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A Skills-Based Framework for Evaluating *Trengkas* Proficiency Among TVET Students at Polytechnic Malaysia

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Abstract

Trengkas, a shorthand system for the Malay language, is a important skill for administrative and professional transcription tasks for stenography students. However, only a few studies have examined Trengkas proficiency through a comprehensive skills-based framework. This study fills this gap by assessing students' Speed, Accuracy, and Transcription Efficiency across five major components of skill: Knowledge, Affection, Conation, Sensory Motion, and Active Cognition Ability. Data was collected from 196 polytechnic students using structured questionnaires measuring transcription and cognitive skills that drive accuracy and efficiency of motivational and emotional engagement. Considering the limited opportunities, students have to practice this skill. The findings reveal that the components of the skill-based framework significantly affected *Trengkas* proficiency. Many students struggle with traditional, real-time dictation; there is a clear need for better pedagogical techniques. The study concludes that a skills-based framework is a useful mechanism for assessing *Trengkas* proficiency, and adjustments to the curriculum are recommended. Bridging gaps in active cognition and motivation can better prepare students for the demands of the workplace. Thus, future research should incorporate technology into *Trengkas* training to streamline learning outcomes.

1. Introduction

Stenography plays a crucial role in administrative and documentation tasks in various industries, particularly those that demand high accuracy and speed in transcription. Hence, it has become an indispensable skill in today's fast-paced professional environment. In the Technical and Vocational Education and Training (TVET) system, stenography is essential to train students for professions requiring fast and accurate information recording. *Trengkas* is a shorthand system developed specifically for the Malay language part of the programme syllabus Diploma in Secretarial Science in Polytechnic Malaysia (JPPKK, 2022, 2024a, 2024b). Accordingly, *Trengkas* allows students to write more efficiently, contributing to their skills matching the requirements of the job market for secretarial and administrative personnel (Abdul Hamid, 1991).

While *Trengkas* proficiency is relevant in vocational education, current assessments are limited in scope. Although the existing studies are generally limited in speed and accuracy (Padilla et al., 2020), stenography mastery encompasses more than these two facets. In particular, cognitive processing, motivation, emotional engagement, and sensory-motor coordination contribute to effective shorthand transcription (Carlisle et al., 2023; Paladhi & Maruthaveeran, 2023). Consequently, a skills-based framework effectively evaluates *Trengkas* proficiency in TVET, equipping students with essential transcription skills tailored to meet real-world job requirements (Lamri & Lubart, 2023).

The need for skilled stenographers is continually rising as documentation techniques evolve. The emphasis on documentation precision and efficiency offers further justification for polytechnic institutions to update their curricula to meet the changing needs of the industry. However, students struggle due to a lack of pacing, feedback, and preparation for real-time. Moreover, these gaps result in students failing to meet workplace expectations, leading to employability and job performance issues in administrative roles.

Previous literature does not provide any structured, skills-based means for assessing *Trengkas* proficiency, especially in TVET education (Green & du Plessis, 2023; Jayalath & Esichaikul, 2020; Yeap et al., 2021). Most studies investigated the Speed and Accuracy of shorthand. Yet, there was limited focus on how Knowledge, Cognition, Active Cognition, Conation, Affection, and Sensory Motion capabilities affect the Speed and Accuracy along with transcription content level. Hence, this study aims to address the following research questions:

1. Is there a significant difference in *Trengkas* proficiency (Speed, Accuracy, and Transcription Efficiency) among students on grade achievement levels?
2. To what extent do the five skill components (Knowledge, Active Cognition, Conation, Affection, and Sensory Motions) affect *Trengkas* proficiency regarding Speed, Accuracy, and Transcription Efficiency?

This study aims to bridge the identified research gap by developing a skills-based framework for evaluating *Trengkas* proficiency among TVET stenography students. Thus, by analysing the role of multiple skill components, this research provides valuable insights into curriculum design by helping educators enhance pedagogical practices to better equip students for real-world transcription tasks. Additionally, this study enhances vocational education research by providing a student learning assessment model relevant to stenography training about industry needs to enhance student workforce readiness.

1.1 Skill Acquisition Theory

Skill Acquisition Theory, as defined by Dekeyser (2020), offers a structure for analysing how complex skills develop over stages of learning. The cognitive stage is defined by the tracking of declarative knowledge, in which they depend on explicit instruction and deliberate practice to develop an underlying understanding of the skill (Cecilio-Fernandes et al., 2020; Suzuki, 2020; Ullman, 2020). In the associative stage, it becomes proceduralism, lowering cognitive load, increasing fluency, and decreasing errors (Muller et al., 2023; Suzuki & Kormos, 2023; Suzuki, 2020). In the autonomous stage, skills become automated, and it takes little thought, enabling the learner to perform quickly and accurately (Ginns et al., 2020; Ortiz et al., 2020). As such, TVET is aligned with this theory in that it is based on progressive skills-building through structured practice and focused feedback while progressively refining skills across content constructs and domains.

Trengkas proficiency is closely linked to Skill Acquisition Theory, where students must connect cognitive mental processes and bodily motor actions, progressing from the basic recognition of a symbol to the skilled automaticity of fluent transcription. However, applying Skill Acquisition Theory in stenography training, particularly *Trengkas*, is scarce (Anderson, 1982). Although theoretical frameworks have established the importance of both declarative and procedural knowledge in skill acquisition, there has yet to be a systematic assessment framework that operationalises *Trengkas* proficiency within this framework. In addition, Lewthwaite and Wulf (2017) described the context of skill acquisition, motivation, and attentional factors as being aligned with acceleration. In contrast, the OPTIMAL theory emphasises enhanced expectancies and autonomy support. Furthermore, the specific motivational and attentional mechanisms that could contribute have not been systematically explored as part of *Trengkas* instruction, restricting understanding of how they could have shaped optimisation in shorthand training.

Another methodological approach is the latent growth curve modelling (Voelkle et al., 2006). It can examine the association of general abilities with skill learning. However, this modelling approach has yet to be properly applied in stenography, which affects the understanding of learning trajectories. In addition, the evidence for using spaced practice in proceduralising and retaining a skill is extensive (Kim et al., 2013). However, its application in shorthand training has remained set upon an assumption and is not supported by empirical evidence, hindering the potential of practice schedules for *Trengkas* users. Finally, previous research has not sufficiently addressed the role of individual differences in cognitive abilities and learning styles in acquiring stenography skills. These research gaps suggest the need for a skills-based framework that fosters motivation, optimal analytical approaches, and student-centred learning practices for a skills-based approach model tailored to *Trengkas* training. Notably, addressing these gaps would allow future studies to develop proof-based

pedagogical approaches that facilitate structured skills development and improve stenography programmes within TVET settings.

1.2 Skills-Based Framework

A skills-based framework considers several competencies, such as Knowledge, Affection, Conation, Sensory Motions, and Active Cognition (Lamri & Lubart, 2023). These competencies reflect beyond traditional shorthand capabilities based primarily on Speed and Accuracy, avoiding the one-dimensional shorthand evaluations of students. This involves both **External Knowledge** (technical job-specific knowledge) and **Internal Knowledge** (retention and recall of memory), which is critical to mastering shorthand skills (Pitts et al., 2022; Venkataramani & Tang, 2023; Ward, 2021). In addition, **Active Cognition** allows learners to perceive, process, and analyse information sustainably, facilitating real-time decision-making and judgment during transcription processes (Sprevak & Smith, 2023; Venkataramani & Tang, 2023). Nonetheless, no previous study has systematically investigated the effect of cognitive processing on *Trengkas* abilities.

However, limited exploration of shorthand persistence is **Conation**, as it plays a major role in students' motivation, willingness to gain skills, and the need to activate cognitive skills (Costantini et al., 2022; Valenzuela et al., 2020). Likewise, emotional engagement, or **Affection**, is key to learning retention and Transcription Efficiency but has yet to be addressed in shorthand performance (Ferguson et al., 2021; Wang et al., 2023). Additionally, **Sensory Motions** related to coordination and movement control underlie transcription Speed and Accuracy, especially in real-time dictation scenarios (Baumann et al., 2023; Leib et al., 2023). Although considered relevant, early research on *Trengkas* has neglected to incorporate Sensory Motion capabilities, resulting in minimal cooperation about the role of fine motor coordination on the overall transcription performance.

There is an apparent absence of a systematic schema that includes all these skill components. Thus, an approach is required that would provide a much more powerful tool for assessing *Trengkas* proficiency. Although prior studies highlight the significance of cognitive and motor skills in learning any skill, the interaction between these abilities and shorthand performance is poorly studied. That is, existing assessments lack an integrated assessment model and not only a theoretical framework but also fail to communicate the multidimensional nature of stenography training. Building on this, the need for efficient stenographers in administrative and professional departments continues to grow, making it essential to implement a rigorous skill-based framework that reflects industry expectations. Thus, this study aims to fill these insights by studying Knowledge, Active Cognition, Conation, Affection, and Sensory Motion toward *Trengkas* skills. Accordingly, this research will develop a holistic framework for shorthand education in TVET institutions and a more effective stenography training programme.

H1: There is a significant difference in *Trengkas* proficiency (Speed, Accuracy, and Transcription Efficiency) among students on grade achievement levels.

1.3 *Trengkas* Proficiency

Trengkas is a shorthand coding system introduced by Ariff and Ariff (2009), prevalent in Malaysia and Indonesia. Essentially inherited from its predecessors, this form bears a substantial similarity with the pronunciation of the Malay language, thus proving to be of little use in transcription in these local contexts. Research on predicting the conversion of the system to work in English using Gregg shorthand was conducted using a deep learning technique conducted by Padilla et al., (2020) .However, no comparable study of *Trengkas* has been performed, especially concerning the outlined framework of a skill. Hence, a holistic assessment depicting Knowledge, Affection, Conation, Sensory Motions, and Active Cognition would be a great way to assess *Trengkas* proficiency.

Ito et al. (2015) described learned stenography skills as related to brain plasticity to show a link between these cognition and motor skills. Nonetheless, the specific implications of these findings for *Trengkas*, which has a unique structure in the context of the Malay language, have received relatively little attention. These differences raise critical questions about the contribution of Cognitive and Sensory Motions to *Trengkas* proficiency and whether the effects observed in previous systems also occur within the context of *Trengkas*. Lee et al. (2014) discussed how learning styles and communication strategies can help identify *Trengkas* students. Still, the study did not explore the implications of such characteristic identification on holistic skill development.

Likewise, Baharudin and Ahmad's (2021) study explored online teaching challenges and opportunities in *Trengkas* but did not adequately explain the implications for skills. Moreover, the study failed to prove that relying on the online learning environment requires Speed, Accuracy, and Transcription Efficiency skills. The impact of online teaching on various determinants, such as student motivation, engagement, and collaborative learning, is also poorly investigated. Thus, these noteworthy gaps highlight an emergent need for

comprehensive research that adopts a skills-based framework to assess *Trengkas* proficiency in contemporary learning contexts.

H2: The five skill components (Knowledge, Affection, Conation, Sensory Motion, and Active Cognition) significantly affect *Trengkas* proficiency in Speed, Accuracy, and Transcription Efficiency.

1.4 Conceptual Model

Fig. 1 displays a correlation between Knowledge, Active Cognition, Conation, Affection, and Sensor Motion Abilities toward *Trengkas* proficiency (Speed, Accuracy, Transcription). This model combines a skills-based framework with Skill Acquisition Theory to provide an organised method to measure its impact on stenography skills within the context of TVET education. Furthermore, this model allows for a holistic and comprehensive evaluation of *Trengkas* proficiency, unlike existing shorthand assessments, which emphasise speed and accuracy while neglecting the task's cognitive, affective, and motor skill dimensions. Additionally, this framework can be utilised for curriculum development in TVET institutions, as it allows educators to create skilled stenography, increasing learning outcomes.

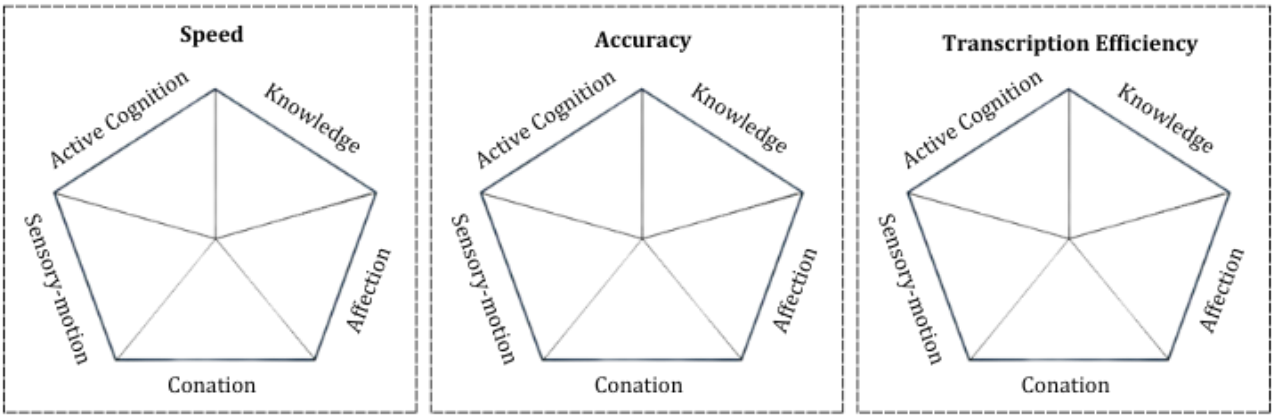

Fig. 1 *Conceptual Model of Trengkas Proficiency Based on a Skills-Based Framework. Adaptation from (Lamri & Lubart, 2023)*

2. Methods

2.1 Research Approach

This research employed a quantitative approach. The study's respondents were stenography students taking the *Trengkas* course at Polytechnic Malaysia. A survey was conducted online using a validated questionnaire on a five-point Likert-type scale (Kusmaryono et al., 2022). The questionnaire focused on five skill components: Knowledge, Affection, Conation, Sensory Motion, and Active Cognition. The items were validated by five experts and addressed two main research questions. As outlined in Table 1, the items assessed overall proficiency and evaluated how each skill component contributes to students' Speed, Accuracy, and Transcription Efficiency. Accordingly, Speed and Transcription Efficiency were assessed by 11 items each, Accuracy by eight items, and Active Cognition by eight items. Meanwhile, Knowledge, Affection, Conation, and Sensory Motion were each represented equally with six items, ensuring comprehensive coverage of the relevant domains.

2.2 Data Collection and Analysis Process

The Department of Polytechnic and Community College Education (DPPCE) granted ethical clearance before the conduct of the study. The sample comprised students pursuing the Diploma in Secretarial Science at selected Polytechnic Malaysia institutions who had completed *Trengkas* courses in Semester 3. These students were invited to participate in the study voluntarily and signed a consent and confidentiality form. A total of 196 responses were obtained from a population of 432 using simple random sampling. Notably, the study achieved a 95% confidence level with a margin of error of 2%, in line with confidence levels between 95% and 99%, which are standard in educational research (Cohen et al., 2022). Simultaneously, Cronbach's Alpha was employed to assess the reliability of Speed, Accuracy, and Transcription Efficiency.

After participants had completed the online survey, the researcher digitalised the responses in Google Forms and uploaded the dataset to IBM SPSS (version 26) for statistical analysis. The dataset was examined to identify response patterns and describe the sample about the constructions studied. Therefore, to address the

research questions, simple linear regression, and multiple regression analyses were conducted to determine statistically significant relationships (Pallant, 2011).

2.3 Reliability of the questionnaire

Cronbach's Alpha was used to evaluate the internal consistency and reliability of the instrument, ensuring its effectiveness in accurately capturing students' *Trengkas* proficiency (see Table 1). According to Sürücü and Maslakçi (2020), a Cronbach's Alpha (α) value of 0.70 or higher indicates a reliable scale. The analysis revealed that variables Speed (α = 0.824), Accuracy (α = 0.854), and Transcription Efficiency (α = 0.826) had an acceptable internal consistency, suggesting that the items were well designed and measuring the targeted constructs reliably. Additionally, skewness values were reported within the acceptable range (±1) for Speed (-0.320), Accuracy (-0.279), and Transcription Efficiency (-0.292). Thus, the data distribution was close to symmetric with a slight negative skew. Similarly, Orcan (2020) stated that skewness and kurtosis values within ±1 indicate normality. Accordingly, the kurtosis values (0.087, -0.372, and -0.317) confirmed that the distributions did not significantly deviate from normality. These findings validate the reliability of the measurement scales and confirm the dataset's suitability for further parametric statistical analysis.

Table 1 *Reliability and Normality Analysis of Trengkas Proficiency Variables*

Scales	Cronbach's Alpha α co-efficient	Reliability Interpretation	Skewness	Kurtosis
Speed	0.824	Accepted	-0.320	0.087
Accuracy	0.854	Accepted	-0.279	-0.372
Transcription Efficiency	0.826	Accepted	-0.292	-0.317

3. Results

3.1 Demographic Profiles

Table 3 presents the participants' demographic profile, which reveals a significant gender imbalance, with female students comprising 93.4% (n = 183) and male students comprising 6.6% (n = 13). The observed gender imbalance, with 93.4% of respondents being female, reflects the demographic reality of secretarial science programs in Malaysian polytechnics, which traditionally attract more female students, as shown in Figure 2 (BKTVET, 2024). This trend is consistent with enrolment patterns across vocational studies, emphasising administrative and clerical competencies. While this may limit generalizability across gender lines, it underscores the importance of designing curriculum interventions that effectively address the dominant learner demographic.

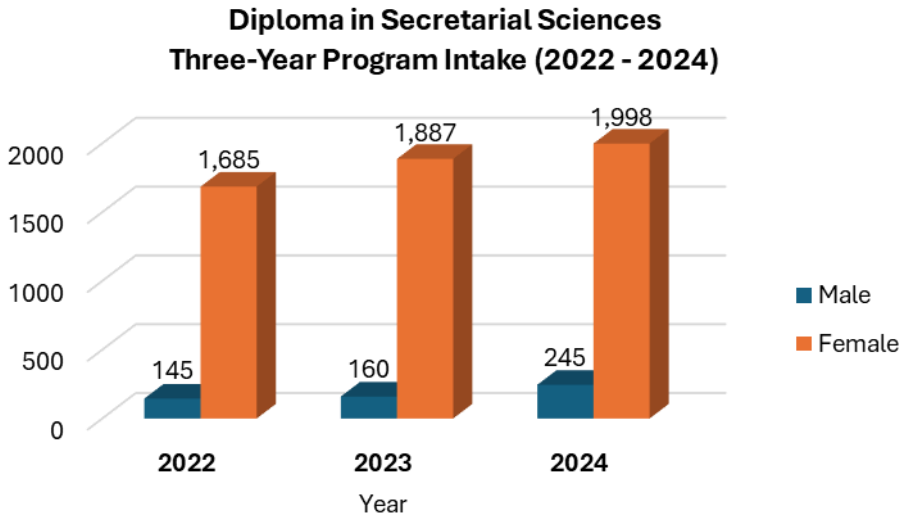

Fig. 2 *Gender Distribution of Trengkas Students across Six Polytechnic Institutions (2022-2024)*

Regarding age distribution, most students (76.5%) are 20 years old, 14.8% are 21 and above, 7.1% are 19, and 1.5% are 18, suggesting that most participants belong to the typical diploma-level age range. The participants represent six polytechnic institutions, with the highest proportion from Politeknik Mersing

(25.5%), followed by Politeknik Sultan Idris Shah (22.4%) and Politeknik Port Dickson (16.3%). Additionally, Politeknik Mukah (14.8%), Politeknik Sultan Ahmad Shah (12.2%), and Politeknik Tuanku Syed Sirajuddin (8.7%) contributed to the diverse institutional representation in the study. Regarding *Trengkas* course performance, most students achieved high academic success, with 31.6% obtaining an A+, 36.7% receiving an A, and 7.7% earning an A-, indicating that over 75% of the participants attained an A-range grade. Furthermore, 15.3% obtained B+, while a smaller percentage received lower grades (B = 3.6%, B- = 3.1%, and C = 2.0%). Therefore, the findings suggest that most of the predominantly female students possess strong *Trengkas* proficiency and exhibit high academic performance in *Trengkas*, demonstrating a strong grasp of the subject matter.

Table 3 *Demographic Profile of Respondents*

Demographic Profiles	Descriptive	Frequencies	Percentage (%)
Gender	Male	13	6.6
	Female	183	93.4
Age	18 years	3	1.5
	19 years	14	7.1
	20 years	150	76.5
	21 years and above	29	14.8
Institutions	Politeknik Sultan Ahmad Shah	24	12.2
	Politeknik Port Dickson	32	16.3
	Politeknik Sultan Idris Shah	44	22.4
	Politeknik Tuanku Syed Sirajuddin	17	8.7
	Politeknik Mersing	50	25.5
	Politeknik Mukah	29	14.8
Trengkas Course Performance	A+	62	31.6
	A	72	36.7
	A-	15	7.7
	B+	30	15.3
	B	7	3.6
	B-	6	3.1
	C	4	2.0

3.2 One-Way ANOVA

Table 4 indicates that One-Way Analysis of Variance (ANOVA) results indicate significant differences in Speed, Accuracy, and Transcription Efficiency across various grade achievement levels. This demonstrates that students' *Trengkas* proficiency varies according to their academic performance. Levene's Test for Equality of Variances confirmed that the assumption of homogeneity was met ($p > 0.05$ for all variables), justifying the application of One-Way ANOVA. The analysis yielded statistically significant differences in Speed ($F(6,189) = 7.491$, $p = 0.000$), Accuracy ($F(6,189) = 4.159$, $p = 0.001$), and Transcription Efficiency ($F(6,189) = 4.550$, $p = 0.000$), leading to the rejection of the null hypothesis.

Furthermore, post hoc analyses using Games-Howell and Tukey HSD tests revealed that students with A+ grades performed significantly better in all three *Trengkas* proficiency measures than those with B and lower grades. However, no significant differences emerged between some intermediate-grade groups (e.g., A and A-), suggesting a gradual decline in proficiency rather than an abrupt decrease. These findings underscore the strong association between academic achievement and *Trengkas* proficiency, emphasising that students who excel in their coursework tend to develop superior Speed, Accuracy, and Transcription Efficiency skills. Thus, H1 is accepted, as results support the existence of significant differences in *Trengkas* proficiency across skill levels.

Table 4 *Trengkas Proficiency Across Grade Achievement Levels*

Variables	Sum of Squares	df	Mean Square	F-Value	Sig. (p-value)
Speed	13.863	6	2.311	7.491	0.000**
Accuracy	8.086	6	1.348	4.159	0.001**
Transcription Efficiency	8.029	6	1.338	4.550	0.000**

**Correlation is significant at the 0.01 level (2-tailed).

3.3 Multiple Linear Regression Analysis

Correlation analysis was utilised to determine if the data was multicollinear. Multiple regression analyses determine the relative effect of independent and dependent variables to analyse the H2 effect between skill

components (Knowledge, Active Cognition, Conation, Affection, and Sensory Motion Abilities) and Speed, Accuracy, and Transcription Efficiency in *Trengkas* proficiency.

3.3.1 Skills Components and Speed

Table 5 summarises the effect of Knowledge, Affection, Conation, Sensory Motion, and Active Cognition on Speed, identifying the key predictors of transcription speed. The model exhibits a strong overall fit, with an R-value of 0.947 and an R^2 of 0.898, indicating that the independent variables collectively account for 89.8% of the variance in Speed. At the same time, the ANOVA results confirm the model's statistical significance ($F = 333.330$, $p < 0.001$), demonstrating that at least one predictor significantly impacts transcription speed.

Among the predictors, Sensory Motion ($\beta = 0.448$, $p < 0.001$) exerts a significantly positive effect, suggesting that motor skill engagement plays a crucial role in enhancing transcription speed. Additionally, Knowledge ($\beta = 0.286$, $p < 0.001$) and Conation ($\beta = 0.189$, $p < 0.001$) significantly contribute to Speed, indicating that a solid understanding of Trengkas principles and strong motivation enhance Transcription Efficiency. Although Affection ($\beta = 0.158$, $p < 0.001$) positively impacts Speed, its effect size is comparatively smaller. Conversely, Active Cognition ($\beta = -0.041$, $p = 0.368$) does not significantly affect Speed, implying that cognitive engagement alone does not directly enhance transcription speed. In addition, the constant term ($p = 0.188$) is also insignificant, suggesting that transcription speed is predominantly affected by the predictor variables rather than an underlying baseline factor.

These findings underscore that sensory motion skills, domain knowledge, and motivation are the primary determinants of transcription speed rather than cognitive processing alone. In essence, the results suggest that training programmes emphasising motor efficiency and knowledge reinforcement may be more effective in improving *Trengkas* proficiency.

Table 5 *Multiple Linear Regression Test Results for Speed*

Model	UnstandardisedFH1 Coefficients		Standardise Coefficients	t-value	Sig. (p-value)	Interpretation
	B	Std. Error	Beta			
1 (Constant)	-0.143	0.108		-1.322	0.188 (I)	Insignificant
Knowledge	0.304	0.051	0.286	5.988	0.000	Significant positive effect
Affection	0.162	0.042	0.158	3.823	0.000	Significant positive effect
Conation	0.183	0.043	0.189	4.288	0.000	Significant positive effect
Sensory Motion	0.411	0.039	0.448	10.578	0.000	Significant effect
Active Cognition	-0.042	0.046	-0.041	-0.903	0.368 (I)	Insignificant
R	0.947					
R Square	0.898					
F value	333.330					
Sig.	0.000					

Predictor: *p < .05; **p < .01. Exact significance levels in parentheses

3.3.2 Skills Components and Accuracy

Table 6 summarises the effect of Knowledge, Affection, Conation, Sensory Motion, and Active Cognition on Accuracy to identify key predictors of transcription accuracy. The model demonstrated a strong fit ($R = 0.948$, $R^2 = 0.898$), explaining 89.8% Accuracy variance. The ANOVA results confirmed statistical significance ($F = 333.687$, $p < 0.001$), indicating that at least one predictor significantly impacts transcription accuracy.

Among the predictors, Active Cognition ($\beta = 0.500$, $p < 0.001$) had the strongest positive effect, underscoring the importance of cognitive engagement in Accuracy. Conation ($\beta = 0.412$, $p < 0.001$) also played a key role, highlighting motivation's impact on transcription performance. Knowledge ($\beta = 0.227$, $p < 0.001$) contributed positively, reinforcing that understanding *Trengkas* principles enhances Accuracy. Conversely, Sensory Motion ($\beta = -0.140$, $p = 0.001$) negatively affected Accuracy, suggesting a trade-off between motor skills and precision. Affection ($\beta = 0.007$, $p = 0.865$) was insignificant, indicating minimal emotional engagement impact.

These findings suggest that cognitive skills and motivation drive transcription accuracy, whereas motor engagement may hinder precision. Thus, training programmes should prioritise cognitive strategies and motivation-driven learning to optimise *Trengkas* proficiency.

Table 6 *Multiple Linear Regression Test Results for Accuracy*

Model	Unstandardised Coefficients		Standardise Coefficients	t-value	Sig. (p-value)	Interpretation
	B	Std. Error	Beta			
1 (Constant)	-0.001	0.106		-1.322	0.996 (I)	Insignificant
Knowledge	0.236	0.050	0.227	5.988	0.000	Significant positive effect
Affection	0.007	0.042	0.007	3.823	0.865 (I)	Insignificant
Conation	0.392	0.042	0.412	4.288	0.000	Significant positive effect
Sensory Motion	-0.126	0.038	-0.140	10.578	0.001	Significant negative effect
Active Cognition	0.497	0.045	0.500	-0.903	0.000	Significant positive effect
R	0.948					
R Square	0.898					
F value	333.687					
Sig.	0.000					

Predictor: *p < .05; **p < .01. Exact significance levels in parentheses

3.3.3 Skills Components and Transcription Efficiency

Table 7 presents the effect of Knowledge, Affection, Conation, Sensory Motion, and Active Cognition on Transcription Efficiency to identify key predictors of performance. The model exhibited a strong fit ($R = 0.934$, $R^2 = 0.872$), indicating that the predictor variables collectively account for 87.2% of the variance in Transcription Efficiency. The ANOVA results confirmed the model's statistical significance ($F = 258.971$, $p < 0.001$), demonstrating that at least one predictor significantly affects Transcription Efficiency.

Among the predictors, Active Cognition ($\beta = 0.410$, $p < 0.001$) exerted a positive effect, emphasising the role of cognitive engagement in improving Transcription Efficiency. Additionally, Affection ($\beta = 0.242$, $p < 0.001$) exhibited a strong positive effect, suggesting that emotional engagement enhances transcription performance. Furthermore, Sensory Motion ($\beta = 0.167$, $p = 0.001$) and Conation ($\beta = 0.102$, $p = 0.039$) significantly contributed to Transcription Efficiency, underscoring the significance of motor skills and motivation in improving performance. Knowledge ($\beta = 0.113$, $p = 0.036$) was also a significant predictor. This reinforces that understanding *Trengkas* principles enhances Transcription Efficiency.

Conversely, the constant term ($p = 0.189$) was not statistically significant, indicating that Transcription Efficiency is primarily affected by the predictor variables rather than an underlying baseline factor. These findings suggest that cognitive engagement, emotional involvement, and motor skills collectively enhance Transcription Efficiency. Therefore, training programmes should focus on cognitive strategies, emotional reinforcement, and motor skill development to optimise transcription performance.

Table 7 *Multiple Linear Regression Test Results for Transcription Efficiency*

Model	Unstandardised Coefficients		Standardise Coefficients	t-value	Sig. (p-value)	Interpretation
	B	Std. Error	Beta			
1 (Constant)	0.150	0.113		1.319	0.189 (I)	Insignificant
Knowledge	0.112	0.053	0.113	2.107	0.036	Significant positive effect
Affection	0.234	0.045	0.242	5.242	0.000	Significant positive effect
Conation	0.093	0.045	0.102	2.078	0.039	Significant positive effect
Sensory Motion	0.144	0.041	0.167	3.524	0.001	Significant negative effect
Active Cognition	0.391	0.048	0.410	8.095	0.000	Significant positive effect
R	0.934					

R Square	0.872
F value	258.971
Sig.	0.000

Predictor: *p < .05; **p < .01. Exact significance levels in parentheses

Overall results confirm that the five skill components Knowledge, Active Cognition, Conation, Affection, and Sensory Motion Abilities significantly affect Speed, Accuracy, and Transcription Efficiency in *Trengkas* proficiency, leading to the acceptance of H2. The regression models for Speed (R^2 = 0.898, F = 333.330, p < 0.001), Accuracy (R^2 = 0.898, F = 333.687, p < 0.001), and Transcription Efficiency (R^2 = 0.872, F = 258.971, p < 0.001) indicate that the predictor variables collectively explain a substantial proportion of the variance in each dependent variable.

Among the predictors, Active Cognition had the strongest effect on Accuracy and Transcription Efficiency (β = 0.500, p < 0.001 and β = 0.410, p < 0.001, respectively), emphasising the critical role of cognitive engagement in transcription precision and efficiency. Conversely, Sensory Motion had the strongest effect on Speed (β = 0.448, p < 0.001) but negatively affected Accuracy (β = -0.140, p = 0.001), suggesting a trade-off between speed and precision. Additionally, Conation and Affection significantly contributed to Accuracy and Transcription Efficiency, underscoring the significance of motivation and emotional engagement in transcription performance. Additionally, Knowledge positively impacted all aspects of performance, indicating that a good understanding of principles helped stimulate students' memory, thus leading to more efficient transcription. These findings suggest that transcription performance results from cognitive and motor skills, motivation, and emotional engagement. Therefore, H2 is accepted, indicating that all five skill components significantly affect *Trengkas* proficiency, although their effects vary according to Speed, Accuracy, and Efficiency.

4. Discussion and Conclusion

This study applied Skill Acquisition Theory (Dekeyser, 2020) as a foundational lens to understand the multi-faceted development of *Trengkas* proficiency among TVET students. The theory posits three progressive learning stages cognitive, associative, and autonomous (Anderson, 1982) and emphasizes the transformation of declarative knowledge into procedural skill through structured practice and feedback. These stages align well with the progressive mastery required in stenography, particularly *Trengkas*, where speed, accuracy, and efficiency are important. The findings confirmed that the five components of the proposed skills-based framework Knowledge, Affection, Conation, Sensory Motion, and Active Cognition significantly affect *Trengkas* proficiency. For instance, Sensory Motion had the most substantial impact on Speed (β = 0.448, p < .001), consistent with neurocognitive research linking fine motor control with transcription rate (Baumann et al., 2023; Leib et al., 2023). However, its negative effect on Accuracy (β = -0.140, p = .001) echoes concerns raised by Lewthwaite and Wulf (2017), where over-emphasis on motor performance may compromise precision in cognitive tasks.

Conversely, Active Cognition emerged as a critical determinant for Accuracy (β = 0.500, p < .001) and Transcription Efficiency (β = 0.410, p < .001). These results support findings from Sprevak & Smith (2023) and Suzuki & Kormos (2023), who highlight the role of cognitive fluency and predictive processing in enhancing decision-making and performance under time constraints an essential trait in real-time transcription. Conation, reflecting motivational persistence, significantly influenced all three aspects of proficiency. This confirms the theoretical assertions of Valenzuela et al. (2020) and (Costantini et al., 2022), who observed that motivation and goal-directed behavior positively influence skill acquisition and retention. The effect of Affection, while moderate for Speed and Efficiency, was insignificant for Accuracy, suggesting emotional engagement may enhance performance sustainability but does not directly improve technical precision (Ferguson et al., 2021; Wang et al., 2023).

Additionally, the strong positive contribution of Knowledge across all metrics reinforces the premise that both internal recall and external job-related knowledge serve as foundational elements for performance (Pitts et al., 2022; Ward, 2021). The statistically significant differences in proficiency levels across academic grades, as shown by the ANOVA results, provide further support for the hypothesis (H1), confirming that grade achievement levels are associated with transcription performance. These findings complement prior studies on educational assessment in TVET contexts (Green & du Plessis, 2023; Jayalath & Esichaikul, 2020), which underscore the need for differentiated pedagogical strategies based on learners' proficiency levels. Therefore, by incorporating evidence-based teaching practices such as cognitive framing, motivation-based learning, and motor skill reinforcement, students can develop a balanced set of stenographic skills aligned with industry needs. Moreover, the practical implications of this study suggest that an integrated learning approach, which includes theoretical principles, cognitive mechanisms, and motor coordination strategies, will better prepare students for professional transcription applications. Accordingly, future curriculum improvements should

enhance training methodologies through structured learning pathways to achieve comprehensive mastery of *Trengkas* skills.

4.1 Limitations and Future Studies

While the study provides valuable insights into *Trengkas* proficiency, several limitations must be acknowledged. Firstly, the study focuses on the TVET environment at Polytechnic Malaysia, which may limit the applicability of the findings to other educational institutions or different shorthand systems. Furthermore, learning environments, teaching methods, and students' prior experiences may vary across institutions, potentially affecting transcription proficiency. Therefore, future research is recommended to involve cross-institutional studies to enable comparisons across various educational contexts and to provide a more comprehensive understanding of the development of *Trengkas* proficiency.

Second, most data reported from self-reported questionnaires were unsure that responses fully reflected the proficiency levels and their effect on specific factors. This Likert scale approach provides measurable insights into students but fails to encompass real-time transcription capabilities, challenges, and learning experiences. Hence, future studies should include performance-based measures objectively assessing students' Speed, Accuracy, and Transcription Efficiency in real-world settings.

Finally, this study relies heavily on quantitative methods, which, although valuable, may not fully capture the complexity of students' learning experiences. In contrast, qualitative methods such as interviews, focus group discussions, and case studies could provide deeper insights into students' challenges, strategies, and perspectives in mastering *Trengkas* skills. In line with this, student's learning preferences, difficulties adapting to real-time dictation, and the effectiveness of various teaching strategies could further strengthen the proposed skills-based framework.

Furthermore, future research is encouraged to explore technology-enhanced learning approaches. Analysing how digital tools influence the development of *Trengkas* proficiency, such as Artificial Intelligence-based speech-to-text transcription software, gamified learning tools, and virtual reality-based transcription simulations, has the potential to yield new insights. Additionally, various other methodologies can also be explored, such as investigating blended learning approaches (a combination of traditional face-to-face instruction with interactive digital resources), as previously discussed in earlier studies. This approach has the potential to enhance the effectiveness of existing stenography training.

In addition, future research should also consider longitudinal learning progressions, as this can show whether students become more proficient over time. In particular, a longitudinal approach allows researchers to track student development, model key learning periods, and identify the most necessary and effective interventions at various stages of proficiency development. Subsequent studies should also examine how individual differences such as learning styles, cognitive processing speed, and prior experience in stenography provide meaningful context to the skills-based framework. This is to support its implementation among students from diverse backgrounds. Finally, research into the employability outcomes of students based on varying levels of *Trengkas* proficiency may reveal more profound insights into industry expectations and workplace performance requirements. This can help educators align curriculum improvements with professional demands, ensuring students are better prepared with the essential competencies required for successful careers as stenographers.

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Conflict of Interest

The authors declare no conflict of interest or other ethical considerations for this study.

Author Contribution

The authors confirm their contribution to the paper as follows: **study conception and design:** Aziawati Ahmad Azizi, Norsalwati Mohd Razalli, Zainal Ariffin Ahmad; **data collection:** Aziawati Ahmad Azizi, Nurhafizah Hamidon; **analysis and interpretation of results:** Norsalwati Mohd Razalli; **draft manuscript preparation:** Norsalwati Mohd Razalli, Zainal Ariffin Ahmad. All authors reviewed the results and approved the final version of the manuscript.

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