

a listing of available agricultural education and agriculture scholarships at Kansas State University. Provisions have been made to prepare an annual "Teaching Unit Up-Date."

Summary

The recruitment efforts described are having a positive effect on the undergraduate enrollment in the agricultural education program at Kansas State University. This recruitment is based on a plan that:

1. Collected data from undergraduate students and teacher educators on effective recruiting practices;
2. Assigned responsibility for coordinating recruitment activities;
3. Enlisted advice from the agriculture and education communities of the state;

4. Involved the total agricultural education resources of the state;
5. Stressed the key role vocational agriculture teachers play in influencing student career choice;
6. Developed a program of activities to aid in an organized and systematic approach
7. Provided vocational agriculture teachers and guidance counselors with an information kit on careers.

These recruitment activities represent what has been done in one state to attract additional students into an undergraduate curriculum in the College of Agriculture. This approach might be useful in initiating, redirecting, or extensifying student recruitment in other curriculums in Colleges.

Teaching Strategies for Developing Psychomotor Skills

Ed Osborne

Much has been written over the years concerning the appropriate balance of knowledge and practical skills taught in four year college and university agricultural programs. Estimates that more than one-half of the students enrolled in today's agricultural colleges have no experience in agricultural production clearly indicate the need for practical experience as a part of the college program (Berkey, 1981). While the teaching of agricultural principles should provide the necessary foundation for students to move forward, "...the best learning results in an interplay between theory and experience, idea and application, reflection and encounter" (Keeton, 1983, p.2). John Dewey (1969), one of America's greatest educational philosophers, described the relationship between actual experience and education as an "intimate and necessary" one.

Colleges of agriculture in general have exercised their support of theory plus experience by providing structured experiences in skill development during laboratory and classroom sessions. But what are the most effective ways that psychomotor, or manipulative, skills may be developed? What teacher behaviors and practices tend to result in higher student proficiency in propagating plants, shearing sheep, or adjusting a combine? This article will attempt to provide a review of research and theory pertaining to effective instructional activities aimed at developing psychomotor skills.

How Skills Are Learned

In his classic book entitled *Permanent Learning* Lancelot (1944) proposed that manipulative skill

development requires a blending of the mind and muscle. He further explained that manipulative acts are guided by thought, and that a direct relationship exists between the quality of thought and the quality of manipulative performance. Watson (1980) agreed that psychomotor skill development involves both muscle and thinking skills. According to Watson, psychomotor skills are acquired through a three stage process: (1) early cognitive - usually of short duration and includes attention, observation, and thought about how and why the skill is performed, (2) lengthy practice or fixation - includes practice sessions aimed at shaping correct performance, and (3) final autonomous stage - correct performance becomes automatic, with increases in speed, accuracy, dexterity, timing, and greater understanding of application settings. Unfortunately, college students do not always reach the final autonomous stage. However, advanced stages of the skill acquisition process are often attainable.

Psychomotor Skill Variables

This section synthesizes empirically based conclusions, as well as relevant theory, regarding the processes of psychomotor skill development. The variables to be contained in this discussion include: (1) motivation, (2) demonstrations, (3) physical practice, (4) mental practice, and (5) feedback/knowledge of results.

Motivation

A student's motivation has a positive influence on the development of psychomotor skills (Dull, 1977). Dewey (1969) maintained that, if experiences were to be educational, they must account for the principle of puzzlement or indeterminacy. That is, the major step in the teaching process is to create an atmosphere of confusion or perplexity in the student's minds about the problem (skill) at hand. From a review of research studies Watson (1980) presented the following strategies for increasing motivation: (1) use a variety of

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psychological strategies based upon personal goals and interests, values of the skill, and personal challenge, (2) arouse curiosity by presenting a novel idea or a puzzling problem, (3) set challenging, yet obtainable standards for each student, (4) provide feedback and reinforcement and (5) take advantage of natural tendencies to compete.

Demonstrations

Actual demonstration has been widely viewed as the most appropriate strategy for teaching skill development. Filmed demonstrations have also been found to enhance psychomotor skill development (Gould and Roberts, 1982; Watson, 1980). Watson (1980) also concluded that demonstrations improve technique, confidence, and understanding of successful performance.

Gould and Roberts (1982) offered the following summary points:

1. Demonstrations enhance psychomotor skill acquisition.
2. The higher the status of the person presenting the demonstration, the greater the influence of the demonstration on the student's skill acquisition.
3. Tasks should be broken down into subunits for teaching purposes. The skills involved in each subunit should be demonstrated in sequence, allowing students to practice in each subunit before moving to the next.
4. Demonstrations can help reduce anxiety over performing unfamiliar skills.

Physical Practice

Practice may be defined as "...repetition with the intent of improved performance" (Watson, 1980). As one might surmise, actual practice of a manipulative skill is essential to acceptable performance. Furthermore, actual performance of a skill effectively reduces the fear and anxiety that accompanies the performance of many skills in agriculture (Gould and Roberts, 1982).

Distributed practice is more effective in the development of psychomotor skills than massed practice (Lawther, 1966; Fischman, Christina, & Vercruyssen, 1982; Drake, 1981). That is, short, frequent practice sessions over a long period of time are most effective. However, according to Watson (1980), practice sessions must be long enough to allow improvement, and the time period between sessions must be short enough to prevent forgetting.

Performance curves tend to reveal that improvement is usually fastest initially, with a plateau of performance reached after some time. Research evidence suggests, however, that these plateaus are primarily due to student's stopping at their own acceptable levels of performance, rather than to any physical limitations (Watson, 1980).

Mental Practice

Although a majority of research examining the effects of mental practice on physical performance has

involved athletic skills, the research suggests implications in other settings (Weinberg, 1982; Beasley & Heikkinen, 1983; Johnson, 1979). Mental practice may be defined as covert rehearsal of a skill by imaging oneself performing the skill step by step and "feeling" one's way through the movements (Beasley & Heikkinen, 1983). Weinberg (1982) cited early research that showed a strong relationship between mental practice and muscular stimulation.

As noted by Johnson (1979), the early stages of psychomotor skill acquisition are primarily cognitive in nature. During this stage, teachers need to help their students think through the mechanics of performance. Although mental practice has been found to enhance skill acquisition at any time (Beasley & Heikkinen, 1983), it is most effective during the cognitive stages (Johnson, 1979). The fairly large body of research on mental practice indicates that when interspersed with physical practice, it is most effective in improving performance, followed by physical practice only and mental practice only. Research has also shown that mental practice alone, if it follows a demonstration or videotape of the skill being performed, does enhance skill acquisition (Weinberg, 1982).

The following are guidelines for the use of mental practice to improve skills:

1. Students must be familiar with the task (through prior experience, demonstrations, or visuals;) before using mental practice techniques.
2. Students need instruction in the use of mental practice.
3. A combination of physical and mental practice should provide the greatest performance gains.
4. Simple skills, or complex skills broken down into subunits, are best suited for mental practice.
5. Students should perform mental practice in their own time and place.
6. Mental practice sessions should last no longer than five minutes (Beasley & Heikkinen, 1983; Johnson, 1979; Weinberg, 1982).

Feedback/Knowledge of Results

Feedback, or information provided to students regarding their performance results, is essential in psychomotor skill development (Watson, 1980; Braverman & DeCaro, 1979). In order to provide appropriate and timely feedback, psychomotor skills must be identified as open loop, where no feedback can be received until the task is completed (e.g., tattooing cattle, giving injections), or closed loop, where feedback, error detection, and correction are possible during the course of performing the skill (Braverman & DeCaro 1979). These closed loop skills are usually complex skills that may be broken down into component parts (e.g., shearing sheep, tuning an engine). Braverman and DeCaro (1979) offered the following

conclusions regarding feedback and its effects on skill acquisition:

1. The rate of skill improvement depends upon the precision and frequency of knowledge of results.
2. A delay in providing this knowledge does not affect skill acquisition. However, feedback is important, especially in the early stages of practicing a simple closed loop skill.
3. Withdrawal of knowledge of results decreases performance in the early stages of skill development but does not affect performance in the late stages.
4. A variety of types of feedback should be provided, including visual, verbal, and kinesthetic. The use of video-taped and verbal feedback increases performance on open loop, complex skills.

Increasing Retention and Transfer of Skills

Retention may be defined as "the persistence of proficiency on a skill after a period of no practice" (Fischman, et al., 1982). Fischman et al. (1982) identified several variables that influence this extended learning. Obviously, the most important factor in retention is the degree of initial proficiency. Thus, in learning skills students must obtain a high degree of performance initially.

Research has also shown that continued practice is related to improved retention. This concept is known as overlearning. Fischman et al. (1982) concluded that retention is enhanced by an internalization of the skill and its processes. Learners should also practice a skill as soon as possible after the demonstration is given. Events occurring between the demonstration and practice session tend to reduce retention. Fischman et al. (1982) also concluded that relevant information and processes performed in the beginning and ending of a task are better retained, implying that more emphasis during teaching should be placed upon the processes occurring during the middle stages of the task. Finally, Fischman et al. (1982) found substantial evidence that distributed practice increases retention.

Transfer is the application or performance of previously learned skills in other places or settings. Fischman et al. (1982) presents concluding statements helpful to teachers of psychomotor skills. Stallings (1982) also supported these guidelines.

1. Positive transfer is most likely when similarities between practice (learning) and performance (application) sessions are high.
2. Practice should be completed on tasks that parallel in difficulty and design those in transfer settings.
3. Discussion of various examples during the practice stage aids in the transfer of principles and practices.
4. Specific tasks should be practiced in relationship to the complete task. Otherwise,

only isolated parts of the task may be positively transferred.

5. As in retention, transfer is greatest with high levels of initial task proficiency.

The Teaching Process

The most highly regarded approach to teaching psychomotor skills involves a number of phases, including motivating students, demonstrating the skill, furnishing student practice, and providing appropriate feedback on performance. Interestingly, years ago Lancelot (1944) recommended a systematic teaching strategy for manipulative skill development that encompassed all of these major phases, which have been more recently supported through empirical research. His steps include:

1. Create interest through the use of questioning and discussion of a puzzling problem or aspect of the skill to be developed. This brings students to a psychological feeling that they need to know more and that they need to become more able.
2. Ask students to describe the appropriate steps in performing the skill. Correct errors and explain changes that must be made. Discuss how each step of the skill should be performed, and have the class prepare a set of brief, simple directions for the process. Students will learn more from a demonstration if the how's and why's have been discussed beforehand.
3. Provide a demonstration of the skill. Involving students mentally and physically throughout the demonstration will increase its effectiveness. Steps to be performed should be demonstrated in proper sequence and explained simultaneously.
4. Have students practice the skill. Upon completion, place two finished products before students and ask which is better and why. Lead the group in the development of acceptable standards by which future performance should be judged. Lancelot (1944) strongly argues that this step is essential to appropriate performance.
5. Provide alternating sessions of practice and evaluation until the desired ability level is reached.

Summary

This procedure for teaching manipulative skills includes the most important variables identified with effective psychomotor skill learning. The exception is mental practice, a theory in its infancy at the time of Lancelot's work. (1) The development of psychomotor or manipulative skills is a complex process that for most skills requires high level mental thought as well as physical activity; (2) the preparation and presentation activities of teachers have a definite influence upon skill acquisition; (3) skill acquisition appears to be

highest when students are motivated to perform the skill, demonstrations are provided which can be imitated by students, both physical and mental practice are provided, and knowledge of performance results is provided; and (4) retention and transfer of psychomotor skills may be improved through these same teaching methods.

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INTERNATIONAL AGRICULTURE AGRICULTURAL EDUCATION IN MALI

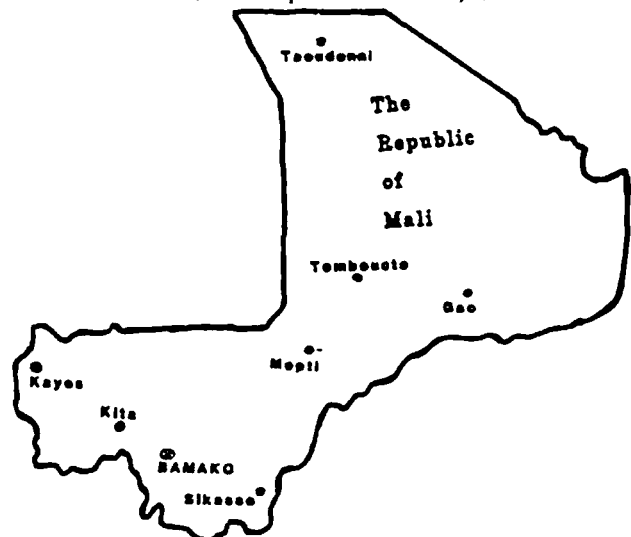
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Increased agricultural production is one of the primary development goals in the Republic of Mali (Houze, 1979). Widespread agricultural education is an important component of the country's developmental strategies. The contribution of Moniteurs d'Agricole (Cooperative Extension agents) in disseminating information and in introducing new cultivation methods, crop varieties, and livestock management techniques is considered essential to efficient agricultural production (Diamond, 1981). Moniteurs d'Agricole are the village junior-level technicians directly responsible for implementing village agricultural development projects. Qualified students interested in careers as Moniteurs d'Agricole must complete a two-year formal training program at one of three different agricultural training centers (Centres d'apprentissage agricole, CAA) and a one-year internship program at one of three different specialized centers (Centre de Specialization, CS). This article will give some insight into the agricultural education program for training Moniteurs d'Agricole in the Republic of Mali.

The Republic of Mali, located between 10° and 26° north latitude and between 4° and 12° west longitude, covers about 465,000 square miles that include the upper basin of the Senegal River and the middle stretches of the Niger River. Mali, the largest coun-

try in West Africa, is landlocked and bordered by Senegal, Mauritania, Algeria, Niger, Upper Volta, the Ivory Coast, and Guinea.

Mali has approximately 6,500,000 inhabitants, most of whom live in the south, with an average population growth of 2.3% per year (Planton, 1979). There are two distinct climatic zones—the Sahelian, north of the 15° north latitude, and the Sudanese to the south. The Sahelian climate is more arid than the Sudanese. Mali has three principal seasons: (1) the rainy season, lasting from June to September or October, depending upon the latitude; (2) the cool dry season, lasting from October or November to February; and (3) the hot dry season, lasting from March to June. After the rainy season, the Harmattan winds (dry trade winds from the northeast desert regions) blow often, causing severe dust clouds. On the whole, Mali is relatively flat. The lowest point in the country is 25 m above sea level (on the Senegal River), while the only mountain worthy of note is Mount Hombori, whose peak reaches 1,155 m



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