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Effect of Team Assisted Individualization on Fabric Embellishment Practical Learning Outcomes

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ABSTRACT

Students in vocational practical courses start with uneven skills, so an instructional model has to cope with that gap without losing sight of individual accountability. This quasi-experimental pretest–posttest study compared Team Assisted Individualization (TAI) with conventional instruction in a Fabric Embellishment Techniques course of a Diploma III Fashion Design program. Two intact parallel classes of 13 students each (N = 26) took part in the second semester of academic year 2024–2025, and a lottery decided which class received TAI. Practical performance was scored on a 0–100 scale before and after instruction. The TAI class rose from 72.38 to 88.85 and the conventional class from 70.77 to 81.31, mean gains of 16.46 and 10.54 points. The classes did not differ significantly at pretest ($p = .231$), although the TAI class started 1.62 points higher. At posttest the difference was 7.54 points, $t(24) = 4.42$, $p < .001$, and the difference in gains was 5.92 points, $t(24) = 6.48$, $p < .001$. Because each condition was delivered to a single intact class, these student-level tests cannot separate the teaching model from class-specific influences, and the results are best treated as preliminary evidence.

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INTRODUCTION

Vocational programs in higher education are built around competencies that can be observed and measured. In the Diploma III Fashion Design Study Program, the Fabric Embellishment Techniques course is a clear case: a student passes only by producing work, and that work is judged on precision, creativity, procedural control, and psychomotor skill rather than on what the student can recite. Kurniati et al. define fabric embellishment as the addition of ornament to cloth so that its quality, aesthetic appeal, and market value increase, using techniques that each have their own characteristics [1]. In a course like this, results depend heavily on how much supervised practice students get, how often they receive feedback, and whether they can improve their work step by step.

Students in this course do not necessarily start from the same place. Some come from fashion-oriented vocational high schools and others from unrelated backgrounds, and such differences may translate into differences in working speed, stitch accuracy, and finally the quality of the finished sample. A pretest lets us describe how far the two classes actually differed when instruction began, instead of assuming it from educational background (see Results). Earlier work on embellishment teaching at the vocational high school level found that cooperative learning supported by job sheets

raised student engagement and practical competence [2]. That finding points toward an approach in which students work together but are still taught, and assessed, as individuals.

The wider literature gives reason to expect cooperative structures to help in skill-oriented courses. A meta-analysis of 40 studies found a moderate positive effect of cooperative learning on learning outcomes in physical education (Hedges' g = 0.459), and the effect for the physical domain, which includes psychomotor abilities, was of similar size (g = 0.471) [3]. The same review names positive interdependence, promotive interaction, and individual accountability as the core elements of cooperative learning [3]. Peer teaching shows a comparable pattern for hands-on skills. In a randomized trial with 63 nursing students, those taught an injection procedure by peers scored higher on a psychomotor checklist than those taught by faculty (median 73.0 versus 52.5), although knowledge and self-efficacy did not differ [4]. A meta-analysis of 81 randomized trials in medical education likewise reported advantages of peer-assisted learning for procedural skills, with weaker or absent effects in some specialized areas [5].

TAI was chosen as the intervention because it combines two things this course needs: heterogeneous teams and individual responsibility, with each student's work assessed individually. In principle, a student who struggles can draw on teammates for help, while a student who is further ahead consolidates his or her own understanding by explaining and demonstrating. In fashion education, Umami and Yulistiana reported that TAI is relevant for classes with differing ability levels and supports peer tutoring [6].

TAI has been tested in several settings. Ariani found differences in learning outcomes favoring TAI in an experimental physics class [7], and Lilanik observed gains in both cognitive and psychomotor outcomes after TAI was used to teach Kartini kebaya pattern making [8]. At the university level, Tinungki et al. reported that TAI improved mathematical problem solving, communication, and self-proficiency compared with conventional teaching [9]. Studies in higher vocational programs also show that deliberately structured teaching models can outperform lecture-based instruction: a quasi-experimental study with higher vocational nursing students found higher academic performance and engagement under a multimodal situational blended model, although its authors caution that the design does not support strong causal claims [10]. Research on vocational graduates adds that the quality of practical learning, collaboration, creativity, communication, and the fit between instruction and workplace requirements all feed into graduate competitiveness [11].

The fashion education evidence on TAI that we could identify is narrow in three ways. First, it comes from vocational high schools: Umami and Yulistiana studied the learning outcomes of fashion students at that level [6], and Lilanik examined Kartini kebaya pattern making in a Year XII fashion class [8]. Second, the only embellishment-specific study we found used cooperative learning with job sheets rather than TAI, again at the vocational high school level [2]. Third, none of these studies involves diploma-level students. The present study responds to that gap. It applies TAI in the Fabric Embellishment Techniques course of a Diploma III program, a higher vocational setting; it concentrates on basic stitching and four embroidery techniques (fantasy embroidery, broderie anglaise, shadow embroidery, and French embroidery); it records performance before and after instruction; and it compares the change with that of conventional instruction. Its contribution is therefore contextual and empirical. It asks whether a model reported in secondary vocational fashion classes also coincides with better practical results in diploma-level embroidery learning, and it does not claim that TAI itself is new.

The study addresses two questions: whether the two classes differed in practical performance before instruction, and whether students taught with TAI reached higher posttest scores and larger pretest-to-posttest gains than students taught conventionally. The aim is to compare the two classes on these measures within the limits of a two-class quasi-experimental design.

METHOD

This study used a quantitative approach with a quasi-experimental pretest–posttest, two-group design. Participants were 26 students of the Diploma III Fashion Design Study Program who took the Fabric Embellishment Techniques course in the second semester of academic year 2024–2025 at the Family Welfare Education Laboratory, Faculty of Engineering, Universitas Negeri Makassar. They were enrolled in two parallel classes of 13 students each, Class A and Class B, which were treated as intact clusters; no student was moved between classes. A lottery between the two classes decided which of them would receive TAI, so that the choice did not rest on the researchers' preference. Class A was drawn as the experimental group and was taught with the Team Assisted Individualization (TAI) model; Class B became the control group and received conventional instruction. Because the lottery operated on whole classes and only two classes were involved, the design is quasi-experimental, and class-level differences cannot be separated from the effect of the intervention.

Pretest and posttest scores were taken from the course assessment records of the two classes and expressed on a 0–100 scale. The pretest was administered before the intervention began and the posttest after instruction. Student names were replaced by codes before the data were analyzed.

1. Variables and Practical Learning Materials
   The independent variable was the instructional model (TAI for the experimental group, conventional instruction for the control group), and the dependent variable was students' practical learning outcomes. The material was delivered progressively from the second to the eighth meeting and covered basic stitches, fantasy embroidery, broderie anglaise, shadow embroidery, and French embroidery.
2. Research Procedures
   The study ran through four stages: planning, implementation, observation, and evaluation. In the planning stage, the course learning plan, instructional modules, job sheets, sample-based instructional media, and assessment instruments were prepared. The experimental class then followed the eight TAI components: Teams, Placement Test, Student Creative, Team Study, Team Scores and Recognition, Teaching Group, Facts Test, and Whole Class Units. Students were organized into teams that were meant to be heterogeneous, as the TAI model prescribes, so that they could help one another, while each student remained individually accountable for his or her own practical work. The control class was taught with the conventional practical approach normally used in the course.
3. Data Collection and Analysis
   Practical work was assessed through performance-based assessment of the finished work samples, using a skills rubric that covered basic stitch samples and the four embroidery techniques taught in the course. The indicators reflected the level of competency reached after instruction [12]. The structure of the rubric is summarized in Table 1.

Table 1. Structure of the Practical Assessment Rubric

Aspect assessed (practical unit)	Weight (%)	Quality criteria
Basic stitches	[25]	Precision, procedural mastery, and creativity of the finished sample
Fantasy embroidery	[20]	Precision, procedural mastery, and creativity of the finished sample
Broderie anglaise	[20]	Precision, procedural mastery, and creativity of the finished sample

Aspect assessed (practical unit)	Weight (%)	Quality criteria
Shadow embroidery	[15]	Precision, procedural mastery, and creativity of the finished sample
French embroidery	[20]	Precision, procedural mastery, and creativity of the finished sample

The aspects follow the five practical units of the course, and within every aspect the quality of the finished sample was judged on precision, procedural mastery, and creativity.

Descriptive statistics were computed for pretest, posttest, and gain (posttest minus pretest). Normality was examined within each class with Shapiro–Wilk tests, and equality of variances with Levene's test. Change within each class was tested with paired-samples t-tests. Differences between the classes in pretest, posttest, and gain were tested with independent-samples t-tests at $\alpha = .05$, with Mann Whitney U tests as a sensitivity check, and effect sizes are reported as Cohen's d with 95% confidence intervals. Because pretest and posttest scores were strongly correlated, an analysis of covariance (ANCOVA) with the pretest as covariate was run as a supplementary analysis after checking the homogeneity of regression slopes. All analyses use students as the unit of analysis, although the intervention was delivered to whole classes; the consequences are discussed below.

4. Research Flowchart

   Figure 1 summarizes the procedure. It starts with forming the experimental and control groups, then moves through preparing instructional materials, delivering the intervention, assessing students' practical learning outcomes, and evaluation. The experimental group worked through the eight TAI components, whereas the control group received conventional practical instruction.

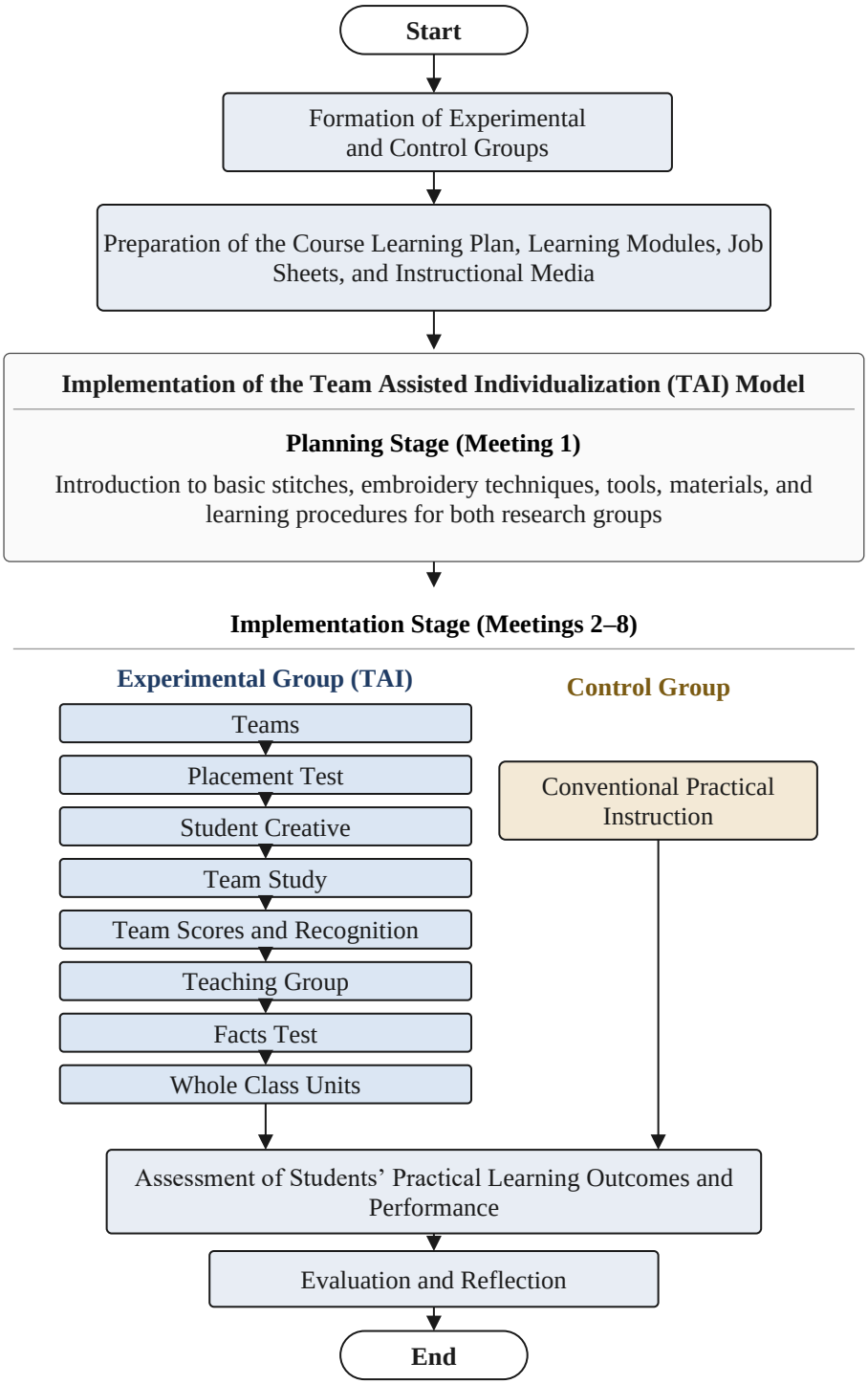


Figure 1. Research Procedure and Implementation Flow of the Team Assisted Individualization (TAI) Model

RESULTS AND DISCUSSION (6-14)

Results

a. Descriptive Results

Table 2 summarizes pretest, posttest, and gain scores. Both classes improved. The TAI class rose from a mean of 72.38 (SD = 3.23) to 88.85 (SD = 4.96), a mean gain of 16.46 points. The

conventional class rose from 70.77 (SD = 3.47) to 81.31 (SD = 3.64), a mean gain of 10.54 points. At pretest the TAI class was 1.62 points ahead; at posttest the gap had widened to 7.54 points.

Table 2. Group Statistics

		N	Mean	Std. Deviation	Std. Error Mean
Pretest	TAI	13	72.385	3.228	0.895
	Conventional	13	70.769	3.468	0.962
Posttest	TAI	13	88.846	4.964	1.377
	Conventional	13	81.308	3.637	1.009
Gain	TAI	13	16.462	2.184	0.606
	Conventional	13	10.538	2.470	0.685

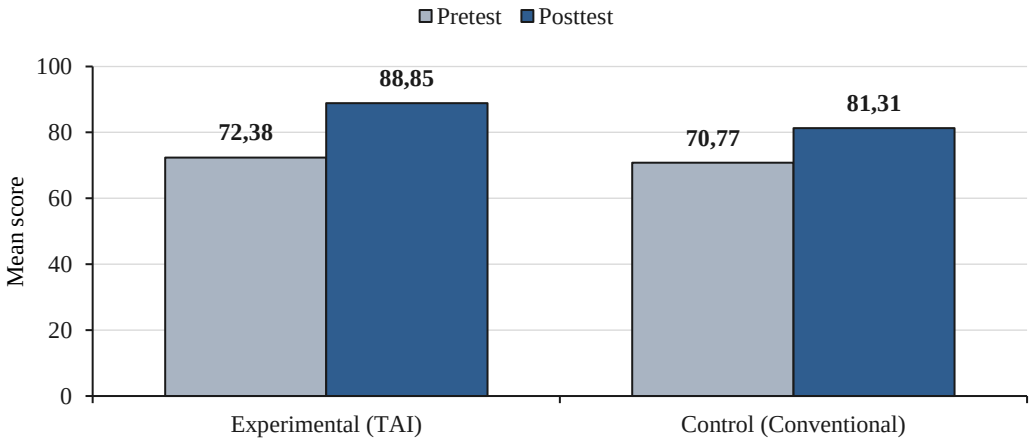


Figure 2. Pretest and Posttest Mean Scores of the Experimental and Control Classes

b. Assumption Testing

Table 3 reports the assumption checks. Scores were approximately normal in every case except the pretest of the conventional class (Shapiro Wilk W = 0.77, p = .003), where one low score of 61 pulled the distribution; for that reason Mann Whitney tests are reported alongside the t-tests. Variances did not differ significantly between the classes (Levene's test, Table 5, p = .721, .202, and .981 for pretest, posttest, and gain).

Table 3. Tests of Normality (Shapiro-Wilk)

		Shapiro-Wilk		
	Class	Statistic	df	Sig.
Pretest	TAI	0.947	13	.560
	Conventional	0.773	13	.003
Posttest	TAI	0.977	13	.963
	Conventional	0.941	13	.471
Gain	TAI	0.938	13	.436
	Conventional	0.914	13	.209

c. Within Group and Between Group Comparisons

Both classes improved significantly from pretest to posttest (Table 4). The TAI class gained 16.46 points, 95% CI [15.14, 17.78], t(12) = 27.18, p < .001; the conventional class gained 10.54 points, 95% CI [9.05, 12.03], t(12) = 15.38, p < .001.

Table 4. Paired Samples Test

Tests of Paired Samples

Pair	Mean	Std. Dev.	Std. Error Mean	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed) Squared
Posttest Pretest, TAI	16.462	2.184	0.606	15.142	17.781	27.178	12	<.001
Posttest Pretest, Conventional	10.538	2.470	0.685	9.046	12.031	15.381	12	<.001

Table 5 compares the two classes. At pretest the difference was not statistically significant, t(24) = 1.23, p = .231 (Mann–Whitney p = .304). A non-significant test with 13 students per class does not establish equivalence, however: the TAI class began 1.62 points higher (d = 0.48, 95% CI [−0.30, 1.26]), so a moderate initial advantage cannot be excluded. At posttest the TAI class scored 7.54 points higher, 95% CI [4.02, 11.06], t(24) = 4.42, p < .001, d = 1.73, 95% CI [0.83, 2.63]. The gain was 5.92 points larger in the TAI class, 95% CI [4.04, 7.81], t(24) = 6.48, p < .001, d = 2.54, 95% CI [1.51, 3.57].

Table 5. Independent Samples Test (TAI vs. Conventional; Equal Variances Assumed)

Tests of Independent Sample

Variable	Levene F	Levene P	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% CI Lower	95% CI Upper
Pretest	0.131	.721	1.229	24	.231	1.615	1.314	−1.097	4.328
Posttest	1.718	.202	4.417	24	<.001	7.538	1.707	4.016	11.061
Gain	0.001	.981	6.477	24	<.001	5.923	0.914	4.036	7.810

As a supplementary check, ANCOVA with the pretest as covariate gave adjusted posttest means of 87.96 for the TAI class and 82.20 for the conventional class, a difference of 5.76 points, 95% CI [3.79, 7.73], F(1, 23) = 36.53, p < .001, partial η^2 = 0.61. The regression slopes of posttest on pretest differed between the classes, however, F(1, 22) = 6.44, p = .019, which violates the ANCOVA assumption of parallel slopes, so this adjusted estimate is indicative only.

In these two classes, the TAI class had both a higher posttest score and a larger gain. The pattern is consistent with a benefit of TAI, but it does not prove one. Each condition was delivered to a single intact class, so class membership and teaching model are completely confounded, and the student-level p-values treat 26 students as independent although they were taught in two groups. The TAI class also started slightly higher, and the parallel-slopes assumption of the covariance analysis was not met. Effect sizes as large as those observed here, from classes of 13, are imprecise and may overstate the true difference.

Discussion

Students in the TAI class scored higher at posttest and gained more than students in the conventional class, and both differences were statistically significant. One plausible explanation lies in the structure of TAI: teams let students help one another, while each person remains responsible for his or her own performance and is scored individually. This mechanism was not tested here, and other explanations cannot be ruled out. The TAI class started 1.62 points higher, but a head start alone does not explain why it also gained more; gain scores, however, can themselves be affected by regression to the mean and by differences in variance, and the ANCOVA slopes were not parallel. The posttest difference (d = 1.73) is larger than the moderate pooled effect reported for cooperative learning in a meta-analysis [3]. With 13 students per class the estimate is imprecise, as its confidence interval ([0.83, 2.63]) shows, and it may overstate what a larger study would find.

This mechanism is relevant to fashion education because students can enter practical courses with different levels of technical experience. In a TAI team, students who struggle can ask a teammate for help, and students who are ahead can reinforce what they know by explaining and demonstrating. Umami and Yulistiana made the same point about TAI and peer tutoring in fashion learning [6], and Lilanik reported cognitive and psychomotor gains in kebaya pattern making [8]. Evidence on psychomotor skills from outside fashion points the same way: nursing students taught by peers outperformed faculty-taught students on a psychomotor checklist [4], and a large meta-analysis found advantages of peer-assisted learning for procedural skills [5]. None of these studies concerns embellishment, so we read them as converging rather than direct evidence. Two further points limit the argument. Pretest scores covered a fairly narrow range (61 to 78), so the classes were less heterogeneous in measured ability than the rationale for TAI assumes, and this study cannot show that TAI suits strongly mixed-ability classes. And we did not measure how the teams actually worked, so the peer-support mechanism remains an interpretation.

Support also comes from higher education. Tinungki et al. found that TAI-based cooperative learning improved university students' problem solving, communication, and self-proficiency [9]. Their field was different, but the working principle is shared: heterogeneous groups combined with individual accountability. Gains are not guaranteed on every outcome, however. In a quasi-experimental comparison of cooperative and lecture teaching with 30 medical laboratory students, the cooperative group improved significantly in learning, yet the between-group difference in learning was not significant, whereas communication skills and attitudes did favor the cooperative approach [13]. Our result therefore adds to a mixed but generally positive literature. The performance-scored, hands-on nature of embellishment work may be one reason the group difference was easier to detect here, although this remains speculation.

For vocational education the implications go beyond scores. Vocational learning is expected to build technical competence together with collaboration, communication, creativity, adaptability, and responsibility, all of which are relevant to workplace demands [11]. TAI is designed to build these into routine class work: students cooperate, exchange feedback, help peers, and still complete individual practical tasks. How well this works depends on implementation. Cavaletto and Miglietta found that cooperative learning improved cohesion and cooperation among students but that many teachers lacked the training to run it effectively [14]. Wu and Zhao showed that the way peer feedback is organized changes what students gain; a structured peer-dialogue condition produced the highest deep-learning scores among the four conditions they compared [15]. Lecturers adopting TAI should therefore plan team composition, feedback routines, and individual checks deliberately instead of simply seating students together.

This study adds contextual and empirical evidence on TAI in skill-based, psychomotor learning at the higher vocational level, a setting that the fashion-education studies cited above, all conducted in vocational high schools [2], [6], [8], did not cover. Its limitations are substantial and shape how far the findings can be taken. First, only two intact classes were compared and the condition was decided by a lottery between classes, so class-level differences, such as cohesion, timetable, or the interaction between lecturer and class, cannot be separated from the effect of TAI. Second, although pretest scores were available, the TAI class started 1.62 points higher, a non-significant difference in a sample this small does not demonstrate equivalence, and the ANCOVA slope assumption was not met. Third, the sample is small (26 students) and comes from a single study program. Fourth, the t-tests treat students as independent although they were taught within classes, which probably makes the p-values optimistic; quasi-experimental studies in vocational classrooms carry similar cautions [10]. Fifth, the pretest and posttest tasks, the rubric weights, and the reliability of the assessors are not documented in this article. Future studies should involve several classes per condition or randomize at class level, use methods that take class membership into account, document the assessment instrument and rater agreement, and examine engagement, creativity, collaboration, and long-term skill retention.

CONCLUSION

In this study, the class taught with the Team Assisted Individualization (TAI) model rose from a mean of 72.38 to 88.85 in practical performance, and the conventional class from 70.77 to 81.31; the TAI class scored higher at posttest and gained more. The pattern is consistent with the idea that team collaboration, peer assistance, and individual accountability can support skill-based learning in vocational fashion education. However, because each condition was delivered to one intact class, the TAI class started slightly higher, and the sample was small, the differences cannot be attributed to TAI alone, and the study does not show that TAI suits every class with mixed ability levels. The findings give preliminary support for TAI as an alternative strategy in practical vocational courses. Studies with several classes per condition and documented assessment procedures are needed before the effect can be confirmed.

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