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VISUAL SCAFFOLDING FOR PRACTICAL SKILL DEVELOPMENT: THE INFLUENCE OF TEMPLATE-ASSISTED LEARNING (TALM) ON PASTRY PIPING SELF-EFFICACY IN CULINARY EDUCATION

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Abstract:

Practical skill development in culinary education requires repeated hands-on practice, feedback, and confidence in performing psychomotor tasks. However, limited practical contact hours and restricted opportunities for independent practice may hinder students' development of practical self-efficacy. This study examined the influence of Template-Assisted Learning Material (TALM) as a visual scaffolding approach on students' self-efficacy in pastry piping skills. Grounded in Bandura's Self-Efficacy Theory, a quantitative pre-test–post-test experiment design was employed with students participating in a practical pastry piping lesson. Data were collected using a five-item self-efficacy questionnaire administered before and after the TALM intervention. Following data screening and matching, 17 paired responses were retained for analysis. Paired-samples t-tests were conducted to examine changes in students' self-efficacy. The findings demonstrated a substantial improvement in overall self-efficacy, with the mean score increasing from 2.72 to 3.87, representing a 42.5% gain. All five self-efficacy items showed statistically significant improvements ($p < .05$). The largest improvement was observed in nozzle selection confidence, which increased by 54.8%, followed by task independence (44.2%) and assessment preparedness (42.9%). The findings suggest that TALM can provide effective visual scaffolding by reducing uncertainty, supporting self-monitoring, and facilitating successful task performance. TALM offers a practical instructional strategy for strengthening students' confidence and autonomy in hands-on pastry education.

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Introduction

Practical skills constitute a foundational component of culinary and pastry education, where learning outcomes depend not only on students' acquisition of theoretical knowledge but also on their ability to translate that knowledge into accurate, consistent, and independent psychomotor performance (Malayao & Buniel, 2025; Woodhouse & Rodgers, 2024). Unlike conventional classroom instruction, practical culinary training requires integrating procedural knowledge, fine psychomotor coordination, sensory judgment, and self-confidence in authentic task environments (Sya'ni et al., 2025). For beginner learners, mastering these competencies concurrently presents a significant cognitive and physical challenge (Yue Fen et al., 2026), particularly when executing precision-based techniques that require precise motor control, pressure regulation, and spatial consistency (Zaenal et al., 2026).

Pastry piping is a quintessential example of a technical culinary skill requiring the coordinated application of cognitive and psychomotor capabilities, as supported by Rajan (2025). Successful piping execution involves selecting an appropriate nozzle, understanding the functional relationship between nozzle geometry and the resulting extruded pattern, controlling hand pressure and movement velocity, and maintaining uniform size, shape, and spacing (Koerich et al., 2024; Zaenal et al., 2026). Although culinary instructors routinely demonstrate these techniques, novice students often struggle to translate visual demonstrations into independent execution. Specifically, while students may recognise different nozzle types theoretically, they often experience uncertainty when matching a specific nozzle to a required design or visualising how the tool operates in three-dimensional space (Zaenal et al., 2026). This cognitive disconnect between tool identification and practical execution impairs performance consistency and undermines student self-confidence during practical laboratory sessions (Koerich et al., 2024; Yue Fen et al., 2026).

Within this instructional context, self-efficacy represents a crucial psychological determinant of practical learning and skill acquisition, as supported by (Latip et al., 2022). Bandura (1977) conceptualised self-efficacy as an individual's belief in their ability to organise and execute the courses of action required to achieve designated performance outcomes. Self-efficacy influences task choice, effort, persistence, and coping with obstacles (Bandura & Adams, 1977). Vocational and practical-training studies align with this pattern, showing that self-efficacy helps learners persist through technical challenges and perform better in hands-on contexts (Jiang, 2024). Indeed, students possessing stronger self-efficacy are more inclined to engage proactively with challenging tasks and persist through repetitive practice. Conversely, students with lower self-efficacy frequently exhibit hesitation, heavy dependence on

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continuous instructor intervention, or task avoidance (Latip et al., 2022). Thus, cultivating students' confidence in their execution capabilities is an essential precursor to achieving technical mastery.

According to self-efficacy theory, the most influential source of efficacy beliefs is enactive mastery experience, wherein authentic task success provides learners with tangible evidence of their capabilities (Bandura, 1977; Bandura & Adams, 1977). However, opportunities for mastery experiences are often constrained when novice learners lack structured guidance during independent practice (Zaenal et al., 2026). In typical high-density practical laboratory environments, instructors must supervise multiple students simultaneously, making continuous individualised feedback unfeasible (Woodhouse & Rodgers, 2024). As a result, learners require instructional aids that provide consistent, task-specific scaffolding beyond the initial demonstration phase. Visual scaffolding is a highly effective pedagogical strategy because it makes procedural expectations and target outcomes explicit, allowing learners to reference structural benchmarks autonomously throughout practice (Minishi et al., 2024; van Nooijen et al., 2024).

Despite the acknowledged importance of instructional resources in culinary education, limited empirical research has investigated the role of structured visual scaffolding in fostering self-efficacy for specialised pastry psychomotor skills (Zaenal et al., 2026). Traditional culinary pedagogy relies primarily on instructor demonstration, verbal instruction, and unassisted trial-and-error practice(Woodhouse & Rodgers, 2024). While these conventional methods remain fundamental, they may not adequately support novice learners who struggle to visualise the dynamic spatial relationship between tool selection, hand movement, and the resulting physical design. An instructional aid that explicitly bridges these spatial and procedural relationships can reduce cognitive load, diminish execution anxiety, and foster self-directed learning, as supported by previous scholars (Minishi et al., 2024).

To address this, the present study introduces Template-Assisted Learning Material (TALM) as a structured visual and physical scaffolding aid for pastry piping instruction. TALM provides learners with an accessible reference that links nozzle identification directly to visual design outcomes and spatial execution guidelines. The material functions as an active scaffold during practical sessions, enabling students to continuously consult the visual reference, self-assess their execution accuracy, and progressively transition toward independent, unassisted performance. Accordingly, this study investigates the empirical effectiveness of TALM in enhancing students' practical self-efficacy in pastry piping tasks.

Literature Review

Underpinning theory -Bandura's Self-Efficacy Theory

This study is grounded in Bandura (1977) Self-Efficacy Theory, a central construct within Social Cognitive Theory. Bandura defined self-efficacy as an individual's belief in their capability to organise and execute the courses of action required to produce designated performance attainments (Bandura & Adams, 1977). Rather than reflecting an individual's actual physical skill level, self-efficacy represents a generative mechanism involving cognitive processing and self-appraisal of one's ability to perform under specific conditions.

In culinary and practical skill education, self-efficacy functions as a critical psychological determinant of learning outcomes (Jiang, 2024). It directly governs learners' choice of tasks, level of effort expenditure, persistence when encountering technical difficulties, and emotional resilience in high-stakes assessment environments, as supported by Bandura & Adams (1977). Students who possess high practical self-efficacy are more likely to approach complex technical tasks as challenges to be mastered, whereas those with low self-efficacy tend to perceive technical demands as personal threats, leading to task hesitation, heavy reliance on instructor intervention, or task avoidance. Thus, Bandura's Self-Efficacy Theory underlines the philosophical underpinning of the study.

Reality Of Hands-On Kitchen Classes In Higher Education Settings

Practical skill acquisition in higher education culinary and pastry art programmes operates within tightly structured institutional timeframes (Abdul Latip et al., 2025). Academic semesters in public and private higher education institutions are typically organised into 10 to 14 weeks of instruction during regular semesters and 7 to 9 weeks during shorter semesters. Within these condensed academic schedules, culinary students are required to complete multiple modules concurrently, including core technical culinary subjects alongside university- and faculty-level requirements (Woodhouse & Rodgers, 2024). This structure creates considerable time pressure and limits the amount of time available for repeated practical skill development(Ma et al., 2023; Sya'ni et al., 2025).

The constraints are particularly evident in practical culinary education, where learning requires access to specialised kitchen laboratories, commercial equipment, and perishable food ingredients (Zaenal et al., 2026). Unlike theoretical subjects, where students can readily engage in self-directed learning outside scheduled classes, practical culinary skills depend heavily on physical facilities and supervised laboratory sessions. Consequently, students often have limited opportunities to access kitchen facilities beyond scheduled practical classes, restricting their ability to practice independently, repeat tasks, and develop skills deliberately (Woodhouse & Rodgers, 2024).

Contextual Challenges In Culinary And Pastry Arts Education

Traditionally, practical culinary instruction relies substantially on vicarious learning (Bandura, 1997), whereby instructors demonstrate specific techniques, such as nozzle selection, piping angle, hand positioning, and pressure control, before students attempt to replicate the demonstrated procedures (Azlan & Goh, 2026; Lehrer, 2024; Zaenal et al., 2026). While demonstration is essential for psychomotor skill development, the conventional approach presents several pedagogical challenges. First, restricted practical contact hours limit opportunities for repeated practice. A practical culinary session may be allocated approximately 4 to 6 hours per week for a particular course or subject. However, a considerable proportion of this time is devoted to administrative briefings, instructor demonstrations, mise en place, sanitation procedures, and kitchen cleaning. The actual time available for individual skill practice is therefore substantially reduced, as supported by Koerich et al. (2024).

Second, high student-to-instructor ratios can constrain individualised instructional support. In practical laboratory classes involving approximately 8 to 20 students, instructors must simultaneously monitor multiple learners, manage safety and workflow, and provide technical feedback. As a result, the amount of direct, individualised guidance available to each student during a practical session may be limited as argued by previous scholars (Koerich et al., 2024; Minishi et al., 2024; Woodhouse & Rodgers, 2024).

Third, cognitive decay between demonstration and execution represents an important challenge for novice learners (Woodhouse & Rodgers, 2024). Following an instructor demonstration, students must retain procedural, spatial, and motor information while preparing their workstations and equipment. When students begin independent practice, some details of the demonstration may no longer be readily accessible, particularly precise hand positioning, piping angle, pressure control, nozzle selection, and the required spatial pattern (Sya'ni et al., 2025; Zaenal et al., 2026). This gap between observation and execution may increase students' dependence on trial-and-error learning and repeated instructor clarification.

Methodology

Research Design And Context

This study employed a quantitative single-group pre-test and post-test pre-experimental research design to evaluate the effectiveness of a TALM tool on students' self-efficacy in practical pastry piping tasks. The research was conducted within the Faculty of Hotel and Tourism Management at a higher education institution in Malaysia. The intervention was embedded into the practical curriculum of the *Fundamentals of Baking* course, a core technical module designed to establish foundational psychomotor competencies in culinary and pastry arts.

Participants And Sampling Procedure

The target population comprised Semester 1 diploma students enrolled in the Fundamentals of Baking course. Purposive sampling was employed using two intact laboratory class sections, each comprising 12 enrolled students, resulting in an initial sample of 24 students. Each class lasted for 6 hours. Participation was voluntary, and informed consent was obtained from all participants prior to data collection. Participants were informed that their decision to participate or withdraw from the study would not affect their academic standing.

Following a two-phase survey administration, data auditing was conducted to pair baseline and post-intervention responses:

1. Baseline (Pre-test): All 24 students (100% response rate) completed the initial survey.
2. Post-Intervention (Post-test): 19 responses were collected. Data cleaning identified one duplicate entry and two respondents who completed only a single phase.
3. Final analytical sample: A matched cohort of $N = 17$ students ($df = 16$) who voluntarily completed both pre- and post-intervention evaluation waves was retained for inferential statistical analysis.

After data screening and matching, 17 students who had completed both the pre-test and post-test surveys were retained as the final analytical sample, representing 70.83% of the initial cohort. Only matched responses were included in the inferential analysis to assess changes in students' self-efficacy at the individual level across the two measurement points.

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Instructional Intervention And Experimental Procedure

The experimental procedure was structured across three distinct instructional phases during a scheduled practical laboratory session (Refer to Figure 2).

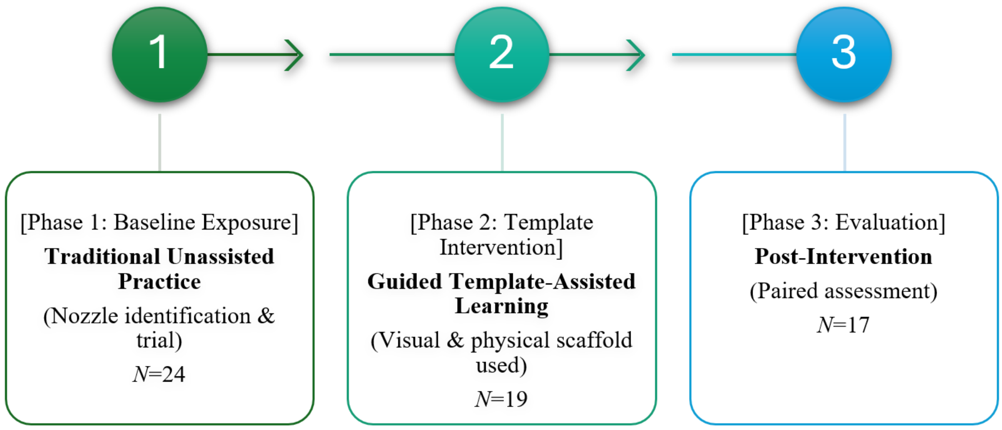

Figure 1: Study Instructional Phases

Source: Author's own sources

Phase 1: Initial Unassisted Exposure (Baseline)

Prior to introducing the template tool, students received a standard traditional demonstration from the course instructor on basic piping techniques (such as, nozzle fitting, bag holding, pressure control, and border formation). Students were given a single unassisted trial session to perform piping tasks using standard piping bags and various nozzle tips. Immediately following this unassisted exposure, students completed the Pre-Intervention Self-Efficacy Survey to establish baseline confidence scores.

Phase 2: Template-Assisted Learning (Intervention)

In the subsequent instructional lesson, the TALM Template was introduced as a physical and visual scaffolding aid. The template consisted of a laminated, food-safe printed surface featuring 1:1 scale visual diagrams matching specific nozzle tips to their corresponding extruded piping designs, complete with spatial boundaries and hand-angle indicators. Students performed practical piping drills directly over/alongside the guided template sheets (refer Figure 2).

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Figure 2: TALM Intervention Session.
Source: Author's own sources

Phase 3: Post-Intervention Evaluation

Immediately after concluding the template-assisted lesson, students administered the Post-Intervention Survey using identical self-efficacy questionnaire items to evaluate changes in perceived competency and readiness.

Research Instrument And Operationalisation

The survey instrument was developed to assess students' practical self-efficacy in pastry piping tasks, drawing on Bandura's (1997) self-efficacy framework. The instrument focused on students' perceived capability to perform key aspects of the piping process, particularly those requiring the integration of cognitive understanding, psychomotor control, and affective confidence. The questionnaire comprised five core Likert-scale items representing distinct aspects of practical self-efficacy: Nozzle Selection Confidence, Task Independence, Design Consistency, Skill Mastery Belief, and Assessment Preparedness.

Nozzle Selection Confidence assessed students' confidence in identifying and selecting the appropriate piping nozzle to produce a desired icing pattern. This item represented the cognitive dimension of practical self-efficacy, particularly students' ability to associate nozzle type and shape with the expected piping outcome. Meanwhile, Task Independence measured students' confidence in performing the piping task without continuous assistance or guidance from the instructor. This represented the psychomotor dimension, reflecting students' perceived ability to independently execute the required practical procedure.

Moreover, Design Consistency assessed students' confidence in maintaining consistent size, shape, spacing, and visual pattern during piping. This item represented the psychomotor dimension of self-efficacy, particularly the perceived ability to control hand movement, pressure, speed, and spatial positioning during practical execution. Besides, Skill Mastery Belief measured students' confidence in their ability to develop and successfully master pastry piping skills through practice and repeated performance. This represented the affective dimension, reflecting students' perceived capability to improve and successfully perform the skill.

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Additionally, Assessment Preparedness assessed students' confidence in performing piping tasks during practical assessment or examination conditions. This item represented the affective dimension, capturing students' perceived readiness to demonstrate the required skill under evaluative conditions.

Each item was rated using a five-point Likert scale, ranging from 1 = Strongly Disagree to 5 = Strongly Agree, with higher scores indicating greater perceived self-efficacy in performing pastry piping tasks. The same instrument was administered during both the pre-test and post-test to enable comparison of students perceived self-efficacy before and after exposure to the TALM intervention.

Data Analysis Protocol

All survey responses were coded and analysed using Excel, Python (scipy.stats) and, where applicable, IBM SPSS Statistics. The analysis was conducted based on the 16 matched pre-test and post-test responses retained after data screening. To address the research objectives, three levels of analysis were performed as outlined below:

1. First, descriptive statistics were used to summarise students' self-efficacy scores before and after the TALM intervention. Means (M), Standard Deviations (SD), Mean Differences (Δ), and Percentage Gains (%) were calculated for baseline and post-intervention scores, which use to to describe the direction and magnitude of changes in students perceived self-efficacy following the intervention.
2. Second, an inferential statistic was conducted to determine whether the differences between pre-test and post-test scores were statistically significant. A Paired-Samples t-Test ($\alpha = .05$, two-tailed) was executed to evaluate whether mean score improvements were statistically significant ($p < .05$). Prior to conducting the test, the distribution of the paired difference scores was examined to assess the normality assumption required for the paired-samples t-test.
3. Third, effect size analysis was conducted to determine the practical magnitude of the observed changes beyond statistical significance. Standardised effect sizes were calculated using Cohen's d for paired samples ($d = \bar{d}/SD_{\text{diff}}$) to determine the practical magnitude of the instructional intervention, categorised as small ($d = 0.20$), medium ($d = 0.50$), or large ($d \geq 0.80$). The combination of statistical significance and effect size provided a more comprehensive assessment of the effectiveness of the TALM intervention on students' practical self-efficacy.

Data Analysis

Sample Screening, Data Cleaning, And Matching Procedure

To evaluate the empirical impact of the TALM intervention on culinary students' self-efficacy during a practical pastry piping lesson, a two-wave survey design was executed (pre-intervention vs post-intervention). Data were gathered using a structured questionnaire administered immediately before template introduction (baseline survey) and after completion of the template-assisted practical session.

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A total of $N_{\text{pre}} = 24$ responses were recorded in the baseline survey, whereas $N_{\text{post}} = 19$ submissions were registered in the post-intervention wave. To preserve data integrity and meet the parametric assumptions of paired inferential testing, a rigorous multi-stage data auditing and matching protocol was conducted, including duplicate response identification and crossmatching between pre- and post-test sets. Moreover, only participants who provided complete, verifiable responses across both survey phases were retained. This screening yielded a final matched sample of N=17 paired respondents, which was used in data analysis.

Assumption Testing For Normality

Prior to conducting the paired-samples t-test, the parametric assumption of normality was evaluated on the difference scores ($\Delta = \text{Post} - \text{Pre}$) using the Shapiro-Wilk *(W)* test ($N = 17$). The composite overall self-efficacy difference scores satisfied the normality assumption ($W = 0.947, p = .418$). Individually, difference scores for Q2 ($W = 0.932, p = .234$), Q3 ($W = 0.930, p = .222$), Q4 ($W = 0.919, p = .141$), and Q5 ($W = 0.926, p = .189$) were all normally distributed ($p > .05$). Although Q1 exhibited a minor deviation from normality ($W = 0.884, p = .037$) due to rapid baseline-to-post-test score ceiling shifts, a supplementary non-parametric Wilcoxon Signed-Rank test confirmed that the improvement remained highly statistically significant ($W = 0.0, p = .0008$). Consequently, parametric paired-samples t-test statistics were retained for reporting consistency.

Item-Level Analysis Of Self-Efficacy Constructs

Table 1 outlines the item-by-item breakdown of mean scores, standard deviations, mean differences (Δ), percentage gains, paired t-statistic, and p-values across the five self-efficacy items. Across all five items, the overall composite self-efficacy score increased significantly from a pre-test baseline of $M = 2.71\ (SD = 1.07)$ to a post-test mean of $M = 3.87\ (SD = 0.71)$, representing an overall mean gain of $+1.15$ Likert points ($+42.4\%$). A paired-samples t-test confirmed that this overall improvement was statistically significant, $t(16) = 3.872, p = .0014$,Cohen's $d = 0.94$, demonstrating a large practical intervention influence across all students. Additionally, to better understand the findings in detail, it was divided into 3 sub-sections.

Table 1: Paired-Samples t-Test For Survey Items ($N = 17$)

Items code	Self-Efficacy Construct	Pre-Test Mean (SD)	Post-Test Mean (SD)	Mean Diff (Δ)	Gain (%)	t-statistic	p-value	Cohen's *d*	Cohen's *d* effect
Q1	**Nozzle Selection Confidence** *(I am confident in selecting the correct piping nozzle)*	2.47 (0.87)	3.82 (0.88)	+1.35	+54.8%	4.770	0.0002	**1.16**	Large
Q2	**Task Independence** *(I can perform piping tasks without assistance)*	2.53 (1.12)	3.65 (0.79)	+1.12	+44.2%	3.271	0.0048	**0.79**	Medium
Q3	**Design Consistency**	2.71 (1.26)	3.71 (0.85)	+1.00	+37.0%	2.828	0.0121	**0.69**	Medium

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	(I am confident producing consistent piping designs)								
Q4	**Skill Mastery Belief** *(I believe I can master piping skills taught in this course)*	3.00 (1.22)	4.06 (0.90)	+1.06	+35.3%	3.497	0.0030	**0.85**	Large
Q5	**Assessment Preparedness** *(I feel prepared for practical pastry assessments)*	2.88 (1.32)	4.12 (0.60)	+1.24	+42.9%	3.347	0.0041	**0.81**	Large
Average		2.71 (1.07)	3.87 (0.71)	+1.15	+42.4%	-	-	-	-
Note: Statistical significance established at $p < 0.05$ (two-tailed). Degrees of freedom $df = 16$. Cohen d (0.2 = Small effect, 0.5 = Medium effect, and 0.8 = Large effect)									

Source: Author's own sources

Cognitive Offloading And Tool Selection Precision (Item Q1)

A detailed analysis reveals how the template-assisted learning intervention targeted cognitive mapping, psychomotor control, and affective readiness among culinary students. The most substantial shift was observed in students' confidence regarding nozzle selection (Q1), which recorded the largest mean increase ($\Delta = +1.35$, $+54.8\%$) and a very large, standardised effect size ($t(16) = 4.770, p = .0002$, Cohen's $d = 1.16$). Baseline scores indicated that tool selection was students' primary weakness ($M = 2.47, SD = 0.87$), driven by the cognitive challenge of associating metal nozzle tips with three-dimensional extruded icing patterns. This difficulty may have stemmed from students' uncertainty about which nozzle number and shape would produce a particular piping pattern. The TALM provided a clear visual guide that connected the physical nozzle to the expected piping shape, helping students more easily understand what pattern each nozzle would produce. This visual guidance may have reduced confusion during tool selection and contributed to the significant improvement in students' confidence, with the post-test mean increasing to 3.82 ($M = 3.82, SD = 0.88$).

Autonomy Scaffolding And Motor Execution Consistency (Items Q2 & Q3)

In addition to cognitive offloading, the intervention significantly scaffolded student autonomy and motor execution consistency. Perceived task independence (Q2) improved markedly ($\Delta = +1.12, +44.2\%, t(16) = 3.271, p = .0048$, Cohen's $d = 0.79$), while confidence in producing consistent piping designs (Q3) increased by $+1.00$ Likert point ($t(16) = 2.828, p = .0121$, Cohen's $d = 0.69$). In a practical pastry class, students may initially require frequent guidance from instructors to determine the correct hand position, piping direction, pressure, and pattern. The visual boundaries and shape guides provided by the template allowed students to follow the required pattern more easily while monitoring their own performance. This guidance may have enabled students to make adjustments during the task with less dependence on instructor assistance, thereby supporting greater confidence in performing piping tasks independently and producing more consistent designs.

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Affective Mindset, Anxiety Mitigation And Assessment Readiness (Items Q4 & Q5)

The intervention exerted a profound influence on students' affective mindset and assessment readiness. Students' belief in their capacity to master the piping technique (Q4) rose significantly from a neutral baseline to high agreement ($M_{\text{pre}} = 3.00, M_{\text{post}} = 4.06, \Delta = +1.06, t(16) = 3.497, p = .0030$,Cohen's $d = 0.85$). In accordance with Bandura's self-efficacy framework, experiencing early, scaffolded success provided enactive mastery experiences that fostered a positive growth mindset. Alongside, practical assessment preparedness (Q5) achieved the highest post-intervention rating across the study ($M = 4.12, \Delta = +1.24, t(16) = 3.347, p = .0041$,Cohen's $d = 0.81$). Standard deviation for assessment preparedness dropped sharply from $SD = 1.32$ to $SD = 0.60$. This variance demonstrates that the template successfully mitigated evaluation anxiety and elevated lower-performing students to a shared, high-confidence benchmark ahead of summative practical examinations.

Discussion

The findings indicate that the use of TALM was associated with an improvement in students' self-efficacy in practical pastry piping skill. This finding suggests that TALM can serve as a useful visual learning scaffold for novice students who must integrate procedural knowledge, psychomotor coordination, and confidence during practical performance. Rather than relying solely on instructor demonstration and verbal explanation, students were provided with a structured visual reference they could consult during practice. This may have reduced uncertainty and helped students approach piping tasks with greater confidence as supported by Woodhouse & Rodgers (2024).

The findings are consistent with Bandura (1977) self-efficacy theory, particularly the importance of mastery experiences in developing perceived capability. Students develop stronger self-efficacy when they experience successful performance and recognise that they are capable of completing a task. In the present study, TALM may have supported mastery experiences by breaking the piping task into more understandable visual components. Students could observe the expected piping outcome, attempt the technique, compare their performance with the reference, and repeat the process. Such repeated practice may have provided students with tangible evidence of improvement and consequently strengthened their belief in their ability to perform the skill.

An important aspect of the intervention concerns Nozzle Selection Confidence. For novice students, selecting an appropriate piping nozzle can be challenging because they need to understand the relationship between the nozzle shape and the resulting icing pattern (Zaenal et al., 2026). Knowing the nozzle number or name does not necessarily mean that students understand what pattern it will produce. TALM may have addressed this cognitive difficulty by visually connecting the nozzle with its corresponding piping outcome. This visual mapping can reduce the cognitive uncertainty involved in tool selection and allow students to make practical decisions with greater confidence. The finding therefore highlights the potential value of visual representations in supporting the transition from theoretical knowledge to practical application.

The improvement in Task Independence also suggests that TALM may reduce students' reliance on continuous instructor assistance. During practical classes, novice learners often seek confirmation before selecting tools or executing unfamiliar movements. A readily available template can provide immediate task-related guidance, allowing students to attempt the task independently before seeking further assistance (Minishi et al., 2024). This supports learner autonomy while maintaining the instructor's role as a facilitator and provider of corrective feedback. In this way, TALM complements rather than replaces instructor-led demonstration.

Similarly, Design Consistency is an important indicator of practical self-efficacy because successful piping requires control over hand pressure, movement, speed, spacing, and pattern formation. The template provides students with a visual representation of the desired design that they can use as a reference during repeated practice. This may support self-monitoring and enable students to recognise discrepancies between their intended and actual performance. Consequently, TALM may help students progressively refine their psychomotor control rather than simply reproducing a demonstrated movement from memory.

The improvement in Skill Mastery Belief further indicates that the intervention may have influenced students' perceptions of their capacity to develop the skill through practice. Repeated successful attempts can help learners perceive piping as a skill that can be learned progressively rather than as an ability possessed only by more experienced students. This aligns with the mastery-based explanation of self-efficacy, in which successful experiences strengthen confidence and encourage continued engagement with challenging tasks (Bandura, 1977).

The improvement in Assessment Preparedness is also pedagogically significant. Practical assessments require students to demonstrate skills with less immediate instructor support and often under time or performance pressure. Regular practice using a consistent visual reference may increase familiarity with the required procedure and expected outcome, thereby reducing uncertainty before assessment. TALM may therefore contribute not only to learning during laboratory practice but also to students' perceived readiness to demonstrate their skills in formal assessment conditions.

Academic And Practical Implications

Academically, this study contributes to the literature on practical skills education by extending the application of self-efficacy theory to pastry and culinary learning. The findings suggest that self-efficacy in psychomotor tasks can be supported through structured visual scaffolding that connects cognitive understanding with physical execution. In particular, TALM provides a practical mechanism through which students can translate knowledge of tools and techniques into perceived capability to perform a practical task.

The study also contributes to the limited literature on material-supported approaches to practical culinary education. While self-efficacy has been widely examined in academic and vocational learning, comparatively less attention has been given to how visual learning materials can support confidence during hands-on pastry skill development. By focusing on nozzle selection, task independence, design consistency, skill mastery, and assessment preparedness, the study provides a more task-specific perspective on practical self-efficacy.

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Practically, the findings suggest that TALM can be incorporated into practical pastry instruction as a supplementary learning aid. Instructors can use templates to visually demonstrate the relationship between piping nozzles, hand movements, and expected design outcomes before students begin independent practice. This may be particularly beneficial for novice students who have difficulty translating verbal explanations or instructor demonstrations into physical movements.

TALM may also help promote greater learner independence during laboratory sessions. Instead of repeatedly seeking confirmation from instructors, students can refer to the visual material when selecting tools, following procedures, or checking their piping patterns. This allows instructors to focus more on individual corrective feedback and higher-level coaching while students manage routine aspects of their practice.

For curriculum and instructional design, TALM can be integrated into skills-based teaching materials, practical laboratory manuals, digital learning resources, or assessment preparation activities. Its relatively simple format also makes it adaptable to different learning environments without requiring substantial changes to existing practical teaching arrangements.

Study Limitations And Future Research Directions

This study had several limitations. First, the study involved a small final analytical sample of 16 students from two intact laboratory classes at a single higher education institution in Malaysia. Purposive sampling and a single institutional context limit the generalisability of the findings to other culinary programmes, institutions, and student populations. Therefore, the findings should be viewed as preliminary evidence of TALM's potential value rather than broadly generalisable conclusions.

Next, although students' self-efficacy improved following the intervention, the design does not allow the improvement to be attributed exclusively to TALM. Other factors, such as repeated practice, instructor feedback, familiarity with the piping tasks, and normal skill development, may have contributed to the observed changes. Future studies should consider quasi-experimental or experimental designs with control or comparison groups to establish stronger causal evidence.

Moreover, the study measured self-reported self-efficacy rather than actual psychomotor performance. Increased confidence may not necessarily correspond to equivalent improvement in technical competency. Future research should therefore combine self-efficacy measures with objective performance indicators, such as nozzle selection accuracy, piping consistency, design quality, task completion time, and expert-rated practical performance. This would allow researchers to determine whether increased confidence translates into measurable skill improvement.

Future research should also incorporate longitudinal follow-up assessments to determine whether improvements in self-efficacy are sustained over time. A delayed post-test could provide evidence regarding the retention of both confidence and practical skills. In addition, researchers could investigate whether continued use of TALM gradually reduces students' dependence on visual scaffolding as they develop greater autonomy and mastery.

Conclusion

This study demonstrates the potential of TALM as a practical visual scaffold for enhancing students' self-efficacy in pastry piping tasks. The findings indicate improvements in students' confidence in nozzle selection, independent task execution, design consistency, skill mastery, and assessment preparedness following the intervention. TALM provides a clear connection between tool selection, piping technique, and expected design outcomes, supporting students as they progress from instructor-guided demonstration towards more independent practice. Despite the study's small sample and pre-experimental design, the findings provide promising preliminary evidence for incorporating visual scaffolding into practical culinary education. Future research using larger samples, control groups, and objective performance measures is recommended to further validate TALM's effectiveness.

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Ethics Statement:	The course involved in this study has obtained approval from faculty and the University, and the study was conducted in adherence to the institutional ethics guidelines. Participants were confirmed to participate voluntarily.
Author Contribution Statement:	The author contributed significantly to the development of this manuscript. The full-size TALM template is available upon request from the corresponding author, which can be used in class.

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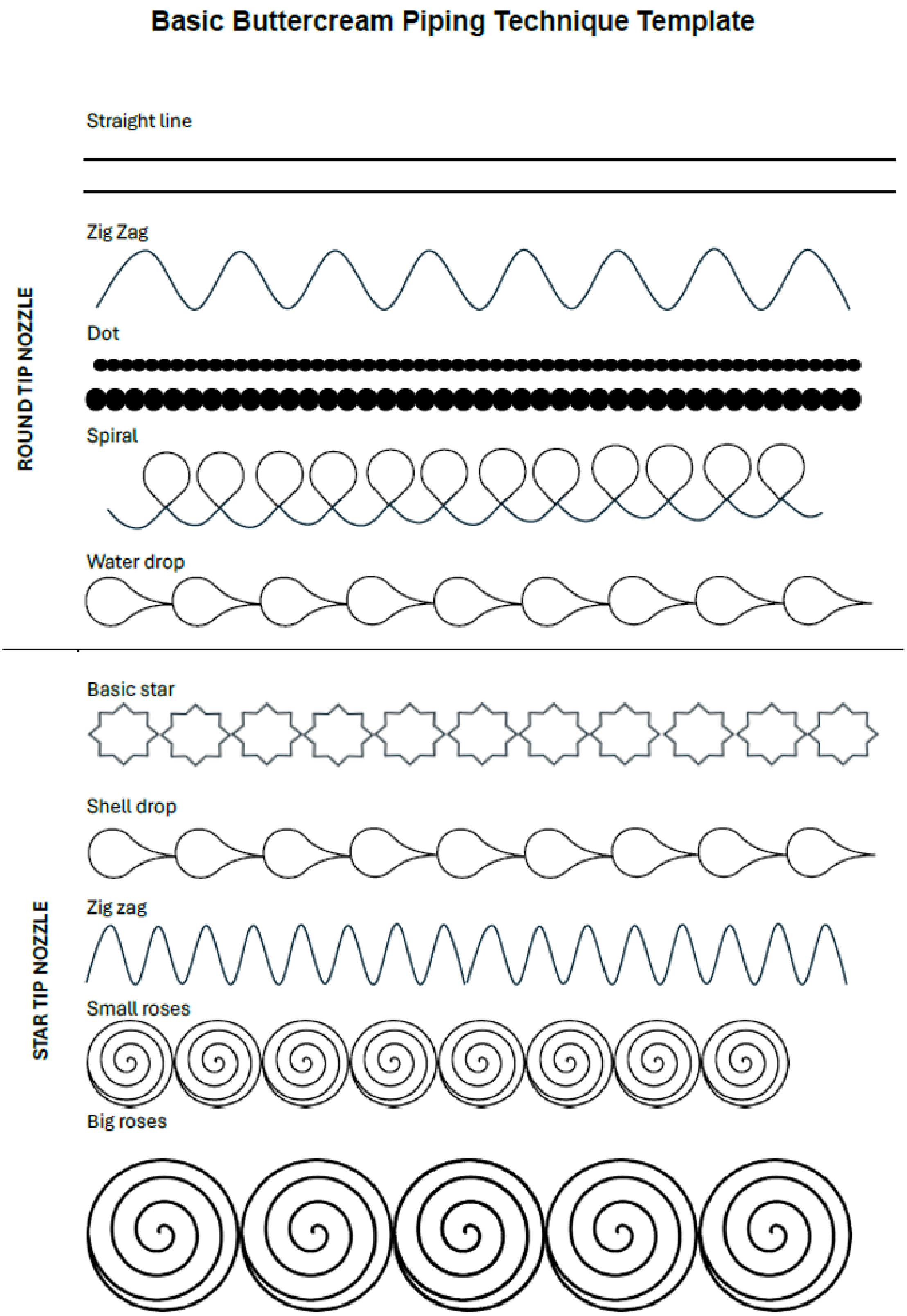
Appendix 1 – The Full-Size Template for Basic Piping Techniques in Cake Decoration
(The full-size template is available upon request from the corresponding author.)



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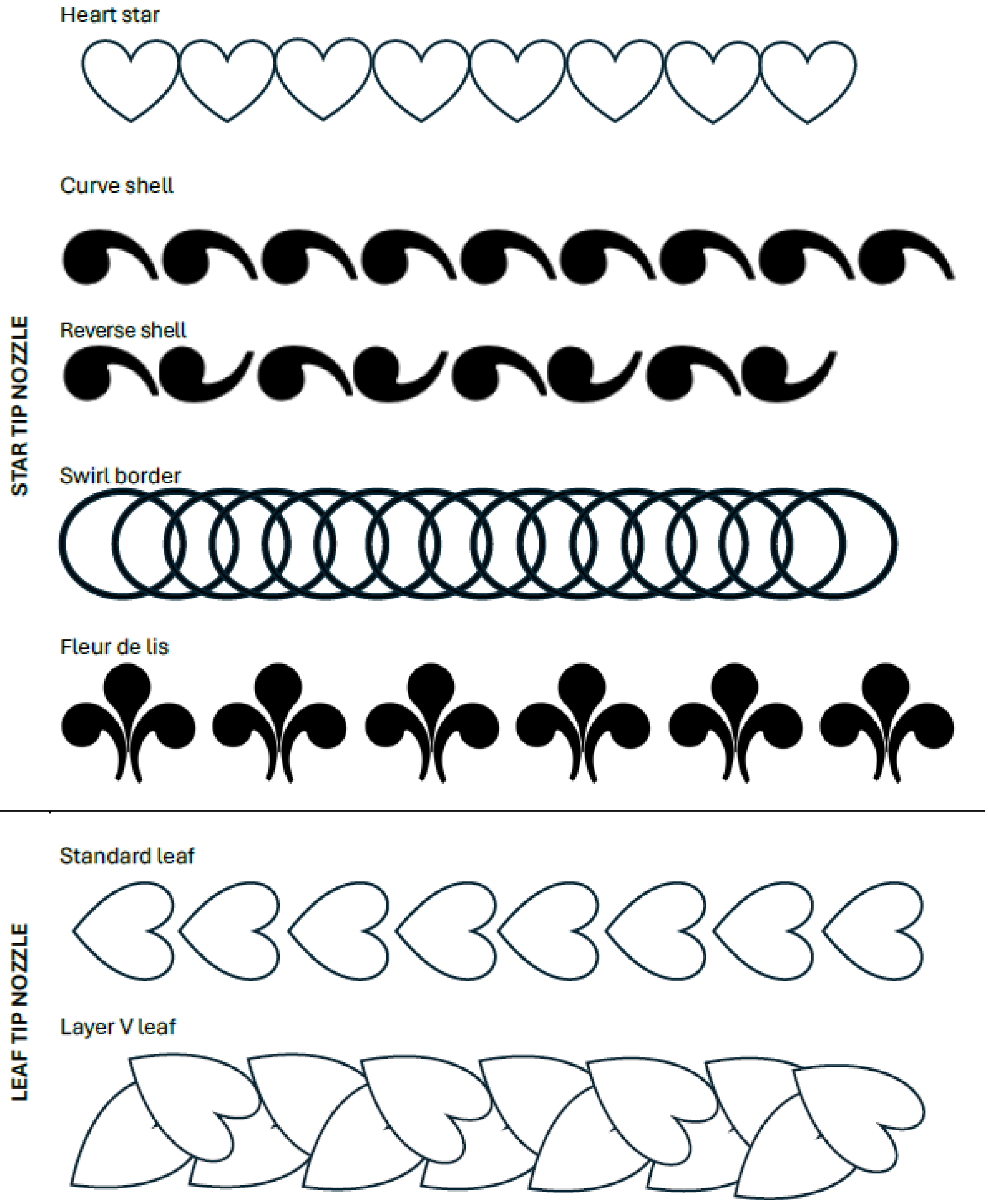

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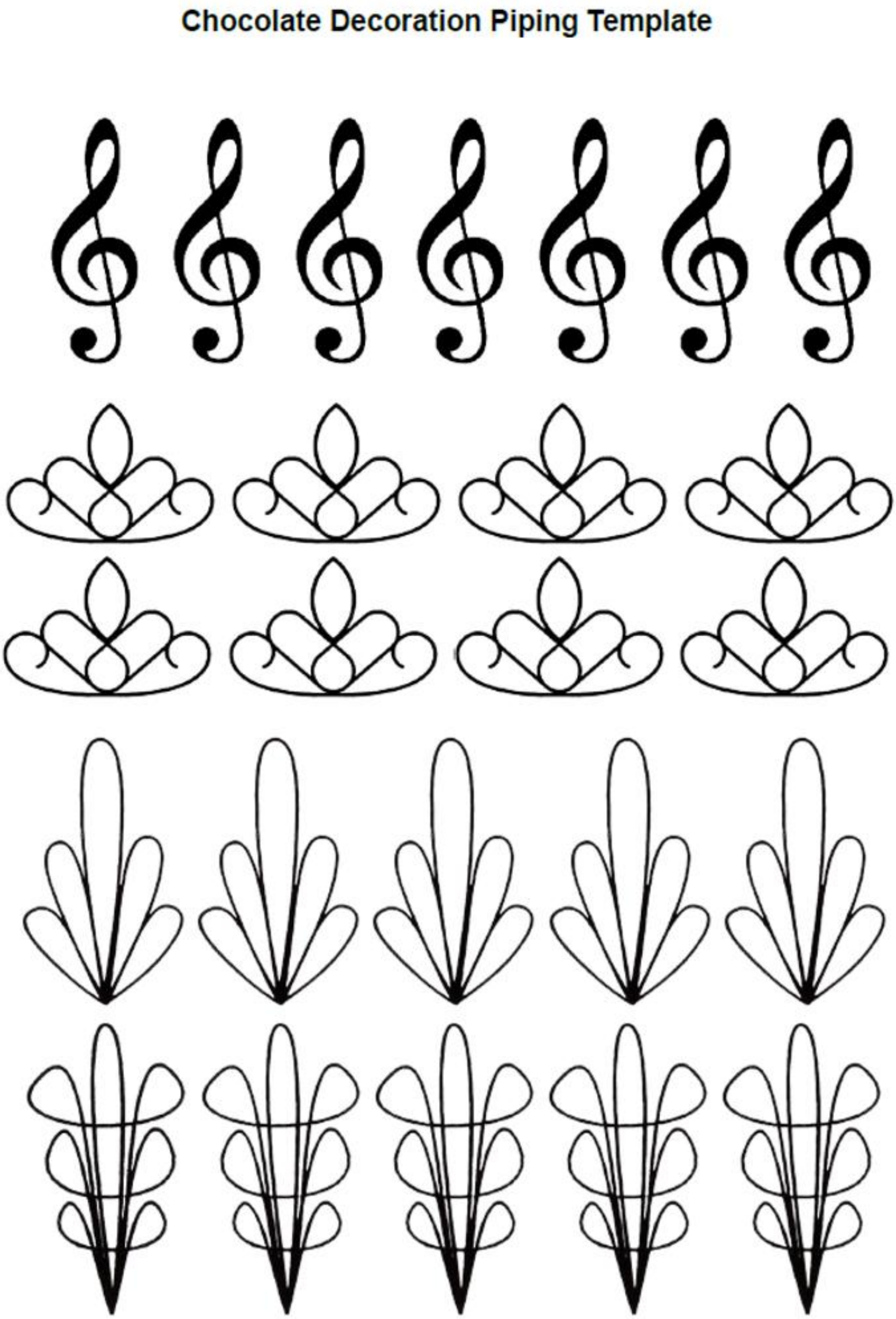
Appendix 2 – The Full-Size Template for Basic Piping Techniques in Chocolate Decoration ***(The full-size template is available upon request from the corresponding author.)***



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