

## ENHANCING PRODUCTION EFFICIENCY AND FARM PROFITABILITY THROUGH INNOVATIVE ENGAGEMENT PROGRAMMING

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### ABSTRACT

An innovative Nebraska Extension program titled “University of Nebraska-Lincoln Testing Ag Performance Solutions” (TAPS, [www.TAPS.unl.edu](http://www.TAPS.unl.edu)) was developed in 2016 at the West Central Research and Extension Center (WCREC) in North Platte, NE, USA. This program was developed to enhance the engagement of agricultural producers in the areas of input use efficiency and profitability by providing a common platform for experiential and peer-to-peer learning with participation by University researchers, extension specialist, and industry personnel. The program hosts annual farm management competitions, where producers are introduced to and are able to use new and developing technologies, tools, methods and other resources without exposing themselves to financial risks. The TAPS Farm Management Competitions allow producers to evaluate many input and management choices, including crop insurance selection, planting density and hybrid selection, marketing strategy, irrigation scheduling and quantity, and fertilizer timing, amount, and method. This article presents the conceptual underpinnings, operational components, and outcomes of the program.

**Keywords:** Compétition, expérientiel learning, Extension, Peer-to-peer learning

### 1. INTRODUCTION

The acronym UNL-TAPS stands for “University of Nebraska Lincoln Testing Agriculture Performance Solutions”. As the first and only known program of its type it will simply be identified here as TAPS. This UNL education/extension/research initiative is a proactive, forward thinking program to enhance farm management and production education through programs such as farm management contests, education and social events, and media materials (i.e. video, written articles and reports). The program is led by UNL extension professionals at the West Central Research and Extension Center, North Platte, Nebraska, USA.

#### Mission Statement:

"To engage farm production stakeholders to TAP into the power of all, thereby synergistically harnessing the unlimited power of farm innovation, entrepreneurialism and technological adoption. To keep the farm industry, farm businesses, farms and farm families viable, resilient, profitable and sustainable through their wise allocation and use of all available resources."

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## 1.1 Taps Core Programs

The TAPS core programs are real life, real time farm management competitions, where participants learn by making critical types of farm production and management choices on scientifically controlled sample plots for a complete season, which are amplified to represent larger scaled operations. This amplification enhances the visibility of even small differences in choices among competitors. Currently contest participants are limited to six decision types: crop insurance selection, planting density (seeds/acre), seed variety selection, nitrogen fertilizer application/s (timing and quantity), irrigation applications (timing and quantity), and marketing of the production. The contests generally started in late February and end in early December after harvest. The actual farming for each competing team consists of three replicated plots totalling less than half an acre per team. These plots are located at UNL's West Central Research and Extension Center and are carefully managed and controlled by the TAPS executive board and facilitation team. The contest results are derived from the amplified outcomes of the smaller plots and simulate a farming operation of 1,000 to 3,000 acres depending on the crop type. Costs are based on the current year's localized UNL crop budgets.

Where applicable some of the costs relate to each teams' decisions and actual production and are calculated based on choices they make during the season in real time. Competitors make their choices via an interactive website, where real time information about the plots are available and contestant actions are requested and recorded. This website is where the current crop and field status measured by various new and emerging technology related directly to their individual plots are made available for decision making. The amplification and realization of the farms increases applicability and weightiness of each decision and action by contestants. The program focuses on three critical outcomes which are incentivized by cash prizes: 1) Most profitable farm (largest reward), 2) Most water and nutrient efficient farm (second largest reward), and 3) Highest yielding farm (smallest reward). The forgoing critical outcomes are explicitly ranked, with the most emphasized award being profit followed by nutrient and water efficiency. The yield cash award is based on profitability rank. The lower the ranking in profitability of the highest yield the greater the award is penalized. This last condition is consistent with the idea that yield alone does not translate into profit or efficiency.

## 1.2 Conception Of TAPS

The concept of a farm management competition experience sprang from a discussion about how to increase the effectiveness of the universities extension efforts related to irrigation, water conservation, nutrient management, technology adoption, and management capacity. The traditional methods of extension, which are mostly didactic in nature, work well for many topics but seem to fall short in changing paradigms and are difficult to measure true outcomes and changes within individuals. This idea is well reflected in the old saying about self-reliance "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a life time". TAPS focuses on the latter.

To achieve this, the TAPS team recognized that participants needed several things to facilitate engagement at a higher level and to create real changes in thinking and performance. First, clientele need to be a committed part of the process. Secondly, adult learners are action oriented and often learn readily from peers. Third, they are not always convinced that the research information presented by the university applies to them or their situation. Fourth, they are treated as students or learners and as a result, the university is missing opportunities for valuable feedback and the power of their unleashed individual understanding and focus. Fifth, many producers

while interested in the research results are reluctant to trust it without further experience (adoption risk). Sixth, traditional education programs often ignore the value of private sector involvement (i.e., technology companies, equipment manufacturers, service companies), which have a vested interest in producer success. Finally, while the university has a great reputation for being unbiased, it could benefit from real world credibility. To address these seven issues and others TAPS was conceived.

Creating and maintaining TAPS requires many resources and individuals. The university provides the scientific and competition control, physical location, land resource and infrastructure, much of the farming and irrigation equipment, as well as support staff. Local farmers, various equipment manufacturers, dealers, and service companies donated equipment. Some of this equipment has a long useful life; whereas, other equipment or technologies are of a single use nature and must be annually replaced or renewed. Many of these short-lived resources have been provided by others as either in-kind or through monetary donations. It should be recognized that the program is dependent on the generosity of individuals, companies, and organizations of all types. For a current list of the TAPS sponsors and partners please see the website at [TAPS.unl.edu](http://TAPS.unl.edu).

### **1.3 Program Objectives**

This TAPS program was created to fulfil five primary objectives: 1) To facilitate growers discovery and adoption of new and emerging knowledge relative to agriculture production and management, 2) Create a safe environment for the testing, observation, experimentation, and implementation of new and emerging technologies, management, and production techniques, 3) Create an atmosphere of excitement, competition, and learning, 4) Create a forum for collaboration and communication among all stakeholders related to agricultural production (i.e., UNL, producers, tech companies, agriculture service providers, government agencies) to face current and future challenges, and 5) Maintain discovery and information integrity and faithfully share, report, and distribute all outcomes, methods and strategies to all active or latent stakeholders, making the program an engine of change and innovation.

## **2. CONCEPTUAL UNDERPINNINGS**

There are three foundational conceptual components for the TAPS program, which focus on creating self-motivation, self-reliance in learning, and adaptive management capability of associates (participants). The three components are Competition, Experiential, and Peer-to-Peer learning. These methodologies lead directly to fulfilling the objectives and ultimately to achieving the mission statement when combined with the ten operational building blocks (the blocks are discussed later in the operational components section.)

Author Dan Pink claims that if you want to increase innovation and motivation for higher cognitive and complex tasks three things are required, autonomy, mastery, and purpose. According to Pink (2009) people are motivated by autonomy – engagement happens with self-direction. This relates directly to experiential learning where students are autonomous in their choice of what to focus their learning on. Also as a participant in a contest environment, they have autonomy to develop their own strategy and make their own decisions regarding production and marketing. Mastery is about individuals finding fulfilment in progressing and doing something well. This is reflected in various work cultures with such terms as master electrician, master carpenter, master mechanic, etc. Success in the competition, for example by being recognized as most profitable, is just one of the ways to validate and encourage mastery. Also the very act of competing provides participants a certain measure and

validation of their mastery. This is not just private but is also recognized by their peers. In addition, the act of being a competitor is a step toward mastery, learning from others, competing against the best, working in a peer-to-peer fashion, all contribute to fulfilling the need to achieve mastery.

Competition simply increases the desire to be more masterful. Pink (2009) also talks about the motivating effect of purpose. Having and accomplishing something that is considered noble, valuable or recognized by many can be purposeful. When provided the opportunity people enjoy making a contribution or difference. These feelings may be closely tied to recognition, self-fulfilment or both. TAPS contests provide recognition as well as purpose. Remember that TAPS is about finding solutions to common problems faced by individuals and the industry. By being one of those that contributes to finding solutions is one way to have purpose.

Each of these behavioural motivations posed by Pink (2009) are captured by one or more of the three TAPS foundational components; 1) competition, 2) experiential learning, and 3) peer-to-peer learning. In TAPS the competition component is more than an event that interest the contestants, it enhances and enables the experiential and peer-to-peer learning processes. The experiential learning component provides context to the contest and provides real world applicable education. By making it a peer-to-peer environment where two-way communication is encouraged, everyone benefits. Therefore, to better conceptualize the TAPS program a brief discussion of the underlying principles and qualities of each of these three components is undertaken.

## **2.1 Competition**

The TAPS competition conforms to four key principles of “competition success” outlined by Anil Rathi in his Nov. 19, 2014 Harvard Business Review Article, “To Encourage Innovation, Make it a Competition”. These four principles are: 1) A competition should be framed around a specific purpose. (TAPS Purpose: Competitors will maximize economic profit while being water and nitrogen efficient), 2) Challenges need to be divided into manageable implementable steps (TAPS Challenges: Six clearly defined decision types, i.e. crop variety, seed population, N fertilization, irrigation and marketing), 3) Participants must have access to needed resources and expertise. (TAPS Resources: University researchers, specialists, and educators ;participating companies, organization, and groups’ expertise, technology, and methodologies; data, imagery, and information; and grants, entry fees, individual donations), and 4) Individuals that participate must draw value from the competition process (TAPS Individual Value: All participating groups and individuals draw value as they observe, engage with others and see outcomes, use new technology, make innovative choices and decisions, test and benchmark themselves, which all relate directly to their own operation or circumstance).

## **2.2 Experiential Learning**

The following information about experiential learning was taken from Schwartz al. (2012). However, the authors modified some of the content to reflect concepts and ideas, as they understand them to relate to TAPS.“ In its simplest form, experiential learning means learning from experience or learn by doing. Experiential education first immerses learners in an experience and then encourages reflection about the experience to develop new skills, new attitudes, and/or new ways of thinking.”

**Lewis and Williams (1994, p.5):**

“Experiential learning is also built upon a foundation of inter-disciplinary and constructivist learning. Experiential methodology doesn’t treat each subject as being walled off in its own room, unconnected to any other subjects..... How one student (*competitor*\*) chooses to solve a problem will be different from another student (*competitor*), and what one student (*competitor*) takes away from an experience will be different from the others.” *\*italics added for clarity.*

Chapman et al. (1995) created a list of learning characteristics that would most likely be present in an experiential activity:

- Mixture of content and process: There must be a balance between the experiential activities and the underlying content or theory. (This includes articles published, field day events, and other social, reflective, and education undertaken).
- Absence of excessive judgment: There must be a safe space for students (*competitors*) to work through their own process of self-discovery. (Only winners’ names’ are identified in the results. Special care is exercised so that participants are not penalized or embarrassed).
- Engagement in purposeful endeavours: There must be “meaning for the student in the learning, i.e. the learning activities must be personally relevant. (*Competitors* have the opportunity to make the same or similar decisions on their own farming operations making it very purposeful and relevant).
- Encouraging the big picture perspective: Experiential activities must allow the students to make connections between the learning they are doing and the world. Activities should build in students the ability to see relationships in complex systems and find a way to work within them. (*Competitors* have continuous information and can directly observe the result of their management decisions as well of those of other *competitors* who may or may not be more efficient or profitable).
- The role of reflection: Students should be able to reflect on their own learning, bringing “the theory to life” and gaining insight into themselves and their interactions with the world. (*Competitors* are able to reflect at several events during and following the season, including the recognition event where the results and awards are discussed in detail. This allows for deep thought and reflections on whether they might alter their management strategies).
- Creating emotional investment: Students must be fully immersed in the experience, not merely doing what they feel is required of them. The “process needs to engage the learner to a point where what is being learned and experience strikes a critical, central chord within the learner.” (Contest results are based on participants keeping up with their management decisions throughout the season. The competition portion increases individual motivation to be aware of their peers and who might be more profitable and/or efficient).
- The re-examination of thought: By working within a space that has been made safe for self-exploration, students can begin to analyze and even alter their own basic premises. (A TAPS competitor has no monetary risk and their identity, except for the winners, is not revealed).
- The presence of meaningful relationships: Getting students to see their learning in the context of the system, some of these relationships are by the learner beginning to recognize the relationships of “himself as learner, learner to teacher, and learner to the learning environment.” (The peer-to-peer engagement has been huge for TAPS. *Competitors* talk to other *competitors*

about their award winning strategies and what experiences they have had to reinforce those decisions).

- Learning outside the perceived comfort zone: “Learning is enhanced when students are given the opportunity to operate outside of their own comfort zones. (Because it is a safe and competitive environment, participants can contemplate their ideas with others and develop new strategies to succeed).

Key things that make experiential learning the method of choice are:

- The student (competitor) manages their own learning, rather than being told what to do and when to do it.
- The relationship between student (competitor) and instructor is different, with the instructor passing much of the responsibility on to the student (competitor). TAPS goes one-step further, where the instructors are also students (competitors).
- The curriculum itself may not be clearly identified, the student (competitor) may have to identify the knowledge they require and then acquire it themselves, reflecting on their learning as they go along (Moon, 2004, p.165).

Qualities that successful experiential learning imparts to learners:

- Experiential learners have more of a willingness to reorder or alter their conception of a topic.
- They will learn to reason for themselves and are more likely to successfully defend their position.
- They learn to develop clarity of purpose with tasks they undertake and to a larger degree the self-management skills necessary to successfully work alone.
- They learn the value of being open-minded and are able to work with people with different views.
- They are more able to identify the role of emotion in their learning as well as reflect on how they have come to their new knowledge (Moon, 2004, p. 163).

Those who benefits most through experiential learning are:

- The mature learner who has been long removed from the traditional classroom and needs the motivation of contextual learning.
- The learner who needs to personally experience the value of a subject in order to be motivated to learn.
- The learner who has trouble learning within the formal classroom and needs an alternate learning method in order to succeed.

These last three bullet points describe many of those individuals extension professionals consider to be their primary clientele.

### **2.3 Peer-To-Peer Learning**

The following information provides the basis for the TAPS use of peer-to-peer learning. Much of the information is that from Professor Matthew C.E. Gwee, Department of Pharmacology & Medical Education Unit, Faculty of Medicine / Associate Director, CDTL, National University of Singapore with insertions and revisions by the authors. Matthew Gwee, (Boud, 2001) states “...learning with and

from each other is a necessary and important aspect of all courses. The role it plays varies widely and the forms it takes are very diverse, but without it students gain an impoverished education.”

Peer learning essentially refers to students learning with and from each other as fellow learners without any implied authority to any individual, based on the tenet that “Students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers” Matthew Gwee, (Boud, 2001).

The traditional lecture or didactic mode of learning has been criticized for the following three reasons:

- Molding students into passive recipients of information transmitted by the teacher and making them highly dependent on teachers for their learning needs.
- Promoting rote learning that involves mainly memorization, recall, and regurgitation of facts.
- The lecture often results in large amounts of information that at times is difficult to find real application under varying conditions.

Peer-to-Peer learning requires learners to have an increased initiative and take greater responsibility for their own learning and education. In peer learning, students will construct their own meaning and understanding of what they need to learn. Essentially, students will be involved in searching for, collecting, analyzing, evaluating, integrating, and applying information to complete an assignment or solve a problem. Thus, students (competitors) will engage themselves intellectually, emotionally, and socially in “constructive conversation” and learn by talking and questioning each other’s views and reaching consensus or dissent (Boud, 2001).

Peer learning is optimized when incorporated as an integral component of a curriculum, paying special attention to the following two ideas:

- Creating a conducive learning environment: Students must build mutual respect for and trust and confidence in one another, so that they “feel free to express opinions, test ideas, and ask for, or offer help when it is needed” (Smith, 1983). Peer learning can be further enhanced if the “environment of mutual help...continues over time and beyond the classroom” (Boud, 2001). Thus, students are individually and collectively accountable for optimizing their own learning and achievements.
- Learning in small collaborative groups: Many of the key elements for effective peer learning are often incorporated in the design of small collaborative learning groups, and “research shows that students who engage in collaborative learning and group study perform better academically, persist longer, feel better about the educational experience, and have enhanced self-esteem” (Landis, 2000). Furthermore, “the peer support...is a powerful psychological ballast to critical thinking efforts” (Brookfield, 1987).

In addition to content knowledge acquisition, peer learning, especially in small collaborative groups, nurtures and fosters the development of:

- *Self-directed learning skills*, and thus lays the foundation for life-long continuing self-education.
- Critical thinking and problem-solving skills.
- Communication, interpersonal, and teamwork skills.

- Learning through self, peer assessment, and critical reflection.

Peer learning also strongly motivates learning often attributed to the fun and joy of learning in small groups. The outcomes of peer learning ultimately depend on the design strategy, outcome objectives of the course, facilitating skills of the teacher, and the commitment of students and teachers.

In conclusion, peer learning is learner-centered education that transcends content knowledge acquisition. Peer learning optimizes student learning outcomes and provides a more holistic, value-added and quality-enhancing education that will better prepare students for the needs of the workforce in this millennium.

Surprisingly peer-to-peer learning as part of the TAPS competition has been observed to be a very powerful and useful part of the program. This seems at odds with the idea that everyone is competing for a prize. Whether this openness can be attributed to the farm culture of the individuals is unknown. But what is known is that information is freely shared among individual competitors or groups. This might also be attributed to the fact that all decisions at the end of the season are published, however the identity of those who made the decision is not.

### **3. OPERATIONAL COMPONENTS**

The TAPS program has ten operational components. Three of the ten are types of events: 1) Social/education gatherings, 2) Individual/team decision making, and 3) Evaluation, reporting, analysis, project summarization, and information sharing. Three more are physical in nature: 1) The production space, 2) The communication hub, and 3) All other equipment, technology, and facilities. The four remaining are types of participants: 1) Facilitators, 2) Competitors, 3) Integrators, and 4) Followers.

#### **3.1 Event/Activity Types**

The three types of events or actions needed for a successful TAPS program are centred around participant interaction and relationships. These events/activities provide the needed atmosphere and environment that drives the competition, experiential learning process, and peer-to-peer interactions.

#### **3.2 Physical Components**

While the TAPS events create opportunity and atmosphere for education and involvement, the physical components provide experimental and experiential workspace (farm contest site), input effect, output produced, facilitate communication, ensure reliability, realism detail and consistency. Events without actions and results or vice versa would lead to a less than successful experience. The more transparent and clear measurable actions are on detailed precisely measured effects of individual competitors the more there is to learn and discuss among all participants.

#### **3.3 Participant Types**

TAPS is intended to be an experience or journey among all participants rather than just another outreach program. The four participant types are described below:

- Facilitators are all personnel who plan, direct, control, and work with and make TAPS happen. This is generally the executive committee, program coordinator, website administrator, advisors, university scientist,



administrators, extension educators, staff and technicians, and others who assist in facilitating TAPS.

- Competitors are groups or individuals who compete in any TAPS contest, including farmers, business people, NGO's or government organization representatives,
- Integrators are associated individuals, companies, organizations, etc. that have a vested interest in agriculture production, technology, resources, etc. This group includes technology, service, support, regulatory agencies, and businesses.
- Followers are individuals who benefit from the information and results generated by the TAPS program, such as non-competing producers, or stakeholders. It is expected that these followers will benefit from all of the reports, articles, field days, education programs, and interaction with facilitators, competitors, and integrators.

#### 4. OUTCOMES

The majority of competitors have felt the TAPS experience was more than worth their time. During last season's summer field day, we invited several of the previous year's competitors to speak about their experience with TAPS. Two of their comments included thoughts about how powerful TAPS had been in changing their perspectives on how to manage inputs, and how it helped benchmark their skill as a producer. At the end of the 2018 competition, the TAPS executive team interviewed many of the competitors. The following is a small sample of the feedback received from them:

TAPS "Has allowed us to see just how much marketing can affect profits.", "It really opened my eyes to a different way of farming. Instead of just going by what the coop recommends.", "I've gotten more intense on soil sampling. Instead of just one or two pulled per field. 2019 will be my first year grid sampling some." also "Irrigation with moisture probes, utilizing them is vital.", "I think that it showed how to market, gets you the opportunity to use different avenues for marketing . . . nitrogen use and split application of nitrogen.", "Program helped put production into a system rather than discrete actions.", "The information transfer and observations by the peer group will transition our farming operations faster than anything we have encountered in the past."

The Nebraska Corn Board wrote this: "The TAPS program meets farmers where they are at with their own management style and offers them the opportunity to experiment and learn through the program's resources. In that regard, the TAPS program's contribution to the mission of Nebraska Extension is twofold. TAPS not only provides research-based education to farmers, but also allows them to take an active role in contributing to the research through their management decisions, and serve as individual educators through peer-to-peer exchanges. Although officially competing against their peers, the greater value may come from participants competing against themselves as they work to improve their own input use efficiency and profit."

The Ogallala Water Coordinated Agriculture Project (OWCAP) wrote this: "The innovative Testing Ag Performance Solutions program (TAPS, [www.taps.unl.edu](http://www.taps.unl.edu)), developed and implemented so successfully for the past two years by UNL Extension's Chuck Burr, Daran Rudnick, and Matt Stockton, is a truly outstanding program that is demonstrably impacting the mind-set and management practices of irrigators while engaging and educating a much broader audience both in and well beyond Nebraska, including state agency and groundwater management district staff, academics, students, seed and technology providers, and many others."

From the nature of these comments and statements, the TAPS program is on track to meeting their objectives. In addition to these comments, other work is ongoing to publish the associated research and management information. For example, the 2017 TAPS data was used to study the theory and practical significance of water and nitrogen fertilizer use efficiency indices, so that appropriate metrics and recommendations can be developed (Lo et al., 2019). In addition, several extension reports are available on the TAPS website. Nevertheless, the mountain of data collected over the past two years is still been largely un tapped.

## 5. DISCUSSION

TAPS is an intensively concentrated program that requires the support of many different types of organizations and people to be successful. The program is well suited to increasing knowledge, experience, and acumen of all those willing to be engaged. It uses cutting edge methods of education and cooperation to effect changes within all types of participants. In addition, it has a traditional outreach component associated with its website and inclusion in other extension programs. TAPS is oriented towards solving both the individual producers and industry wide issues.

The program has great potential for growth and expansion. More focus is needed on the follower participants where much benefit from sharing, analysing, and publishing the current store of collected data results and outcomes would add increased value. The challenges associated with growing and maintaining this program are like those of any new and emerging program. However, due to the high degree of involvement of the ag production industry the prospects for finding solutions to those challenges are optimistically viewed.

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