Jurnal Sadewa : Publikasi Ilmu Pendidikan, Pembelajaran dan Ilmu Sosial
Volume 4, Nomor 4, November 2026
e-ISSN: 3021-7377; p-ISSN: 3021-7369, Hal. 113-126
DOI: https://doi.org/10.61132/sadewa.v4i4.3199
Tersedia: https://journal.aripi.or.id/index.php/Sadewa

The Effectiveness of Using Feedback Based on Kinematic Models in Learning Certain Fencing Skills

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Abstract. This study aimed to investigate the effectiveness of feedback based on kinematic models in improving students' performance in selected fencing skills. A post-test-only experimental design involving experimental and control groups was employed. The study population consisted of 33 third-year female students at the Faculty of Physical Education and Sports Sciences, University of Anbar, during the 2025–2026 academic year. Twenty students were randomly selected and assigned to an experimental group (n = 10) and a control group (n = 10). The intervention was conducted from Wednesday, 11 March 2026, to Wednesday, 29 April 2026, over eight weeks, with one instructional unit per week. The results indicated that the experimental group outperformed the control group in both fencing skills. For the first skill, the experimental group achieved a mean score of 6.513, compared with 5.946 for the control group, with a calculated t-value of 4.483. For the second skill, the experimental group obtained a mean score of 7.140, compared with 6.280 for the control group, with a calculated t-value of 5.519. Both calculated t-values exceeded the tabulated t-value of 2.048, indicating statistically significant differences in favour of the experimental group at the 0.05 significance level. These findings suggest that feedback based on kinematic models can enhance students' acquisition of selected fencing skills. Therefore, the study recommends incorporating kinematic-model-based feedback into fencing instruction, particularly during the foundational stages of motor-skill learning.

Keywords: Experimental Research; Female Students; Fencing Skills; Kinematic Feedback; Motor Learning.

1. INTRODUCTION

Change within educational practice have close connection with progress within psychology, education, and motor science. These new developments also alter way how sports skill get teach. Physical education at present moment involves far more than merely executing physical activity, since it also attempt for construct motor capacity together alongside cognitive as well as educational growth. For this reason, teaching approach increasingly consider both learner and characteristic of skill. Feedback has important place within this process because student need information about their performance for understand what they do correctly and what need for change. Feedback can help with error correction, but it can also keep student motivate and help them pay attention toward most important part of movement (Wisniewski et al., 2020). Study about augmented feedback also suggest that its effect can change depending on feedback type, task difficulty, and learner characteristic (Petancevski et al., 2022). Digital visual feedback give another way for learner see how their movement being perform and make adjustment based on that information (Hegi et al., 2023). Movement model work within related way because picture or video can show correct form and sequence of action. Student can watch model, try for compare it with their own movement, notice difference, and use these difference for correct next attempt. Previous experimental work also support visual demonstration and augmented visual feedback for complex motor skill, although benefit do not always become same for every task or feedback condition (Miyamoto et al., 2023; Ziv & Odem, 2024; Naser,

Article Received: 15 September 2026; Revised: 12 October 2026; Accepted: 03 November 2026; Published: 09 November 2026.

2026).These idea become especially relevant within fencing because good performance require technical skill, tactical decision, coordination, and accurate movement when trying for score a touch (Manan et al., 2024). As fencing continue for develop within international competition and Olympic Games, there also become need for teaching method that can deal with difficulty within learning technical skill (Hammad, 2021). Conventional instruction may not always give each student enough individual feedback or clear visual example of difficult movement. Research within sports learning increasingly examine video feedback and other visual method because they allow learner for watch movement, check their own performance, and recognize part that still need improvement. Adams et al. (2025), for example, examine different instructional guidance method use with video feedback within physical education and their effect on sports-skill acquisition and retention. Ghanim (2025) also find that augmented visual feedback help female university student learn back handspring. Although these study do not focus on fencing, they give reason for examine whether feedback based on kinematic model can also help student learn particular fencing technique.

During practical fencing class at university level, researcher observe that student have problem when performing some skill, especially lunge and indirect attack (disengagement). One possible reason become that student do not always get enough chance for see correct movement, compare their own execution with it, and receive feedback about their specific mistake. Visual feedback already become examine within different sport, but its use for these particular fencing technique still need further examination. Therefore, study investigate use of feedback based on kinematic model for chosen fencing skill among third-year female student at College of Physical Education and Sports Sciences, University of Anbar, within 2025–2026 academic year. Experimental group receive feedback based on kinematic model, while control group follow conventional instruction. Main question become: Does feedback based on kinematic model improve learning of chosen fencing skill? Researcher expect significant difference between post-test result of two group. Study have limitation toward third-year female student within morning-study programme at College of Physical Education and Sports Sciences, University of Anbar, during 2025–2026 academic year. Experimental period run from 1 March until 10 May 2026, and all procedure take place within fencing hall of same college. Previous evidence also give support toward role of feedback within motor learning. Han et al. (2025), through updated trial sequential meta-analysis, examine how feedback affect learning of motor skill within physical education. Their finding suggest that feedback can support both simple and complex motor-skill acquisition, although they also state that more evidence become need for confirm strength of this effect. This give theoretical reason for using

structured feedback when student need for recognize mistake and improve way they perform movement. Feedback can become useful, but it do not always work within same way under every condition. Its usefulness may depend on when it give, how information present, as well whether it directly relate toward skill being learn. Giving too much information at one time may also make it harder for student for recognize which part of their movement need attention. For this reason, feedback based on kinematic model become worth for examine. It can provide information about movement itself together with help student understand what need for change during practice.

Digital tool have create more way for teacher for provide information about student performance. Müller & Wagner (2025) review use of digital tool for formative assessment within physical education as well as discuss their potential for support continuous feedback, student involvement, and more independent learning (Hartini et al., 2026). Their review also explain that technology alone do not become enough, since it still need for use within suitable teaching plan. Within fencing, kinematic model can provide visual reference for body position, movement direction, as well as sequence of technical action. These detail may become especially useful when skill need for perform quickly and with good coordination. Even so, actual learning benefit of these model need for test with particular skill as well as student, including female university student involve within present study.

Malawski (2022) examine mixed-reality system for fencing weapon practice, making this study closely relate toward present topic. System provide real-time visual feedback by comparing fencer action with record movement model as well as displaying visual cue for technical correction. Finding suggest that novice fencer could perform practice exercise more correctly when using technology. However, system rely on mixed reality for weapon training, while present study use kinematic model as part of instructional intervention for lunge and indirect attack among female university student. Skill, teaching setup, as well as participant therefore were not exactly same. It remain necessary for examine whether feedback based on model can also improve these specific fencing skill under condition use within present study.

Although previous studies have highlighted the potential of feedback, visual demonstrations, and movement models to enhance sports-skill learning, they differ in terms of the sports investigated, instructional technologies employed, feedback delivery methods, and outcome measures. In particular, visual feedback in previous research has not necessarily involved the systematic use of kinematic models to guide the acquisition of specific fencing techniques. The present study addresses this gap by examining the effectiveness of kinematic-model-based feedback in learning two specific fencing skills: the lunge and the indirect attack

(disengagement). Its contextual novelty lies in the application of this instructional approach to third-year female students at the College of Physical Education and Sports Sciences, University of Anbar, a population and learning context that warrant specific empirical investigation. Using a post-test-only experimental design, the study compared an experimental group receiving feedback based on kinematic models with a control group receiving conventional instruction. Unlike approaches that employ visual demonstrations primarily as general instructional aids, the intervention focused on using kinematic movement models to provide students with a clearer reference for understanding and executing the technical components of the selected fencing skills. Accordingly, the study hypothesized that statistically significant differences would exist between the experimental and control groups in post-test performance on both the lunge and the indirect attack (disengagement), with the experimental group achieving significantly higher scores than the control group. This hypothesis enables the study to evaluate the specific contribution of kinematic-model-based feedback within a defined fencing-learning context without assuming that visual feedback produces equivalent effects across all sports, instructional approaches, or learner populations.

Main new aspect of study do not become general idea of feedback or visual model, but how these element were apply toward two chosen fencing skill within university teaching setting. Earlier study examine digital visual feedback within athletics (Mödinger et al., 2024), visual feedback within badminton (Suh & Jeong, 2025), and mixed-reality feedback for fencing weapon practice (Malawski, 2022) . Present work instead examine structured feedback based on kinematic model for lunge and indirect attack among third-year female student and compare it with conventional instruction. Therefore, its contribution relate toward this specific combination of teaching approach, fencing technique, and participant group. It should not understand as claim that previous study never examine feedback or movement model within fencing.

2. THEORETICAL REVIEW

Student cannot improve motor skill only by repeating movement without knowing how well they perform it. Feedback give information about movement quality, accuracy, and effectiveness, which allow learner for notice difference between what they actually do and what they expected for do. Within physical education, this information can support correction and gradual skill development. Feedback can come from learner own sense, know as intrinsic feedback, or from outside source such as teacher, coach, or technology, know as augmented feedback. This distinction become important inside of fencing because skill require speed,

balance, coordination, timing, plus precision at same time. Utility concerning feedback also get influence by way of how clear plus relevant it turn, when it supply, how frequently it supply, learner experience level, plus task difficulty (Mandiangan et al., 2026).

Kinematic model present movement by focus on feature that can observe or measure, such as body position, joint angle, movement path, velocity, acceleration, and coordination between body part over time. Inside of teaching, these model can present through live demonstration, photograph, slow-motion video, or other form concerning visual movement analysis. Student can see how different phase concerning skill connect instead concerning depending only upon verbal explanation (Khairani et al., 2024). When they compare their own performance alongside reference model, difference inside of posture, timing, distance, plus movement direction may become easier for notice. Mödinger et al. (2024) describe video-based visual feedback as promising technique inside concerning physical education, special when student get instruct upon how for comprehend information rather than merely watching demonstration.

Fencing turn into sport where multiple movement frequently require for occur together. Footwork, weapon-arm action, balance control, distance, plus attack timing all need for coordinate during performance execution. When executing lunge, weapon arm plus advancing leg must function alongside each other while body remain balance as well as correct attacking distance remain maintain. Indirect attack, or disengagement, demand weapon for shift around opponent blade while hand, arm, plus body adjust toward fresh attacking direction. These movement can turn tough for novice for comprehend through spoken instruction alone. Kinematic model may assist inside concerning making technical detail more visible. Varesco et al. (2024) also debate connection between attention, attack accuracy, as well as movement velocity inside concerning fencing, backing requirement for teaching strategy that consider both movement quality plus outcome effectiveness concerning final action.

Displaying student movement model do not automatically signify they will acquire skill correctly. Manner how feedback get arrange during practice session also matter. Lesson can start alongside demonstration concerning proper movement, follow by way of student personal attempt. Following that, teacher can point out critical error, allowing student for compare performance alongside model plus try again. This process can repeat as student gradually improve. Amount and timing of feedback still need for fit learner, difficulty of skill, and purpose of lesson. Petancevski et al. (2022), within systematic review, find that augmented feedback can support motor performance and learning across different gross motor and sport-specific skill. However, best frequency, timing, and duration of feedback were not fully

establish. Present study therefore examine whether kinematic model combine with structured feedback can help student recognise mistake as well as develop more accurate movement pattern. Comparison between two group become necessary for assess whether this approach produce better learning outcome.

3. METHODOLOGY

The experimental method was employed to examine the effect of feedback based on kinematic models on the acquisition of selected fencing skills. The study adopted a post-test-only design involving experimental and control groups. Twenty third-year female students from the College of Physical Education and Sports Sciences, University of Anbar, were selected and assigned to the two groups, with 10 students in each group. The experimental group received instruction incorporating feedback based on kinematic models, whereas the control group received conventional instruction. The intervention was conducted over eight weeks, with one instructional unit per week. Following the intervention, both groups completed the same post-tests assessing performance in the lunge and indirect attack (disengagement), using consistent testing procedures and assessment criteria to facilitate comparisons between groups. Because the design did not include a pre-test, initial equivalence between the groups could not be established directly through baseline performance measurements. Therefore, the method of group allocation and any available information on participants' previous fencing experience and skill levels should be considered when interpreting the findings. To minimize measurement bias, the same test protocols, performance criteria, and testing conditions should be applied to both groups, preferably with an assessor who is unaware of group membership. These methodological considerations are important for evaluating whether differences in post-test performance can reasonably be attributed to the instructional intervention. The design is consistent with research investigating the contribution of technology-supported feedback to sports-skill acquisition, while recognizing the limitations of drawing causal conclusions when baseline equivalence and potential sources of bias have not been fully established.(Hammad et al., 2025). However, study do not use pre-test measurement, so finding show difference after intervention rather than definite improvement from measured baseline.

Research population consist 33 third-year female student enrol within morning-study programme at College of Physical Education and Sports Sciences, University of Anbar, during 2025–2026 academic year. From this population, 20 student were choose randomly through drawing-lot procedure. Chosen student were then divide into two group, with 10 student within experimental group and another 10 within control group. Sample represent 60.60% of total

population. This sample size permit researcher for compare two instructional condition, although relatively small quantity concerning candidate require for get consider when interpreting finding plus applying them toward other group concerning fencing student.

Equipment, Tools, and Data Collection Methods

Various equipment plus data collection instrument were prepare for research work. These include Sabar testing apparatus, projection screen, optical laser unit, foil fencing weapon, plus measuring tape. Data was also collect from Arabic plus international literature, direct observation, testing plus measurement task, plus form for recording test result. Every source serve distinct purpose during research procedure. Reference supply theoretical knowledge, while observation assist researcher for examine how student execute skill. Testing plus measurement were apply for obtain performance mark, plus recording sheet keep outcome arrange for subsequent analysis. Equipment together alongside procedure were prepare beforehand so performance concerning both group could get evaluate under matching condition.

Tests Used in the Study

Lunge accuracy was assessed using the Lunge Accuracy Test. The equipment consisted of a Sabar testing apparatus, a fencing foil, and a metric measuring tape. At the beginning of the test, each participant stood behind a marked starting line, facing the testing apparatus at a distance of 2 metres. Upon receiving the signal, the participant performed a lunge towards the target area, which consisted of four circles, each measuring 8 cm in diameter. After completing the movement, the participant was required to return to the designated starting position and assume the ready stance before commencing the next attempt. Each participant performed a total of 10 attempts. According to the original scoring procedure, each successful attempt was awarded 3 points, whereas an unsuccessful attempt received 0 points, resulting in a maximum possible score of 30 and a minimum score of 0. An attempt was considered unsuccessful if the participant failed to return to the prescribed starting stance. All scores were recorded on a standardized assessment sheet to facilitate subsequent comparisons between the experimental and control groups. Higher scores indicated greater lunge accuracy and more consistent performance in accordance with the test's scoring criteria.

To ensure methodological rigour, the validity and reliability of the testing instrument and scoring procedure should be established and reported. Content validity may be assessed through expert evaluation by qualified fencing coaches or specialists in fencing instruction and sports measurement. Test–retest reliability or inter-rater reliability may be used, where appropriate, to determine the consistency of scores across repeated assessments or different

assessors. The testing conditions, target dimensions, execution instructions, and scoring criteria should be standardized for all participants. The specific validity and reliability procedures, including any relevant coefficients, should be reported based on the procedures actually conducted in the study.

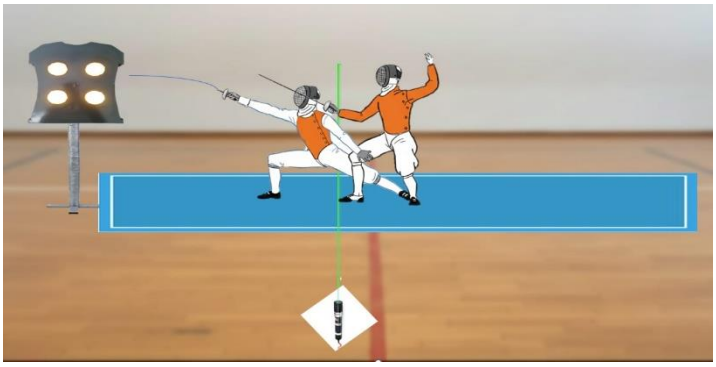


Figure 1. Illustration of the Lunge Test.

Indirect Attack Test (Disengagement)

Secondary test evaluate Indirect Attack Test, also label Disengagement Test. This test was apply for evaluate how accurately student could alter direction concerning attacking action while executing technique inside concerning foil fencing. Matching basic setup was apply, including Sabar testing apparatus, foil, plus metric measuring tape. Candidate start behind marked line, 2 metre away from testing unit. Upon signal, she execute indirect attack by way of shifting direction concerning attack toward target. Four circle, each 8 centimetre inside concerning diameter, were draw upon target board. Following every attempt, candidate return toward starting line plus gain ready posture. Ten attempt were complete. If student do not return toward designate starting position, attempt was count as unsuccessful. Each successful attack receive 3 point, producing maximum score of 30 and minimum of 0. Higher score represent better accuracy when performing indirect attack. Score were then record for comparison between experimental and control group.

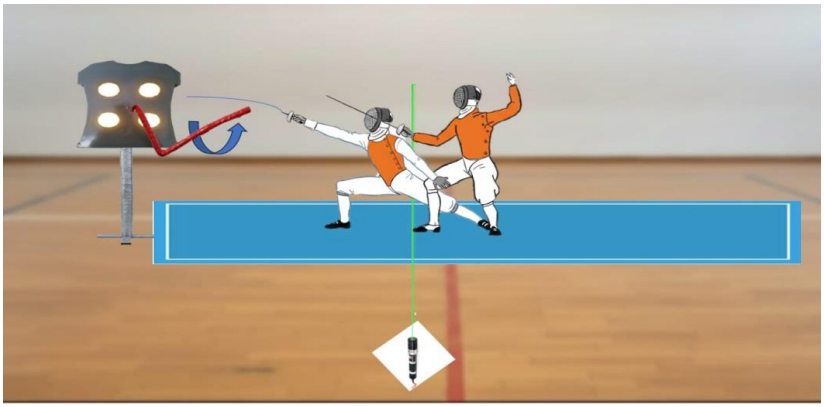


Figure 2. Illustration of the Indirect Attack (Disengagement) Test.

Field Research Procedures

Before main experiment, pilot experiment was carry out on Monday, 2 March 2026, at 11:00 a.m. within fencing hall of College of Physical Education and Sports Sciences, University of Anbar. Several female student who were not part of main sample take part. Purpose was for check whether test could carry out properly, estimate time need for testing, find possible problem within procedure, and prepare assistant research team for administering test and recording score. This preliminary activity help researcher make sure that testing process become practical and could perform within organize manner during main study.

Main Experiment

Intervention with main sample start on Wednesday, 11 March 2026 and finish on Wednesday, 29 April 2026. There were eight instructional unit, with one unit conduct each week. Sixteen drill associated toward two chosen skill, lunge plus indirect attack, were insert inside concerning practical section concerning main part. Every teaching unit get split into three section. Warm-up section last 20 minute, main section last 60 minute, plus final section last 10 minute.

Every instructional unit start alongside 20-minute warm-up section involving general plus specific physical preparation. Main section last 60 minute plus include both instruction plus practical drill. During teaching phase, researcher explain technique plus display visual movement model. Essential detail, including arm plus hand position, body balance, plus footwork, were clarify through demonstration. Student get ask for inspect movement carefully plus subsequently repeat it by themself. During practical stage, they perform exercise and receive immediate feedback after their attempt. Correction mainly focus on error that have greatest effect toward accuracy. Researcher could also present visual model again so student could compare expect movement with their own performance. They then repeat exercise while trying for apply correction. Final 10 minute were use for recreational game as well as cool-down activity, completing 90-minute instructional unit.

Post-Tests

Post-test were carry out after intervention upon Sunday, 3 May 2026, at 10:00 a.m. inside concerning fencing hall at College concerning Physical Education plus Sports Sciences, University concerning Anbar. Both group complete same two test. Lunge Accuracy Test was conduct first, follow by way of Indirect Attack Test. Testing procedure remain same for experimental plus control group so their post-intervention performance could compare under consistent condition.

Statistical Methods

The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including means and standard deviations, were calculated to summarize the post-test performance of the experimental and control groups. An independent-samples t-test was used to determine whether statistically significant differences existed between the two groups in their post-test scores for the selected fencing skills. Before conducting the t-test, the normality of the score distributions was assessed using the Shapiro–Wilk test, while the homogeneity of variances was examined using Levene's test. The assumptions were evaluated at a significance level of 0.05. When the assumptions of the conventional independent-samples t-test were satisfied, the equal-variances-assumed results were interpreted; otherwise, Welch's t-test was considered, as appropriate. The results were reported using the calculated t-statistic, degrees of freedom (df), exact p-value, mean difference, and, where available, the 95% confidence interval. Statistical significance was established at $p < 0.05$. All statistical decisions were based on the actual SPSS output to ensure transparency and reproducibility.

Some methodological detail still need for clarify before study get present inside concerning final form. Arabic source describe eight instructional unit deliver at one unit per week between 11 March to 29 April 2026. It also refer toward 16 exercise for two chosen skill. It should confirm whether 16 exercise were distribute across all eight unit or whether each unit contain 16 exercise. These become different arrangement along with how it could affect how intervention get describe. Another issue concern source wording, which refer toward movement demonstration as "free throw." Since study focus upon fencing, this expression may become terminology error. English version should refer toward relevant fencing movement model, provided that this interpretation get confirm against original source.

4. RESULT AND DISCUSSION

Table 1. Comparison of Post-Test Results Between the Control and Experimental Groups for the Lunge and Indirect Attack Skills.

No.	Skill	Unit	Control group Mean	SD	Experimental group Mean	SD	Calculated t	Sig.
1	Lunge accuracy	Points	6.70	1.33	8.00	0.81	2.62	0.01
2	Indirect attack (disengagement)	Points	5.80	1.03	7.30	1.15	3.05	0.00

Critical t value was reported having a 2.101 point at 0.05 significance level. There were 10 student inside concerning each group. Mean refer toward arithmetic mean, SD refer toward standard deviation, plus Sig. refer toward significance value.

Post-test outcome inside concerning Table 1 display higher mean mark for experimental group inside concerning both skill. For lunge accuracy test, experimental group secure mean concerning 8.00 (SD = 0.81), while control group record 6.70 (SD = 1.33). Calculated t-value become 2.62, exceeding critical value concerning 2.101. This indicate statistically significant difference at 0.05 level, assuming reported test as well as its degree concerning freedom become correct. Matching trend appear inside concerning indirect attack test. Experimental group obtain mean mark concerning 7.30 (SD = 1.15), compare alongside 5.80 (SD = 1.03) inside concerning control group. Its t-value concerning 3.05 also become higher than 2.101. Reported result therefore indicate better post-test performance by way of experimental group inside concerning both chosen skill following instructional intervention.

One possible explanation for higher score become way feedback based upon model was use during practice. Student were not only tell whether their performance become correct or incorrect. They also receive visual reference showing how movement should perform. This give them chance for compare their own execution alongside intended movement pattern as well as recognise technical difference. For example, they could pay closer attention toward body position, balance, footwork, plus attack direction. When specific correction were follow by way of another attempt, student could immediately try for apply information they receive. Repeating this process may have help them understand movement more clearly plus perform them alongside better accuracy by way concerning end concerning instructional period.

Niźnikowski et al. (2025) report finding that become relevant toward use of feedback during technical-skill learning. Their study find that feedback direct toward important technical element produce better learning outcome than feedback trying for address every error within complex gymnastic skill. This suggest that student may benefit more when they know which part of movement need most attention instead of receiving too many correction at once. Suh & Jeong (2025) also report that quantitative visual feedback improve performance accuracy and movement coordination within badminton striking. Although badminton and fencing involve different action, general principle remain relevant toward both sport. Within each case, student receive specific information about their performance and can use it for adjust movement during later attempt.

Fencing also place considerable demand upon attention plus ability for process visual information. Varesco et al. (2024) find that trained fencer perform better than novice fencer inside concerning attack accuracy as well as execution speed, highlighting importance concerning visual-spatial attention plus technical experience. Inside concerning present intervention, student receive visual demonstration along with immediate corrective

information. This may have help them pay closer attention toward movement detail that become important for accurate execution. Such guidance could become particularly useful during indirect attack because student need for change weapon direction while maintaining coordination plus directing attack toward target. Visual model may have make these movement requirement easier for recognise, although present result do not establish which specific aspect concerning feedback contribute most toward improvement.

Higher post-test score provide support for using kinematic model together with corrective feedback within fencing instruction, but some limitation need for consider. Only 20 student participate, and study use post-test-only design. Because no pre-test was conduct, it do not become possible for confirm directly that two group have exactly same skill level before intervention, even though participant were select randomly and divide into group. There was also no delayed test for determine whether observed difference remain after teaching period end. Future study could include larger sample, pre-test, and retention test. These addition would provide stronger evidence about student starting ability, their progress during instruction, together with whether effect of feedback based on model continue over time.

5. CONCLUSIONS AND RECOMMENDATIONS

Finding suggest that feedback based on kinematic model may become useful when teaching lunge and indirect attack, also know as disengagement, within fencing. Experimental group got higher post-test score than control group within both skill. By combining visual demonstration, comparison with intended movement, corrective information, as well as repeated practice, student develop clear understanding of technique along with improvement upon their practice. This approach may therefore help student coordinate movement as well as performing skill more accurately during learning process. Result provide practical support for including kinematic model and structured feedback within teaching of basic fencing skill. However, small sample & post-test-only design need further study to determine how consistent these benefit occur together alongside whether they still remain over time.

Recommendations

Feedback based on kinematic models should be incorporated into fencing-skill instruction, particularly for students who are still in the early stages of learning basic motor skills. Teachers are encouraged to make greater use of modern instructional media, including video demonstrations, live demonstrations, and ideal movement models, to provide students with clearer references and a better understanding of correct movement techniques during

motor-skill practice. The integration of these instructional approaches is expected to support more effective learning and improve students' ability to perform fencing skills accurately.

Furthermore, the effectiveness of feedback based on kinematic models should be examined among learners from different age groups to determine whether this approach produces different outcomes across various stages of motor learning and skill development. Future studies are also recommended to investigate the application of kinematic model-based feedback to other fencing techniques and skills in different sports. Such research would help determine the broader applicability of this instructional approach and provide additional evidence regarding its effectiveness in supporting motor-skill acquisition and development.

REFERENCES

Adams, A., Belcher, D., Jenkins, A., & Goad, T. (2025). Utilizing video feedback for effective motor skill learning in online physical education. International Journal of Kinesiology in Higher Education, 9(1), 14–30. https://doi.org/10.1080/24711616.2024.2421764.

Ghanim, M. R. (2025). The neurocognitive effect of augmented visual feedback on learning the back handspring skill in gymnastics among college students diverse learning methods. Indonesian Journal of Physical Education and Sport Science, 5(3), 397–407. https://doi.org/10.52188/ijpess.v5i3.1435

Hammad, S. H. (2021). The effect of skill-based exercises using educational technologies on selected sensorimotor perceptual abilities and the performance of offensive and defensive foil-fencing skills among participants aged 15–16 years [Doctoral dissertation, University of Anbar, College of Physical Education and Sports Sciences].

Han, Y., Zhang, M., Ji, L., & Syed Ali, S. K. (2025). Can feedback promote motor skill acquisition in physical education? An updated trial sequential meta-analysis. Journal of Teaching in Physical Education. https://doi.org/10.1123/jtpe.2024-0353

Hartini, H., Sari, Y. K., Basuki, T. W., & Jati, C. P. (2026). Development of learning technology in physical education, sports, and health at elementary school: (Study on third graders). *LITERACY: International Scientific Journals of Social, Education, Humanities*, *5*(1). https://doi.org/10.56910/literacy.v5i1.3434

Hegi, H., Heitz, J., & Kredel, R. (2023). Sensor-based augmented visual feedback for coordination training in healthy adults: A scoping review. Frontiers in Sports and Active Living, 5, Article 1145247. https://doi.org/10.3389/fspor.2023.1145247

Khairani, M., Nesya, S. R., & Gusmaneli, G. (2024). Teknik untuk mendapatkan umpan balik dalam proses pembelajaran. *Jurnal Pendidikan, Bahasa dan Budaya*, *3*(2). https://doi.org/10.55606/jpbb.v3i2.3079

Manan, A., Rimasa, D., & Kodrat, H. (2024). Perancangan alat talent identification aspek quickness berbasis IoT. *Jurnal Sains dan Teknologi*, *3*(2). https://doi.org/10.58169/saintek.v3i2.670

Mandiangan, R., Bondi, R., & Patras, F. T. (2026). Pengaruh gaya mengajar dan umpan balik terhadap hasil belajar passing bawah bola voli. *Jurnal Nakula: Pusat Ilmu Pendidikan, Bahasa dan Ilmu Sosial*, *4*(2). https://doi.org/10.61132/nakula.v4i2.2689

Miyamoto, W., Kawahara, Y., Mori, S., Setsu, K., & Hattori, F. (2023). Augmented visual feedback for complex motor skill acquisition: A demonstration with healthy young adults. Perceptual and Motor Skills, 130(6), 2685–2699. https://doi.org/10.1177/00315125231205042

Malawski, F. (2022). Immersive feedback in fencing training using mixed reality. Computer Science, 23(1). https://doi.org/10.7494/csci.2022.23.1.4570

Mödinger, M., Woll, A., & Wagner, I. (2024). Motor learning with digital media in physical education—a digital-based methodological teaching concept for the implementation of visual feedback. German Journal of Exercise and Sport Research, 54, 500–509. https://doi.org/10.1007/s12662-024-00955-5

Müller, J., & Wagner, I. (2025). Formative assessment of motor learning through digital tools in physical education: A systematic literature review. Physical Education and Sport Pedagogy. https://doi.org/10.1177/1356336X251357207

Naser, M. J. A. (2026). Effectiveness of feedback using motor models on free throw accuracy and retention rate among female students. *Jurnal Nakula: Pusat Ilmu Pendidikan, Bahasa dan Ilmu Sosial, 4*(3). https://doi.org/10.61132/nakula.v4i3.2743

Niźnikowski, T., Arnista, P., Sadowski, J., Mastalerz, A., Romero-Ramos, O., Fernández-Rodríguez, E., et al. (2025). Enhancing the learning of sports skills through verbal feedback. Frontiers in Sports and Active Living, 7, Article 1519365. https://doi.org/10.3389/fspor.2025.1519365

Petancevski, E. L., Inns, J., Fransen, J., & Impellizzeri, F. M. (2022). The effect of augmented feedback on the performance and learning of gross motor and sport-specific skills: A systematic review. Psychology of Sport and Exercise, 63, Article 102277. https://doi.org/10.1016/j.psychsport.2022.102277.

Suh, D., & Jeong, J. (2025). Effects of quantitative and qualitative visual feedback on motor learning in male novices during a badminton underhand-clear striking task. Journal of Motor Behavior, 57(6), 723–736. https://doi.org/10.1080/00222895.2025.2550373

Varesco, G., Sarcher, A., Doron, J., & Jubeau, M. (2024). Striking a balance: Exploring attention, attack accuracy and speed in fencing performance. European Journal of Sport Science, 24(9), 1278–1286. https://doi.org/10.1002/ejsc.12176

Wisniewski, B., Zierer, K., & Hattie, J. (2020). The influence of instructional strategies on motor learning: A meta-analytic review. Educational Psychology Review, 32, 1063–1088. https://doi.org/10.1007/s10648-019-09486-0

Ziv, G., & Odem, C. (2024). The effectiveness of concurrent positive and negative visual feedback on a computerized motor task of varying difficulties. Communications in Kinesiology, 1(6). https://doi.org/10.51224/cik.2024.63