

Practice Setting Modification and Skill Acquisition

by Cheryl A. Coker

Abstract

One hindrance to maximizing the amount of time students are actively engaged in quality practice is the wait time that results from limited equipment (e.g. basketball goals) and/or facilities (e.g. shot put ring). A possible solution to counteract this problem would be to modify the natural performance setting. Empirical evidence regarding the effectiveness of this approach on skill acquisition however has been lacking. Consequently, the purpose of this study was to investigate the differences of two practice schedules (natural vs. modified) on the acquisition of the soccer throw-in for distance. A modified schedule, where participants practiced 50% of the time in a natural performance setting and 50% of the time in a modified setting was equally effective to practicing in a natural performance setting 100% of the time for skill acquisition.

Practice Setting Modification and Skill Acquisition

According to Rink (2002), the single most critical instructional variable for the development of skill proficiency is the amount of practice time a learner spends at an appropriate level. Pangrazi and Darst (1997) concur, indicating that unless learners are provided ample opportunities for skill practice, their ability to learn motor skills is impeded. Students, however, spend 20 to 25% of class time waiting (Beauchamp, Darst & Thomson, 1990; Seidentop & Tannehill, 2000). This waiting deprives learners of valuable time that could be spent engaged in quality practice.

One factor that contributes to student wait time is the lack of equipment (e.g. basketball goals) and/or facilities (e.g. shot put ring). In a study examining the effects of class size and equipment

availability on student involvement in physical education, Hastie and Saunders (1991) found that students in classes where there was a lack of equipment were disadvantaged from fewer opportunities to interact with the skill being learned. Unfortunately, poor and inadequate equipment and facilities are continuing challenges faced by field-based professionals (Horn, 1987; Pangrazi & Darst, 1997). Creative solutions must, therefore, be developed to resolve such challenges and maximize learners' activity time.

One strategy that has been employed in certain situations is to perform the skill in a modified setting. For example, when only one shot put ring is available, students may throw into a net, a technique that has been employed by throwers when practice must be moved indoors in the event of inclement weather. This strategy not only provides an additional area in which to practice but also eliminates the time required to retrieve one's implement. The question remains however, how such modifications impact skill acquisition.

When performing a movement in its natural setting (such as throwing the shot put into the throwing area from the ring), information regarding both the outcome and the movement characteristics that led to the outcome are available to the learner through sensory feedback. Augmented information may also be provided in the form of knowledge of results (KR), knowledge of performance (KP) or both from a teacher or coach. Through both internal and external sources learners receive information that serves to guide the modification of subsequent attempts in an effort to correct errors and improve skill proficiency. The modified setting suggested above in the shot put example, however, eliminates feedback about the outcome of the performance as

well as the flight characteristics of the implement. Rather than completely eliminating this potentially valuable information, the implementation of a 50/50 schedule between the natural and modified setting may be more pragmatic. Not only would the number of practice attempts be greater if one rotated between the two settings, but students would still have the benefit of receiving feedback intermittently that is normally afforded by the natural performance setting. Consequently, the purpose of this study was to investigate the effects of two practice schedules (natural vs. modified setting) on the acquisition of a novel motor skill.

Method

Participants

Twenty-two right-handed individuals (11 males, 11 females; M age =26 years) from a university population volunteered to serve as subjects. None had any experience with the soccer throw in and each was randomly assigned to one of two experimental groups differentiated by practice schedule. Group 1 (N=10) was designated the natural setting group and group 2 the modified setting group (N=12). Subjects signed informed consent forms and the university's human subjects committee approved experimental procedures.

Task

The task was the soccer throw-in with a hop step approach. Subjects performed a pretest, post-test and retention test that consisted of 10 throws. A standard size 5 soccer ball was used for all testing and practice trials. The objective was to perform a legal, technically correct throw that would maximize displacement (result in the furthest throw). Legal throwing technique required that the subject release the ball with both feet in contact with the ground, that the release occur prior to passing the boundary line (simulating a soccer pitch's sideline) and that the ball be released above the head.

Testing Procedures

Upon arrival to the testing sessions, reflective markers were placed on the right shoulder (acromion process), elbow (lateral humeral epicondyle), wrist (distal styloid process), hip (greater trochanter) knee, ankle and foot. Prior to the pretest a brief video demonstration of the soccer throw in was shown highlighting the grip, the steps and the three rules that defined a legal throw. Subjects were also given three walk-throughs of the approach and informed that the objective of the skill was to throw as far as possible using a technically correct and legal throw. Two practice throws were then provided followed by 10 measured throws. All test trials were performed in a gymnasium with standard court markings. The designated boundary line was the free throw line on one side of the gymnasium. Following each throw, the experimenter placed a numbered marker (signifying which of the ten throws it represented) on the floor at its landing site. Measurements were retrieved after subjects completed the test. All test throws were also videotaped using an S-VHS camera capturing the subject's right side in the sagittal plane at 60 HZ. No KR was given to the subjects regarding the distance of their throws but all subjects had full view of the outcome. One day following the final of three acquisition sessions, subjects performed a posttest. A retention test was conducted 12 days later. Both tests followed the same protocol as the pretest with the exception of providing the subject with the introductory videotape.

Acquisition Procedures

The acquisition period was designed such that immediately following the pretest, subjects participated in the first of three consecutive practice sessions (one session per day) which consisted of 60 practice throws. Reflective markers were removed and subjects were shown an instructional videotape demonstrating the throw-in and providing instructional cues. Following the viewing of the videotape, 4 blocks of 15 throws were performed with 2 minutes rest between

blocks for a total of 60 throws. A pilot test conducted earlier determined that this amount would not overly fatigue subjects. The natural setting group performed all trials (100% natural setting) from the same position as they had during testing and therefore had full view of the outcome of each throw (could see where it landed, flight characteristics etc.). The modified setting group, on the other hand, alternated each block between the full view condition and throwing into a tarp that was mounted on the wall (50% natural setting and 50% modified setting). The designated boundary line in the tarp condition was placed such that the ball was still rising at its point of contact with the tarp therefore eliminating the performers ability to view both the ball's complete trajectory and the outcome of the throw. The starting condition for the alternate group (tarp or full view) was counterbalanced across subjects.

Throughout the practice sessions, all subjects were asked to concentrate on learning the technical aspects of the soccer throw in and received average prescriptive knowledge of performance (KP) regarding their technique. The schedule for the provision of KP was such that all subjects received one feedback statement after every third trial for the first 4 practice blocks (60 throws) and every 5th trial for the remaining practice trials. The content of the KP was based on a prioritized task analysis of the soccer throw-in that was examined and deemed appropriate by three independent soccer experts and was based on the average performance error observed in the series (three or five trials). The complete listing of the KP statements is provided in Table 1.

Data Analysis

Legal throws were determined by reviewing the video of each testing session. All throws that did not meet the three criteria previously stated were omitted. Because of the novelty of the task, many pretest throws were judged to be illegal.

Consequently, while the top five post and retention test throws were used in the data analysis, only the best three pretest measures were included.

In addition to throwing distance, five kinematic variables were examined: (1) height of release, (2) velocity of release, (3) angle of release, (4) time from the hop landing to the heel strike of the plant foot and (5) time from the heel strike of the plant foot to release. Kinematic data were digitized and analyzed using the PEAK Motus 2-dimensional motion analysis system. Separate ANOVA with repeated measures procedures were used to assess differences in throwing distance and kinematic measurements. An alpha level was set at .05 for all tests. It was hypothesized that the 50/50 alternating schedule would be equally effective to practicing in a natural performance setting 100% of the time.

Results

Means and standard deviations for all measures across tests are provided in Table 2. Results indicated that subjects significantly improved in throwing distance from the pretest to the posttest and from the pretest to the retention test ($F(1,20) = 18.27$). A significant increase was also found for the velocity at release ($F(1,20) = 13.54$) from the pretest to the retention test and from the posttest to the retention test. Furthermore, subjects released the ball from a significantly higher point during the retention test as compared to both the pretest and post test ($F(1,20) = 10.36$). Significant differences were also found between the pretest and post test and pretest and retention test for the time between the hop landing and heel strike of the plant foot ($F(1,20)=11.17$). No significant group effects were found for any measure nor were there any significant group by test interactions (see Table 3). Additionally, no significant differences were revealed for angle of release or for time from heel strike to release.

Table 1: Priority List of KP Statements for the Soccer Throw-In.

Soccer Throw-In KP Statements

1. Start with your right foot slightly in front of you.
2. The step sequence is Left, Right, Right, Left.
3. Throw with both hands equally.
4. The first two steps should be longer/shorter.
5. Keep both feet in contact with the ground by dragging your right toes along the ground.
6. Remember that you can step over the line in your follow through.
7. The ball should move into the throwing position behind your neck as you start the hop.
8. Start the throwing motion after your left foot has planted and you are rocking over it.
9. The hop should be longer/shorter.
10. The hop should be forward not upward.
11. Land your hop leaning back.
12. Stay tall by bending less at your hips when you release the ball.
13. Throw the ball forward and up.
14. Release the ball higher/more forward.
15. Throw the ball using a whipping action.
16. Your final stride should be shorter/longer.
17. Turn your thumbs down as you release the ball.
18. There should not be any breaks in the motion; the skill should flow.
19. Adjust your starting position so you don't go over the line.
20. You have performed the correct motion.

Table 2: Means and standard deviations for all measures across tests.

Group	Pretest		Posttest		Retention Test	
	Mean	SD	Mean	SD	Mean	SD
Distance Thrown*	14.29 m	4.07	15.62m	4.08	15.74m	4.04
Velocity of Release*	8.93m/s	1.61	9.31m/s	1.68	10.16m/s	1.65
Height of Release*	2.07m	.14	2.11m	.21	2.21m	.29
Angle of Release	99.23°	11.65	100.12°	12.46	94.1°	18.83
Time from hop to heel strike*	.27s	.08	.23s	.05	.21s	.05
Time from heel strike to release	.21s	.06	.21s	.06	.21s	.06

* $p < .05$

Table 3: Means and F score for Test by Group.

Variable	Pretest		Posttest		Retention Test		F
	G1	G2	G1	G2	G1	G2	
Distance Thrown (m)	14.55	14.09	16.08	15.25	16.17	15.38	.201
Velocity of Release (m/s)	9.35	8.58	9.52	9.13	10.24	10.10	.893
Height of Release (m)	2.09	2.06	2.17	2.05	2.31	2.12	.149
Angle of Release (degrees)	9.82	10.02	10.12	9.9	9.81	9.01	1.324
Time from hop to heel strike(s)	.26	.28	.24	.22	.23	.21	1.906
Time from heel strike to release(s)	.23	.20	.21	.20	.21	.20	.683

Discussion

While many field-based professionals employ strategies to decrease wait time, little empirical evidence exists regarding their effectiveness with respect to skill acquisition. The purpose of this study was to examine one such strategy, practicing using a 50/50 alternating schedule between a natural and modified performance setting.

The data revealed no significant differences between the two practice schedules. Subjects in both groups however, showed significant improvement in the distance thrown, increased the velocity with which they threw, released the ball at a greater height and were able to transition from the landing of the hop to the heel strike of the plant foot more quickly. In other words, both the 100% natural and 50/50 modified practice schedules facilitated skill acquisition. Consequently, alternating between a natural and modified setting appeared to be a viable strategy to incorporate in physical education to reduce wait time.

Also of interest was the fact that each group received an equal number of practice attempts. In a practical setting, instructors would likely rotate learners following a given time period as opposed to the completion of a set number of trials. As stated previously, a modified schedule would afford learners additional practice attempts as compared to following a 100% natural setting schedule. Accordingly, greater learning gains would be expected as a consequence of the increased opportunities to be engaged in practice. It is therefore recommended that future investigations examine this issue from a time perspective.

REFERENCES

- Beauchamp, L., Darst, P.W. & Thompson, L.P. (1990). Academic Learning Time as an Indication of Quality High School Physical Education, *JOPERD*. 61(1), 92-95.
- Hastie, P.A & Saunders, J.E. (1991). Effects of class size and equipment availability on student involvement in physical education. *Journal of Experimental Education*. 59, 212-224.
- Horn, T.S. (1987). How to conduct effective practices. In V. Seefeldt (Ed.). *Handbook for Youth Sports Coaches* (pp.193-209). NASPE/AAHPERD.
- Pangrazi, R.P. & Darst, P.W. (1997). *Dynamic Physical Education for Secondary School Students*. Boston, MA: Allyn and Bacon.
- Rink, J.E. (2002). *Teaching Physical Education for Learning*. Boston, MA: WCB McGraw-Hill.
- Seidentop, D. & Tannehill, D. (2000). *Developing Teaching Skills in Physical Education*. Mountainview, CA: Mayfield Publishing.

Dr. Coker is a member of the Physical Education, Recreation and Dance department at New Mexico State University.