop critical research thinking as a base upon which their ability to idealize, initialize, analyze data, source and evaluate information, report findings, and communicate effectively. A research process and publication underscored by critical research thinking have the potential to contribute significantly to academic knowledge and inform decision-making through knowledge. Also, a research process through critical research thinking redefines the research process and findings through evidence-based critical data analysis and findings.

Keywords: Academic writing, Critical research thinking, Critical thinking skills, Critical thinking, Publications, Research thinking

Introduction

In today's world, knowledge is a key component for success, especially for scholars who create knowledge. This knowledge is built on critical thinking which can be seen as a key component of research thinking, which also drives academic study. Critical thinking as a key component promotes academic and non-academic success (Bezanilla, Galindo-Domínguez & Poblete, 2021; Tahira & Haider, 2019). Research thinking fosters the generation of new knowledge, the evaluation of prior data, the presentation of findings, and engagement in scholarly discussions. Research thinking involves critical factors such as critical thinking, evaluation and analysis, creativity, problem-solving, information synthesis, ethical considerations, and abilities to communicate which are explored in this area. This study aims to clarify the significance of developing critical thinking skills in academic research, writing, and publication. To achieve an informed research process from idealization, identification of gaps, analysis of existing literature, conducting a literature search, data analysis, discussion, and reporting, scholars and students are required to develop research thinking abilities (skills).

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Through research thinking, scholars and students can navigate academic writing, conduct meaningful research with findings that inform decisions, and contribute effectively. This introductory section of the paper presents research thinking's importance within the higher education community in promoting academic research writing processes and outcomes. This short paper emphasizes that research thinking is the best way to ease the academic scholarly process and journey in building a strong foundation for quality research process and publication.

Background of the study

Research thinking within the academic community is critical in discovering and strengthening the academic quality and its impact in real life. To advance academic and non-academic knowledge and make meaningful contributions in a given discipline towards solving problems, one should be able to think critically in accessing existing knowledge, identify research gap/s, evaluate literature, and report findings.

Research thinking assists in assessing meaningful academic writing outcomes in building an individual's ability to understand existing data and draw meaningful content. It also improves problem-solving skills to assist researchers in navigating challenging and complex research disciplines, areas, or topics. Also, research thinking is propelled by innovative creativity and thinking with the ability to motivate researchers to process an idea or topic through deep thinking and creatively to create novel ideas and methods. Furthermore, research thinking assists one with the ability to combine data across sources, develop ideas and concepts, and provide meaningful arguments in theory and practice.

Additionally, ethical considerations are regarded as a critical part of the research thinking process because they enable research writing processing by allowing researchers to follow standards in a literature review, research design, data gathering, discussions, and reporting. to handle the ethical ramifications of their research by following moral standards for literature review, research design, data collection, and reporting. Researchers must clearly and convincingly explain their findings in various formats, including written reports, presentations, and scholarly publications, also, effective communication skills are essential to research thinking. Scholars can improve their analytical skills, get a deeper comprehension of research topics, and make a significant contribution to the academic community by exploring the complexities of research thinking. The context for a thorough examination of research thinking and its revolutionary influence on academic writing and publication success is established by this study background.

Critical thinking

Critical thinking is categorized as a critical aspect of human endeavor that propels success. According to Wallmann and Hoover (2012), critical thinking is valuable across disciplines in propelling success. It enables one to be able to evaluate and analyze information in problem-solving. Critical thinking involves learning to think independently and formulating opinions supported by existing evidence, prompting an academic to become a self-reliant thinker and researcher. However, writing research papers is identified as a common method for developing critical thinking skills, involving various levels of reasoning that become progressively more abstract and complex (Lin, Lin & Zhu, 2018; Wallmann & Hoover, 2012; Kurfiss, 1988).

Nonetheless, critical thinking is a crucial skill that involves analyzing, evaluating, and synthesizing information to make informed decisions and solve complex problems. In the context of scientific research, developing critical thinking skills is essential for academics and students to excel in their research writing and publication careers. One key aspect of critical thinking is the ability to assess information critically. This involves questioning assumptions, evaluating evidence, and considering alternative perspectives. Wallmann and Hoover (2012) suggest that engaging students and academics in the scientific method, including formulating research questions, data collection, and statistical analysis, can enhance critical thinking and higher-level reasoning. Encouraging students and academics to participate in the manuscript submission process for publishing their research is seen as a way to promote critical thinking (DeNigris, Stanislaus & Sheets, 2020; McNair, Le Phuong, Cseri & Szekely, 2019; Wallmann & Hoover, 2012). According to Tahira and Haider (2019), critical thinking is an essential key to academic writing success. While Islamiyah and Fajri (2020) suggest that it is an outcome of that every graduate.

Research thinking

Academic research involves critical thinking skills in a systematic process toward producing scientific facts. As mentioned in this paper critical thinking is essential to academic writing success. Then, research thinking is a term that lies within the concept of “thinking” logically and constructively in discovering knowledge and solutions to address or add knowledge. According to Smith (2020), research thinking involves the application of critical thinking skills to the research process. Research thinking involves the ability of academic or student scholars to think critically in initiating research processes or ideas through objective thinking. The objective-thinking in the context of the paper deals with thinking that has a defined objective. According to this study, research thinking is a process of logically and systematically using critical thinking skills in thinking about research ideas and concepts with the ability to conceptualize ideas, analyze, evaluate, and summarise. The ability of the academic scholar to produce, identify, or discover a new idea or solution involves the ability to engage in a research thinking process.

Research thinking encompasses the ability to analyze, evaluate, and synthesize information gathered through research materials. By cultivating strong research thinking skills, researchers (lecturers and students) can conduct rigorous and impactful research, contribute to knowledge advancement in their field, and make informed decisions based on evidence and critical analysis. According to Smith (2020), research thinking involves some important aspects:

- a. **Formulation of question:** The starting point of research thinking is formulating clear, concise, and focused questions (research questions). These questions form the base upon which the research process is rolled out and assist in defining the research focus area or scope of the study.
- b. **Information gathering:** This aspect is all about identifying relevant materials, gathering information through interviews, surveys, or observations, evaluating them, and assessing their reliability.
- c. **Critical analysis:** Research thinking demands that researchers develop to carefully evaluate, assess, and analyze collected data, literature, and other relevant research findings. This aspect involves the ability to identify data patterns, incompatibilities, missing links, and knowledge gaps.
- d. **Problem-solving:** This aspect requires the researchers to develop problem-solving abilities involving critical and analytical skills in addressing different research challenges, interpreting results, and drawing impactful conclusions from the collected data.
- e. **Creativity and innovation:** Research thinking has to do with creative thinking towards generating original or new ideas, research methods, or methodologies. To achieve this aspect, researchers need to think within and outside the box in contributing novelly to their research field.
- f. **Synthesis of information:** Research thinking empowers researchers to synthesize relevant and available information across sources in building a coherent argument, viewpoint, theories, or research hypotheses. This aspect includes the combination of different research findings into a single unit like a model or framework.
- g. **Ethical considerations:** Research thinking involves the ability to develop sound ethical considerations in a given research process covering the literature review, research design, data gathering, interpretation, and reporting. Scholars (lecturers or students) are demanded to critically consider and evaluate the ethical issues and standard issues surrounding a given research focus area, or topic.
- h. **Communication skills:** Research thinking involves effective communication of research findings. Communication skills also involve clear research writing and presentation of findings and publications.

Critical research thinking (CRT)

Critical thinking abilities go beyond the ability to think normally. It involves the ability of lecturers and students to develop the skills to gear towards success in writing and publication. It is essential in the digital age for education and un-educational (professional) content learning and is used to improve some values and thinking (Facione, 2011; Lai, 2011; Murawski, 2014; Heard, Scoular, Duckworth & Ramalingam, 2020). These skills consist of the ability to collect, analyze, and access relevant and available information that propel effective decision-making processes. Then, critical research thinking (CRT) involves the ability of one to visualize, and conceptualize the research topic, develop the research objective, search for existing and relevant information (materials), assess them, and discover new insights in informing effective decision-making to solve real-life challenges. In research thinking, CRT is critical for starting and conducting research writing,

engaging with sources constructively, discovering new insights, and solving real-life challenges. For example, CRT assists researchers in figuring out potential research topics or ideas, effectively carrying out research, and publishing an article that solves real-world challenges.

The benefits of critical research thinking

It is not in doubt the benefits of CRT as a skill. Lecturers and students can benefit from CRT in providing a deeper understanding of the research process and conducting meaningful and impactful research writing. According to Tahira and Haider (2019) and Wolcott, Baril, Cunningham, Fordham and Pierre (2002), CRT enables scholars to understand and establish a research interest, gather data, analyze, critique existing views, develop an effective argument, and provide relevant findings. The benefits allow scholars, lecturers, students, and others to perfect their writing skills, deepen research topic and objective understanding, and improve data analysis. Additionally, CRT empowers scholars to critique existing views and scholarly standpoints, identify patterns in arguments, assess evidence, and draw informed conclusions. These skills are critical to functioning and succeeding academically and improve one's ability to transfer from theory to life practice and make one more participatory in social discourse (Tahira & Haider, 2019, Regier, 2011).

Moreover, the process of developing effective critical research thinking skills can increase self-confidence and independent learning and writing. Encouraging students and academics to argue and question, can help them gain a sense of control over their education, even academic writing and research, ultimately enhancing their understanding of their research interest (Darling-Hammond, Flook, Cook-Harvey, Barron & Osher, 2020; Tahira & Haider, 2019). Through critical research thinking, students and academics can effectively communicate their ideas, engage with complex concepts, and contribute meaningfully to the academic body of knowledge and discussions. Incorporating critical research thinking into the academic writing process can also help academic scholars adapt to the expectations of the academic community in contributing meaningfully. By familiarizing students and academics with critical research thinking, higher education institutions can provide them with the necessary tools and pieces of training to increase their skills to meet higher standards of academic research writing toward publications.

How to develop critical research thinking

Developing critical research thinking involves honing your ability to analyze, evaluate, and interpret information effectively. By practicing these strategies and approaches, a scholar including students can cultivate critical research thinking skills and become a more effective and discerning researcher. Here are some key steps to enhance your critical research-thinking skills (Iyer, 2019; Kurfiss, 1988):

- a. Ask thoughtful questions:** Start by asking relevant and probing questions about the research topic. This helps you focus your inquiry (question) and identify key areas for exploration or investigation.
- b. Evaluate information sources:** Critically assess the credibility, reliability, and relevance of the sources you use in your research. It involves the consideration of the author's research interest and expertise, the publication date, and the source's quality and standard.
- c. Analyze information and interpret data:** It involves the process of breaking down complex and challenging information into smaller parts to understand the underlying concepts, meaning, and argument behind it. It helps to source for patterns, links, relationships, connections, inconsistencies, and discrepancies in the data.
- d. Consider multiple perspectives:** Engaging diverse opinions, and viewpoints and considering alternative explanations and interpretations of the findings. Also, the step challenges personal opinions, and assumptions and allows the consideration of viewpoints from others and be able to conceptualize research topics. This helps one to create a more comprehensive understanding of the topic.
- e. Apply logic and reasoning:** This step consists of logical reasoning in evaluating views and arguments, identifying assumptions, and detecting fallacies in the research. This step also identifies logical false beliefs, unsupported assumptions (claims), and gaps in the reasoning process. It ensures that academic conclusions are drawn from empirical evidence and logical reasoning.
- f. Synthesize information:** Information is integrated across sources in creating and developing logical and well-supported views and arguments. The synthesized information is a combination of ideas, and the development of new insights, perspectives, and opinions.

- g. Reflect on your thinking:** This step involves inward analysis and reflection of personal thoughts, the research process, and concluding to make decisions. This step understands the impact of personal views, biases, assumptions, and prior knowledge on data analysis.
- h. Communicate clearly:** The step stresses the need for a clear and concise communication of one's thoughts and findings. Achieving the step involves the provision of correct and effective communication in sharing research findings and new insights with the right audience or identified group.
- i. Seek feedback:** The research findings and outcome must be shared with peer groups or individuals, mentors, or field experts for opinions and feedback. The feedback can be constructive in giving the opportunity for critical analysis, and reflection in modifying and enhancing the research quality.

Conclusion

This research paper is essential in today's changing and challenging world of information (digital age). This research discovered the very important impact and roles of CRT in carrying out academic writing processes and publications. The study established the place of conceptualization of ideas, critical analysis of literature, problem-solving, innovation and creativity, information synthesis, ethical considerations, and communication skills. These skills assist in developing critical thinking in the research process. Through critical research thinking skills, scholars and students can improve their ability to initialize research ideas, access relevant information, analyze data, and communicate their research findings. Research thinking can improve the ability to understand a given research topic, critique existing knowledge, and evaluate empirical studies. However, the integration of critical research thinking into the academic writing process can contribute meaningfully to publishing high-quality research to impact the academic community. It also enhances the scholars' research capabilities to empower the decision-making process on empirical evidence and reasoning. At this point, this study highlights the positive benefits and impact of critical research thinking in the process of pursuing quality scholarly research and academic excellence

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References

1. Bezanilla, M. J., Galindo-Domínguez, H., & Poblete, M. (2021). Importance of Teaching Critical Thinking in Higher Education and Existing Difficulties According to Teacher's Views. *REMIE-Multidisciplinary Journal of Educational Research*, 11(1).
2. DeNigris, D., Stanislaus, S., & Sheets, K. (2020). Why Your Students Should Publish in Undergraduate Journals: Benefits of Engaging Students in the Research Process. *Copyright and other legal notices*, 470.
3. Facione, P. A. (2011). Critical thinking: What it is and why it counts. *Insight assessment*, 1(1), 1-23.
4. Heard, J., Scoular, C., Duckworth, D., Ramalingam, D., & Teo, I. (2020). Critical thinking: Skill development framework.
5. Islamiyah, M., & Fajri, M. (2020). Investigating Indonesian Master's students' perception of critical thinking in Academic Writing in a British university. *The Qualitative Report*, 25(12), 4402-4422.
6. Iyer, L. (2019). Critical thinking and its importance in education. Retrieved from https://www.researchgate.net/publication/339433132_Critical_Thinking_and_its_Importance_in_Education
7. Kurfiss, J. G. (1988). *Critical Thinking: Theory, Research, Practice, and Possibilities*. ASHE-ERIC Higher Education Report No. 2, 1988. ASHE-ERIC Higher Education Reports, The George Washington University, One Dupont Circle, Suite 630, Dept. RC, Washington, DC 20036-1183.
8. Lai, E. R. (2011). Critical thinking: A literature review. *Pearson's Research Reports*, 6(1), 40-41.
9. Lin, Y., Lin, Y., & Zhu. (2018). *Developing critical thinking in EFL classes* (pp. 19-23). Singapore: Springer.
10. McNair, R., Le Phuong, H. A., Cseri, L., & Szekely, G. (2019). Peer review of manuscripts: A valuable yet neglected educational tool for early-career researchers. *Education Research Intern*

11. Murawski, L. M. (2014). Critical thinking in the classroom... and beyond. *Journal of learning in higher education*, 10(1), 25-30.
12. Regier, J. (2011). Why is academic success important. *Saskatchewan School Boards Association*.
13. Smith, M. (2020). Is critical thinking really critical? A research study of the intentional planning for the teaching of critical thinking in the middle grades.
14. Tahira, M., & Haider, G. (2019). The role of critical thinking in academic writing: An investigation of EFL students' perceptions and writing experiences. *International Online Journal of Primary Education*, 8(1), 1-30.
15. Tahira, M., & Haider, G. (2019). The role of critical thinking in academic writing: An investigation of efl students' perceptions and writing experiences. *International Online Journal of Primary Education*, 8(1), 1-30.
16. Wallmann, H. W., & Hoover, D. L. (2012). Research and critical thinking: An important link for exercise science students transitioning to physical therapy. *International journal of exercise science*, 5(2), 93.
17. Wolcott, S. K., Baril, C. P., Cunningham, B. M., Fordham, D. R., & Pierre, K. S. (2002). Critical thought on critical thinking research. *Journal of Accounting Education*, 20(2), 85-103.





**3rd International Conference on Emerging Technology and
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Theme 3:

Emerging Technologies in Agriculture (ETA)

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Effects of wet and dry milling on the viscoelastic properties of tofu (meat analogue) from soybean (*Glycine max*) and sesame (*Sesamum indicum*) blends coagulated with tamarind

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Abstract: A study investigated the impact of wet and dry milling on the viscoelastic properties of tofu produced from soybean and sesame blends coagulated with tamarind. The soybean-to-sesame ratios examined were 100:0, 82.5:17.5, 65:35, 47.5:52.5, 30:70, and 0:100. The physical properties of the processed flour were evaluated, and the wet and dry milled blends were subsequently converted into tofu using tamarind as a coagulant. Mechanical tests, including stress-strain and stress relaxation analyses, were conducted. The results showed that 100% soybean dry-milled tofu coagulated with tamarind (100:0) exhibited the highest initial weight (446.6 kg) and coagulation time (13 mins). Notably, the dry-milled soybean tofu demonstrated superior stress-strain yield (1.002 N/mm²) and relaxation time (240 s), indicating a harder chewability compared to wet-milled tofu. These findings suggest that dry milling produces tofu with enhanced textural properties, making it more suitable for applications requiring a firmer texture.

Keywords: Coagulants, Milling, Physicochemical properties, Stress relaxation, Stress strain, Tofu

Introduction

In Nigeria, the consumption of animal protein is an indication of social and economic class. This is because meat is one of the nutritious foods used for human consumption. The trend has changed from animal protein consumption to vegetable protein consumption due to the health challenges caused by high consumption of animal meat. Soybean protein's three-dimensional structure makes it suitable for textured protein products, such as tofu, a fermented soybean product used as a meat analogue. According to historical records, tofu originated in Northern China around 164 BC, attributed to Lord Liu An, a Han Dynasty prince (Sacks et al., 2006). Alternatively, its production method may have been discovered accidentally when boiled soybean slurry mixed with impure sea salt, containing calcium and magnesium salts, caused the mixture to curdle and form a tofu-like gel.

Tofu offers numerous health benefits, including reduced cancer risk, antioxidant properties, and increased availability of essential nutrients like folate, vitamin K, calcium, magnesium, iron, and fiber (Ezeama & Dobson, 2019). As a nutritious food, tofu typically contains 11-12.4% protein and various phytonutrients,

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such as flavonoids, isoflavonoids, phenolic acids, protein, and polypeptides Tofu also plays a role in preventing and treating obesity, type 2 diabetes, and chronic obstructive pulmonary diseases (Iwe, 2003). Sesame, an underutilized legume, boasts high oil (48-58% fat), protein (16.96%), and carbohydrate (26.04%) content, along with significant dietary fiber (16.9%) (Nzikou, 2009). Sesame seeds are exceptionally rich in iron, magnesium, manganese, copper, calcium, thiamine, and tocopherol (Bedigian, 2003). Lignans, particularly sesamin, exhibit antioxidant and anti-cancer properties, while phytosterols help reduce blood cholesterol levels (Obiajunwa et al., 2005). Although sesame seeds lack lysine, they are rich in sulfur amino acids like methionine and cystine, making them a suitable supplement to soybean-based diets. This will also help to diversify the use of under-utilized legumes such as sesame in tofu production.

Milling or size reduction is the unit operation in which the average size of solid pieces of food is reduced by the application of grinding, compression, or impact forces. It is one of the factors that affect the surface sulfhydryl content and surface hydrophobicity of soymilk protein. This in turn affected the rheological properties of soymilk as well as the texture of soycurd (Tofu) (Makoto et al., 2012). Cereals of various kinds are processed by soaking, fermentation, and milling (wet or dry) to detoxify the anti-nutritional factors, increase palatability, and improve bio-availability of nutrients (Otitoju, 2009). Likewise, tofu from soybean is generally produced using wet or dry milling methods. Wet grinding of soybean reduces the particle size and has a profound effect on the protein recovery in soymilk (Vishwanathan et al., 2011). This wet milling method is not only used for tofu products but also in other grains such as rice flour (Sukson & Naivikul, 2006), Ogi products (Otitoju, 2009), soymilk products (Vishwanathan et al., 2011). It is also believed that the soaking period leads to a reduction in nutritional inhibitors and toxic substances thus improving dietary protein digestibility (Iwe, 2003). However, wet milling results in a large amount of waste water and the leaching of nutrients during soaking (Chen et al., 2003). Nevertheless, studies have shown that dry milled flour retains components such as protein, lipid, and ash at higher levels than wet milled flour thus offering more nutritive products. However, dry milling causes more damage to the starch leading to higher solubility of nutrients (Jitranut & Jirarat, 2016, Preece et al., 2017).

Tamarind is a leguminous tree in the family of Fabaceae indigenous to Tropical Africa. The genus *Tamarindus* is a monotypic taxon having a single species (Locke & Remer, 1991). Tamarind's raw nutritional value per 100g according to the USDA Database entry is given as follows – Carbohydrate 62.5g, Dietary fibre 5.1g, fat 0.6g, protein 2.8g, Thiamine 0.428mg, Riboflavin 0.152mg, Niacin 1.938mg, Pantothenic acid 0.143mg, Vitamin E 0.1mg, Vitamin K 2.8mg, Calcium 74mg, Iron 2.8mg, Magnesium 92mg, Phosphorus 113mg, Potassium 6.28mg, Sodium 28mg.

Tamarind contains high potassium, sodium, and iron. Tofu coagulated with tamarind produced 0.85% of potassium, 2.99% in sodium, iron content also ranked 5.11%, and a high 6.05% in phosphorus indicating that tamarind coagulated tofu is very rich in mineral content that comes from the coagulant (Ezeama & Dobson, 2019). Therefore, this study investigates the effect of wet and dry milling on the proximate composition, and physical and viscoelastic properties of tofu from blends of soybean and sesame using tamarind as a coagulant.

Materials and methods

Source of materials

The soybean and coagulant (Tamarind) were obtained from Aba market, *Ahia Ohuru* in Abia State. The sesame seeds were purchased from Abakpa market in Ebonyi State, Nigeria.

Sample preparation and tofu production

The soybean sample was cleaned by separating stones and other unwanted materials from it. Thereafter, it was dehulled and milled to flour using an attrition mill. The milled soybean was then allowed to cool before storing in a dry container. The sesame sample was cleaned and milled to flour and also allowed to cool before storing it in an airtight container. The processed soybean and sesame flours were used for Tofu production by dry milling method (Ezeama & Dobson, 2019). Another soybean and sesame seed samples were cleaned for Tofu production by wet milling method (Iwe, 2003). The Tamarind seeds were made into a solution by squeezing out the pulp from the seed with clean water. The pulp was stored in an airtight container.

Tofu formulation from soybean and sesame blends

An optimal mixture experimental design for two variables was adopted in this study for tofu formulation. The variables are X_1 and X_2 ,

X_1 = Content of soybean (%)

X_2 =Content of sesame (%).

The total number of experiments were five (5) each for wet and dry milling method of tofu production. The minimum and maximum values for the component proportion for the soybean/sesame blend for tofu formulation was $30 \leq X_1 \leq 100$, $0 \leq X_2 \leq 70$.

The D Optimal mixture design for the two variables for the tofu formulation

RUN	SOYBEAN (%) X_1	SESAME (%) X_2
1	100	0
2	82.5	17.5
3	65	35
4	42.5	57.5
5	30	70

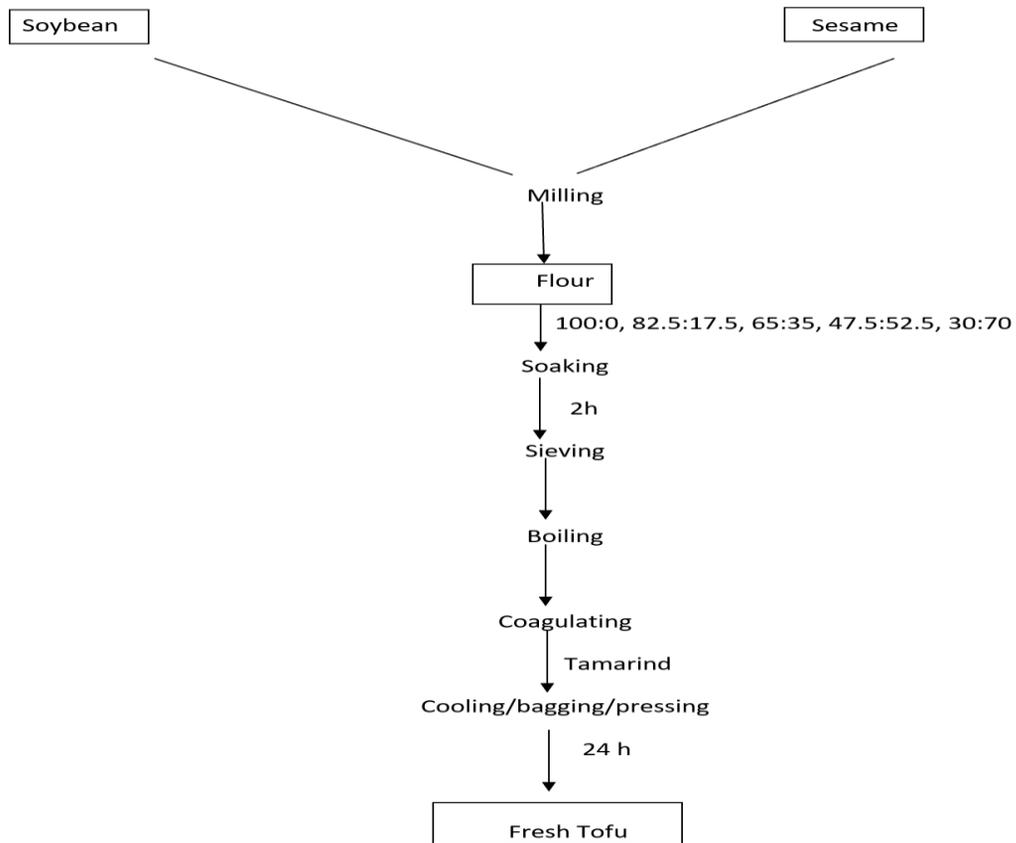
Tofu production

In wet milled method, 1 Kg of soybean/sesame seeds were weighed in the ratios of 100:0, 82.5:17.5, 65:35, 47.5:52.5 and 30:70. The weighed blend ratios of soybean/sesame seeds were soaked in 5000ml of sterilized water for 12 h in five sterile containers for each blend ratio, according to the method described (Sacks et al., 2006). Thereafter, the soaked soybean/sesame seeds were ground, sieved with a muslin cloth and milk collected. Three thousand millilitre (3000 ml) each of soy/sesame milk (100:0 82.5:17.5, 65:35, 47.5:52.5, 30:70) was boiled for 15 min at 80°C. On reaching the boiling point, tamarind solution (0.314 mol/dm³) was added and allowed to coagulate the soy/sesame milk. After coagulation, the coagulated milk was poured in a cloth bag to drain the water.

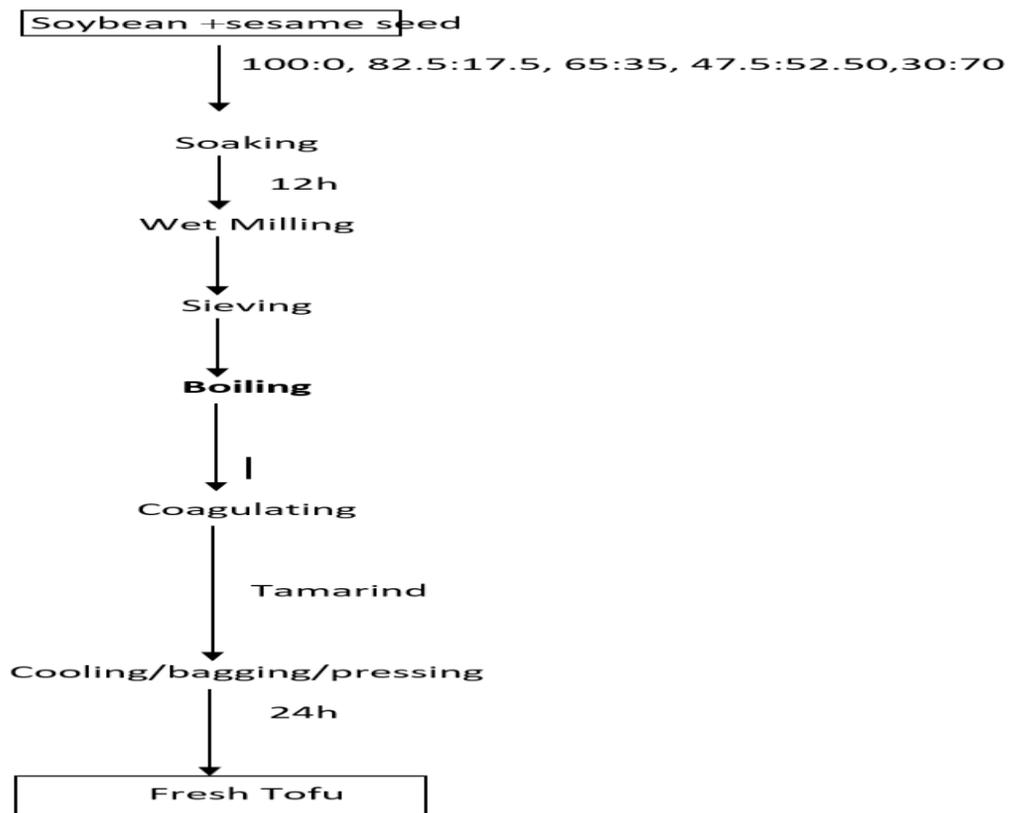
In dry milled method, 1 Kg of soybean/sesame seeds were weighed into blend ratios of 100:0. 82.5:17.5, 65:35, 47.5:52.5 and 30:70. The weighed blend ratios of soybean/sesame seed were ground to flour and the flour samples were soaked in five sterilized containers for 2 h. After soaking, the soybean/sesame flours were sieved with a muslin cloth and milk collected and coagulated with tamarind.

The Ph of the soymilk collected was tested before and after coagulation with a Digital PhMeter.

The coagulated milk from the various blends were bagged and weighed with an electronic weighing machine before and after pressing with a Press.



Flow chart of Tofu processing by using dry milling method from blends of soybean and sesame



Flow chart of Tofu processing by using wet milling method from blends of soybean and sesame

Stress relaxation test

The stress relaxation test of tofu was carried out using a Testometer Material Testing machine, 0500-10080 (Bourne, 2002). The tofu samples were cut in a rectangular shape of 20×10×8.00 mm, a preload of 0.500 N at a preload speed of 200 mm/min was set. A step compression test type was done at 240 mm/min. the compression was at 50 % of the original height. The force decaying time curves was recorded at intervals and the stress relaxation curve was plotted and the following parameters calculated.

$$\text{Rate of decay of applied stress} = \frac{d\sigma}{d}$$

dσ = change in stress

d= change in time

Stress strain test

The stress strain of the tofu was done with a Testometer material testing machine (Bourne, 2002). The tofu samples were cut to a regular dimension of 20 mm breath, 10.00 mm width and 8.00 mm height. The machine was set at a preload of 0.500 N at a speed test of 10.000 mm/min. The compression was at 50 % strain.

Determination of minerals

The mineral composition of the samples were determined by the method described by Onwuka (2005). The minerals determined were Calcium, Potassium, Sodium, Phosphorous, Magnesium and Iron using Atomic Absorption Spectrophotometer. One gram of the dried sample weighed out for each of the minerals to be determined. Then 20ml of the acid mixture (650ml Conc HNO₃, 80ml PCA, 20ml Conc H₂SO₄) was added in the digestion flask with the 1g weighed dried sample. The flask was heated until a clear digest was obtained. The dilute was digested with distilled water made up to the 500 ml mark. Appropriate dilutions were made for each element.

Proximate analysis

Proximate analyses of the fresh tofu made from the three coagulants were determined. The moisture content, crude protein, fat, crude fibre and carbohydrate were determined.

Moisture content determination

The moisture content of the fresh tofu was determined by the conventional method (AOAC, 1990). Moisture cans were dried in the oven and put in the desiccators to cool. The cans were weighed after cooling and 2g of the samples were put in each moisture can and placed in the oven and heated at 150⁰C for 3 hours. The samples were weighed after each hour until a constant weight was obtained and thereafter the cans were cooled in the desiccators before weighing. The difference was determined and expressed as a percentage of the original sample weight. The content of the fresh tofu sample was calculated as follows.

$$\% \text{ moisture} = \frac{\text{weight of sample before drying} - \text{weight after drying}}{\text{Original weight of sample}} \times 100$$

Original weight of sample

Ash content determination

In determining the ash content of the samples, the method recommended by AOAC (1990) was used. Porcelain crucibles were thoroughly dried by heating at 600⁰C and then cooled in the desiccators before weighing quickly to prevent moisture absorption. The crucible containing the sample were covered and placed into the muffle furnace whose temperature had already been set at 550⁰C. This temperature was maintained for about two hours until a whitish ash was obtained. After two hours, the muffle furnace was switched off and the crucibles containing the sample weighed and percentage ash content determined as outlined below.

$$\% \text{ ash} = \frac{(\text{weight of crucible} + \text{Ash}) - \text{weight of crucible}}{\text{Original weight of sample}} \times 100$$

Crude fibre determination

This is determined by the method described by James (1996). Two grams (2g) of sample was treated with 150ml of 1.25% H₂SO₄ solution for 30 minutes. It was washed with several portion of hot distilled water using a two-fold muslin cloth to retain the sample particles. When drained dried, the washed sample was carefully transferred back to the flask and 150ml of 1.25% NaOH solution was added to it. It was again boiled for 30 minutes, washed as before with hot water and allowed to drain dry. It was then very carefully transferred quantitatively to be weighed in a porcelain crucible. The sample in the crucible was dried for one hour, at 105°C in the oven, cooled in a desiccators and re-weighed. It was then finally burnt to ashes in a muffle furnace, cooled and weighed crude fibre content was calculated using the formula below.

$$\% \text{ crude fibre} = 100 \frac{(W_2 - W_3)}{W}$$

Where

W = weight of sample analyzed

W₂ = weight of crucible + sample after drying the oven

W₃ = weight of crucible + sample after ashing.

Fat determination

Fat content was determined by the continuous solvent extraction in soxhlet reflux apparatus (Pearson, 1976). Two grams (2g) of each sample was wrapped in a porous filter paper and placed in a soxhlet reflux filter. An oil extraction flask was weighed and filled with 200ml petroleum ether. The reflux flask was mounted on the extraction flask and connected to a condenser. The solvent was brought to boil on an electro thermal heater. The vaporized solvent (petroleum ether) was condensed into the reflux flask to completely submerged the wrapped sample and extract the fat therein. When the reflux flask is filled, it refluxed carrying the extracted oil back into the extraction flask while the boiling continued. The cycle of boiling, vaporization, condensation extraction and reflux was allowed to go on for four hours before the solvent was recovered leaving the extracted oil in the flask. The flask (with oil) was further dried in the oven at 60°C for 30 minutes to remove any remaining solvent. It was cooled in the desiccators and weighed. The fat content was calculated as:-

$$\% \text{ fat} = \frac{W_2 - W_1}{\text{Weight of sample}} \times 100$$

Where W₁ = weight of empty extraction flask

W₂ = weight of flask + oil extraction

Protein content determination

This was carried out by the Kjeldahi method (Pearson, 1976). Half a gram (0.5g) of the sample was digested by boiling in 10ml of conc. H₂SO₄ in the presence of one selenium catalyst tablet. Digestion was done under a fume cupboard until a clear solution (digest) was obtained. The digest was diluted with distilled water and transferred to a 100ml volume flask where it was made up to mark with the distilled water.

An aliquot (10ml) of the digest was mixed with equal volume of 45% NaOH solution in a Kjeldahi apparatus and distilled. The distillate was collected in 10ml of 4% boric acid solution into which three drop of mixed indicator (methyl red/bromocressol green) was added. A total of 50ml distillate was collected and titrated against 0.02N H₂SO₄ from green to a deep red endpoint. A reagent blank without sample was also digested, distilled and titrated as described above.

Results and discussion

Soybean flour has high protein, ash, and carbohydrate content with low moisture. It also has high mineral content which when combined together affects the processing and behaviour of food system as judged by the

quality of the final products (Hayta et al., 2002). More so, sesame flour is nutritionally rich in protein, fats and essential minerals (Ogungbenle & Onoge, 2014).

The proximate compositions of wet and dry milled soybean /sesame flour as shown in Table 1 showed that the protein content of the samples ranged from 16.89-30.45%. The sample with 100% dry milled soybean flour ranked the highest (30.45%) while the flour with 100% wet milled sesame ranked the lowest (18.25%). There were significant differences ($p < 0.05$) in the protein content of the flour samples. There was a decrease in protein content as sesame flour was added to soybean flour. Thus soybean flour is a remarkable source of protein for both animal and human consumption (Ogungbenle & Onoge, 2014).

The moisture content ranked highest in 100% wet milled soybean flour (W100:0) (13.07%) and lowest in dry milled soybean/sesame flour with 47.5% soybean and 52.5% sesame (D47.5:52.5) (6.36%). The high moisture content in wet milled soybean/sesame flour could be as a result of soaking time of the sample. Absorption of water led to some decrease in fats, protein, ash, fibre and carbohydrate. The low moisture content in the samples would enhance their shelf-life by preventing the growth of microorganisms during storage (Ezeama, 2007).

The fibre content of dry milled soybean/ sesame flour ranged from (4.69-6.16%). The D30:70 and W30:70 ranked the highest while D0:100 ranked lowest. The combination of the fibre content in soybean and sesame made D30:70 to rank high in fibre content. The moderate fibre content in these flour samples make them suitable for easy digestion in the colon and also help to reduce the risk of bowel cancer and gallstones when soybean and sesame flour are used in various ratio for food production.

The fat content from wet and dry milled soybean/sesame flour ranged from 23.34-46.37% with 100% dry milled sesame flour ranking highest while 100% wet milled soybean ranked the lowest. There were significant differences ($P < 0.05$) in the fat content of the samples. As the sesame flour was added to the soybean flour it increased the fat content of the mixture. This result showed that sesame flour can be used as better source of oil than soybean flour. Oil improve overall food palatability, flavor and mouth feel. It also enhanced the tocopherol and Vitamin E action that is supposed to help in prevention of cancer and other heart ailment (Ogungbenle & Onoge, 2014). Therefore, incorporating soybean and sesame in the daily diet is very nutritious.

The ash content increased as more sesame flour was added to the mixture of soybean flour. The ash content ranged from 4.01– 6.71% with the 100% dry milled sesame flour ranking the highest while 100% soybean flour ranked the lowest (Table 2).

Table 1: Proximate composition of wet and dry milled soybean/ sesame flour (%)

Soybean: sesame	Moisture content	Fat	Ash	Protein	Fiber	Carbohydrate
D100:0	7.24 ^g ±3.15	26.39 ^g ±0.02	4.16 ^e ±0.01	30.47 ^a ±0.21*	5.22 ^c ±0.11	25.52 ^a ±0.10*
D82.5:17.5	6.89 ^h ±5.20	30.34 ^e ±0.05	4.21 ^e ±0.01	30.13 ^a ±0.15	5.46 ^d ±0.23	20.50 ^b ±0.15
D65:35	6.54 ⁱ ±3.00	33.56 ^d ±0.10	4.65 ^d ±0.01	29.50 ^b ±0.20	5.76 ^c ±0.25	18.02 ^d ±0.17
D47.5:52.5	6.36 ^j ±2.50	35.47 ^e ±0.07	5.35 ^{cd} ±0.01	29.36 ^b ±0.21	6.04 ^b ±0.20	14.05 ^e ±0.10
D30:70	6.68 ^h ±5.00	38.62 ^b ±0.05	6.23 ^b ±0.01	29.65 ^b ±0.11	6.15 ^a ±0.19	11.69 ^h ±0.10
D0:100	6.72 ^h ±2.00	46.36 ^a ±0.10*	6.70 ^a ±0.01*	18.24 ^e ±0.17	4.69 ^f ±0.10	15.75 ^f ±0.20
W100:0	12.64 ^c ±7.40	23.34 ^h ±0.05	4.01 ^f ±0.22	27.34 ^c ±0.01	5.46 ^d ±1.05	25.65 ^a ±2.00*
W82.5:17.5	13.07 ^a ±8.15*	28.69 ^g ±0.08	4.18 ^e ±0.50	27.06 ^c ±0.01	5.72 ^c ±2.00	19.83 ^c ±3.35
W65:35	12.78 ^b ±5.20	30.42 ^d ±0.10	4.63 ^d ±0.75	26.48 ^d ±0.01	6.19 ^a ±1.20	18.08 ^d ±2.24
W47.5:52.5	11.14 ^d ±4.30	33.09 ^c ±0.15	4.92 ^b ±0.25	26.65 ^d ±0.01	6.15 ^a ±1.50	16.88 ^e ±4.00
W30:70	10.36 ^e ±5.00	35.78 ^c ±0.20	5.38 ^{cd} ±0.31	26.76 ^d ±0.01	6.22 ^a ±1.70*	14.05 ^e ±2.20
W0:100	10.25 ^f ±7.50	45.01 ^{ab} ±0.35*	5.90 ^c ±0.80	16.89 ^f ±0.01	4.86 ^e ±1.83	15.60 ^f ±2.00

Values are means ± standard deviation of three determinations.

Values in column with different superscripts are significantly different ($P < 0.05$)

Dry = Dry milled soybean/sesame flour

W = Wet milled soybean/sesame flour

Table 2 showed the physical characteristics of fresh tofu from wet and dry milled soybean/sesame blend coagulated with tamarind. The pH of the tofu before and after coagulation ranged from 4.91–4.95 and 4.50–4.90, respectively. The reduction in the acidity of the sample before and after coagulation could be as a result of the addition of tamarind used as coagulant with a pH value of 3.30. The use of tamarind as coagulant with

high citric and tartaric acid content brought the sample pH to an isoelectric range of 4.2 – 5.6 where the solubility of protein is at minimum. This led to the precipitation of protein. This agreed with Shurtleff and Aoyagi (2000) that at isoelectric range of 4.2-5.6 soybean protein coagulates. There were no significant differences ($P<0.05$) between the pH of the samples before the coagulation. This could be as a result of the fact that the isoelectric point of both soy protein and sesame protein are the same at 4.5 (Shurtleff & Aoyagi, 2000; Zhao et al., 2012).

The coagulation time ranged from 12.00 – 13.00 min. The coagulation time of wet and dry milled soybean/sesame tofu at 100:0, 82.5:17.5 and 65:35 ranked the highest while the coagulation time of wet and dry milled soybean/sesame tofu at 30:70 and 47.5:52.5 ranked lowest. This could be as a result of the high oil content in sesame compared to soybean. When high fat soymilk is subjected to boiling, a marked viscosity increase accompanying coagulation will be observed (Abe et al., 2015). This could be as a result of the lipophilic bonding with the protein from the high fat soymilk which formed an association of soft gel. The exposed SH groups that result from further heat transformation of this gel are thought to form SS bonds and a hard gel is therefore formed. Therefore, higher oil content led to lower coagulation time.

The initial weights of the soy/sesame milk samples were the same before coagulation at 300 ml. After coagulation, the final weight of the coagulated milk ranged from 170.00– 446.00 kg. There were significant differences ($P<0.05$) in the final weight of the coagulated milk in all the samples. The final weight of the coagulated milk of TD100:0 (446.00 kg) ranked highest while the final weight of the coagulated milk of TW30:70 (170.00 kg) ranked lowest. The decrease in weight of TW30:70 could be as a result of some of the soluble proteins (oleosin proteins) which are wedged in the oil body surfaces (Chen & Omu, 2010). Upon coagulation and pressing, these proteins together with the oil are removed from Tofu, therefore having a lower final weight. As the sesame with high oil content increased, the final weight decreased. The weight of the dry matter ranged from 71.74– 126 kg. There were significant differences ($P<0.05$) in all the weight of the dry matter in all samples. The weight of the dry matter of TD47.5:62.5 ranked highest while TW82.5:17.5 ranked the lowest. Wet milling increases the amount of total dietary fibre due to the hydration and break down of insoluble fibres (Lehtinen, 2012). This may be result to the leaching of dry matter contained in the food materials. This could be the reason why wet milled soybean/sesame tofu produced lower dry matter. This agreed with the finding of Nnam and Otitoju (Nnam, 2002 & Otitoju 2009).

Table 2: Physical characteristics of fresh Tofu from wet and dry milled Soybean Sesame blend coagulated with tamarind

	Sample pH			Coagulation Time (Min)	Sample Weight (Kg)		
	Coagulant	Before Coagulation	After Coagulation		Initial	Final	Dry Matter
	3.30						
TD 100:0		4.80	4.50 ^a	13.00 ^a	300	446.00 ^a	110.40 ^c
TD 82.5:17.5	3.30	4.80	4.56 ^a	13.00 ^a	300	363.40 ^b	107.00 ^d
TD 65:35	3.30	4.83	4.50 ^a	13.00 ^a	300	266.20 ^d	106.00 ^d
TD 47.5:52.5	3.30	4.82	4.52 ^a	12.00 ^c	300	208.90 ^e	126.00 ^a
TD 30:70	3.30	4.70	4.50 ^a	12.50 ^b	300	184.50 ^e	118.00 ^c
TW 100:0	3.30	4.95	4.87 ^b	13.00 ^a	300	345.00 ^c	68.60 ^g
TW 82.5:17.5	3.30	4.91	4.86 ^b	13.00 ^a	300	343.00 ^c	71.74 ^f
TW 65:35	3.30	4.90	4.87 ^b	13.00 ^a	300	240.00 ^e	120.40 ^b
TW 47.5:52.5	3.30	4.90	4.89 ^b	12.00 ^b	300	240.00 ^e	84.80 ^e
TW 30:70	3.30	4.95	4.90 ^b	12.00 ^b	300	170.00 ^f	81.07 ^e

Values are means ± standard deviation of three determinations.

Values in column with different superscripts are significantly different (P<0.05)

TW = Wet milled soybean/sesame flour coagulated with tamarind.

TD = Dry milled soybean/sesame flour coagulated with tamarind.

Figure 3 and 4 shows the stress strain test for wet and dry milled tofu treated with tamarind. From the graph, TW30:70 and TD30:70 had the lowest stress and strain yield while TW 100:0 and TD100:0 had the highest stress yield as well as the highest strain yield. A material with low stress and low strain yield is a soft and weak material. In soft materials, a large stress (pressure) will produce a large strain (low deformation) but in weak material large stress will produce a low shear stress (high breakage). A material with a high stress is a hard material. A strong material is a material with a high strain yield. From figure 3 and 4, TW 65:35 and TD65:35 had the highest stress yield and a low strain yield. This indicates its hardness, high strength, and higher force to break as well as high ductility. This could be as a result of the 35% addition of sesame with a high mucilaginous gum as the soluble fibre to the soybean (Ali et al. 2014). Thus the 65% soybean and 35% sesame blend produced harder and more elastic tofu compared to the other blends.

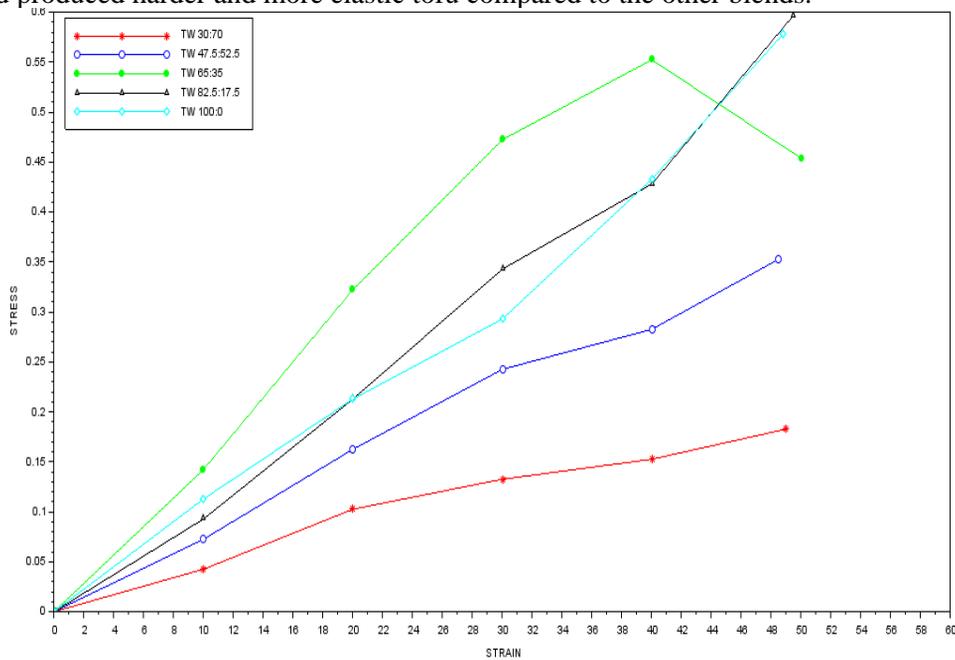


Figure 3: Stress strain test of tofu processed from wet milled soybean/sesame blend coagulated with Tamarind

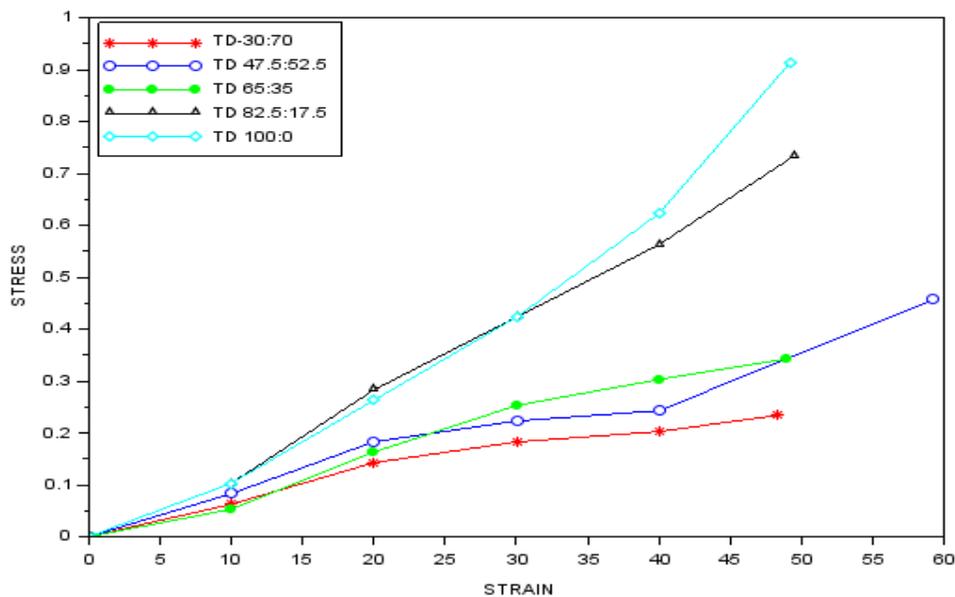
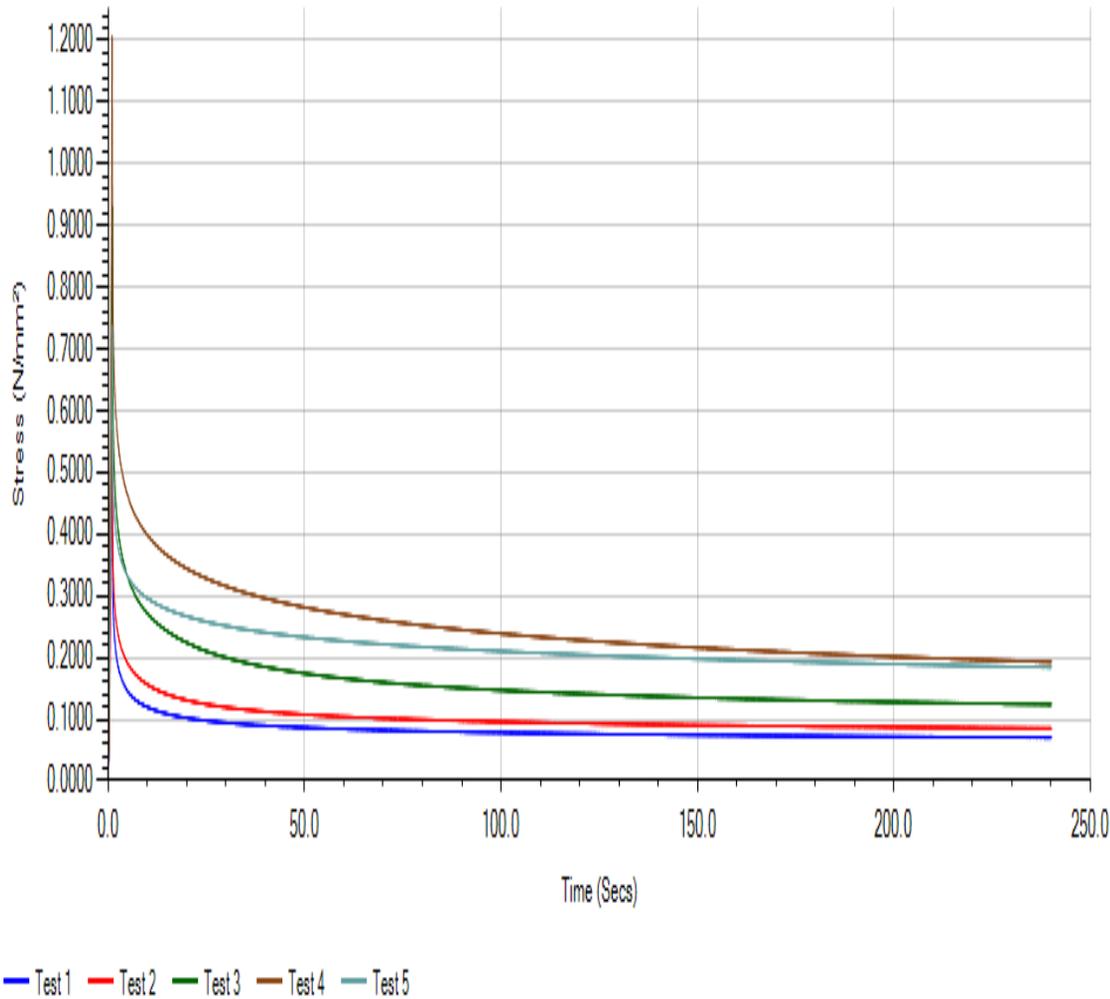


Figure 4: Stress strain test of tofu processed from dry milled soybean and sesame blend coagulated with Tamarind

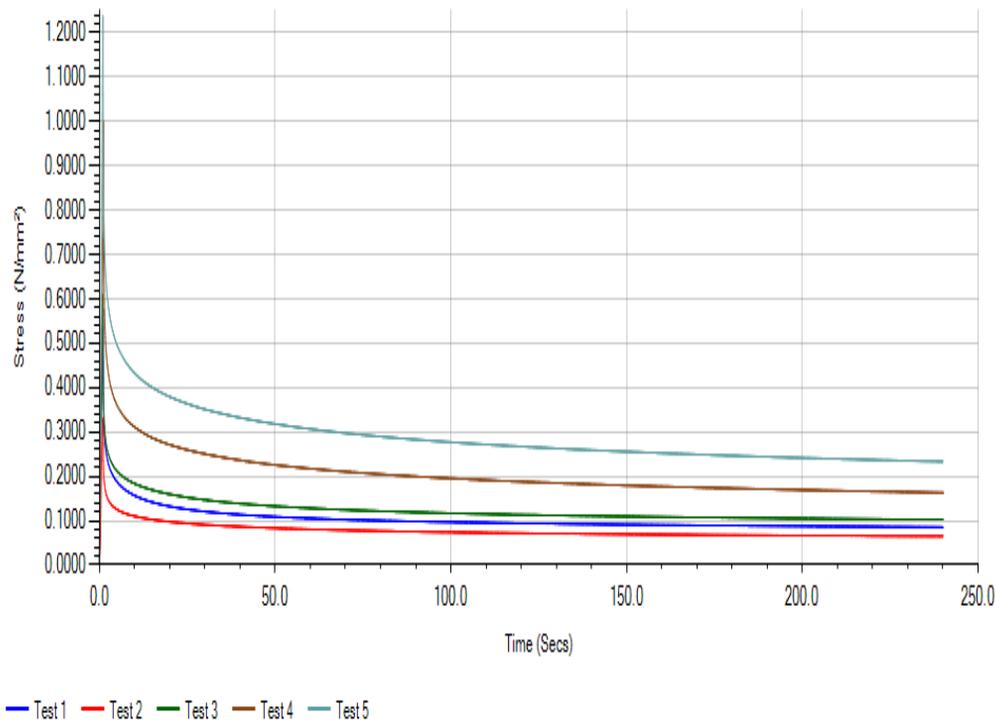
Figure 5 shows the stress relaxation time of tofu from wet milled soybean sesame flour coagulated with tamarind. The stress relaxation time is a measure of how fast the stress decays (Bark & Mittai, 2006) a material that has a longer relaxation time indicates less viscous than elastic in nature. The stress relaxation time ranged from (50 – 240s) with TW65:35 ranking the highest while TW30:70 ranked the lowest. This shows that TW65:35 had the highest elasticity compared to other tofu samples while TW30:70 is more viscous in nature.

Figure 6 shows the stress relaxation time of tofu from dry milled soybean sesame flour coagulated with tamarind. The internal stress ranged from (0.244 – 1.005N/mm²) with TD100.0 ranking the highest. The stress relaxation time ranged from (50 – 240s). TD100:0 had the highest relaxation time while TD30:70 had the lowest. This shows that TD100:0 was harder and more elastic, while TD30:70 was more viscous and softer. TD47.5:52.5 had the highest internal stress and lowest relaxation time (50s). This indicates a hard and less elastic tofu (Bark & Mittai, 2006; Rao, 2012). The combination of soybean and sesame led to the high internal stress (Makinde & Adebite, 2018).



Test1=TW30:70, Test2=TW47.5:52.5, Test3=TW65:35, Test4=TW82.5:17.5, Test5=TW100:0

Figure 5: Stress relaxation test of tofu processed from wet milled soybean and sesame blend coagulated with tamarind



Test1=TD30:70,Test2=TD47.5:52.5,Test3=TD65:35,Test4=TD82.5:17.5,Test5=TD100:0

Figure 6: Stress relaxation test of tofu processed from dry milled soybean and sesame blend coagulated with Tamarind

Provide a dedicated section that show “the contributions of the study”.

Recommendations

Based on the research use dry milling method in the production of tofu is recommended, because it saves time and energy.

Tamarind is highly available and affordable, it should be used both as coagulant and colorant.

Sesame seed should be made popular and produced in larger quantity for the production of tofu in Nigeria.

Further research should be made to mechanise tofu processing so as improve texture and shelf life stability.

Conclusion

Milling process affected the physical, chemical and viscoelastic properties of tofu. Dry milled soybean/sesame flour gave a higher protein content value. Wet milled flour gave tofu with more elastic than viscous nature. Wet and dry milled flour from 65% soybean and 35% sesame (TD65:35) produced tofu with the highest stress and strain yield. Therefore the blend of soybean and sesame for production of meat analogue is highly acceptable nutritionally, texturally and physically for all age brackets at the blend of 65% soybean and 35% sesame.

References

1. Abe, N., Wu, C. Y., & Kim, Y. K/. (2015). Development of an efficient soymilk cream production method by pappan digestive, heat treatment and low speed centrifugation. *Bioscience, Biotechnology and Biochemistry* 79(11):1890-2.
2. AOAC (1990). Association of Official Analytical Chemist.
3. Bark, O., & Mittai, G. S. (2006). Dynamics Of Changes In Viscoelastic Properties Of Tofu During Frying *International Journal Of Food Properties*, 9(1), 73-83
4. Bedigian, D (2003). Sesame in Africa: Origin and dispersals. In Neumann, K. Butler, A. and Kahlheber, S. Food, fuel and fields – Progress in African archaeobotany. Africa praehistorica colognes. Heinrich-Barth Institute. Pp. 17, 36.
5. Bourne, M. C. (2002). Food Texture and Viscosity Concept and Measurement. (2nd edition). San Diego, C.A. Academic Press.

6. Chen, J. J., Lu, S., & Lii, C. Y. (2003). Physiochemical and Morphological analysis on damaged ice status. *Journal of food drug and analysis*, 11: 283-289.
7. Chen, Y., & Omu, T. (2010). Simple extraction methods of non-allergic intact soybean oil bodies that are thermally stable in an aqueous medium. *Journal of Agricultural Food Chemistry*, 58:7402-7407.
8. Ezeama, C., & Dobson, G. N. (2019). Effect of coagulants on the physicochemical properties of fresh tofu. *African Journal of Food Science*, 13 (12): 287-296.
9. Ezeama, C. F. (2007), Food Microbiology. Fundamentals and Applications. Prints, Lagos
10. Hayta M., Alphaslan, M., & Baysar, A. (2002). Effect of Drying Method on Functional Properties of Tarhana. *A Wheat Flour-yogurt Mixture Journal of Food Science* 67(2): 740-744.
11. Iwe, M. O. (2003). The science and Technology of Soybean. Published by Rojoint Communication Services Ltd, Enugu, Nigeria. James C.S. (1996). *Analytical Chemistry of Foods*. Blackie Academic & Professional New York.
12. James, C. S. (1996). *Analytical Chemistry of Foods*. Blackie Academic & Professional New York
13. Jitranut, L., & Jirarat, A. (2016). Effects of dry milling and wet milling on chemical, Physical and gelatinization properties of rice flour. *Science Direct Rice Science* 23(5) 274-281.
14. Lehtinen, P. O. (2012). Modifying wheat bran for food applications: Effect of Wet Milling and Enzymatic Treatment, *Technical Research Centre Nutritech 1*; 1-11
15. Locke, J., & Remer, N. (1991). Pod form and Non Pod form Variants of Tamarind in Guadalupe Yaghoubian *Agricultural Review*. 2, 122-149.
16. Makoto, S., Shingo, M., Kimiko, T., & Yoshitaka, H. (2012). Characterization of Soymilk prepared by milling and pressing at High Temperature. *Journal of Food Processing and Preservation* (38) :12037-12045
17. Nnam, N. M. (2002). Evaluation of complementary food based on maize, groundnut, pawpaw and mango flour blends. *Nigeria Journal of Nutritional Science*, 23 (182): 8-16.
18. Nzikou, M. L, Matos, G. K, Bouanga Kalou, C. B., Ndangui, N. P. G., Pambou, A., Kimbonguila, T., Silou, M., & Descobry, S. (2009). Chemical Composition on the seeds and oil of sesame (*Sesamum indicum L.*) Gown in Congo- Brazzaville. *Advance Journal of Food Science and Technology*, 1:6-11.
19. Obiajunwa, E. I., Adebisi, F. M., & Omode, P. E (2005). Determination of essential minerals and trace elements in Nigerian sesame seeds using TXRF technique. *Pakistan Journal of Nutrition*, 4:393-395.
20. Ogungbenle, H. N., & Onoge, F. (2014). Nutrient Composition And Functional Properties Of Raw, Defatted Protein Concentrate Of Sesame (*Sesame indicum*) Flour. *European Journal Of Biotechnology And Bioscience* 2(4) 37-43.
21. Onwuka, G. I. (2005). *Food Analysis and Instrumentation Theory and Practice*. Naphtali Prints. Lagos .
22. Otitoju, G. T. (2009). Effect of dry and wet milling process techniques on the nutrient composition and organoleptic attributes of fermented yellow maize (*Zea mays*). *African Journal of Food Science*, 3(4): 113-116.
23. Preece, K. E, Hooshyar, N., & Zuidan, N. J. (2017). Whole soybean protein extraction processes, *a Review Innovative Food Science & Emerging Technologies* 43; 163-172.
24. Sacks, F. M., Lichtenstein, A., Van, H. L., Harris, W., Kris-Etherton, P., & Winston, M. (2006). American Heart Association Nutrition Committee Soy Protein, Isoflavones, and Cardiovascular Health. *An American Heart Association Science Advisory for Professionals From the Nutrition Committee, Circulation* 113(7): 1034-1044
25. Sukson, A., & Naivikul, O. (2006). Effect of dry and wet milling process and chemical, physiochemical properties and starch molecular structure of rice statutes, *Kaselstart Journal: Nutritive Science* 40: 125-134.
26. Vishwanath, K. H., Vasudeva, S., & Subramanian, R. (2011). Wet grinding characteristics of soymilk extraction *Journal of Food Engineering* 106(1) 28-38.
27. Zhao, J., Liu, D., Chen, F., & Liu, G. (2012). Functional properties of sesame seed protein prepared by two different methods. *Journal of Chemistry*, 34, 1- 5.

