

Designed for Learning: Use of Skill Tracker in Veterinary Education

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Abstract

Although learning is a natural process, many of the systems designed to support education do not contribute positively to the experience of students. This paper reports on the design of Skill Tracker, a software system developed at Massey University to manage processes around student skill acquisition, and initially applied to the university's Veterinary Science program. The software has been designed around guiding ideas relevant to learning in a professional context: the "progress principle" and Communities of Practice. The paper outlines how these ideas have shaped the design of the software. While Skill Tracker enables the university to collect data that inform the management of the Veterinary School, the underlying purpose of the system is to enhance the experience of students. In order to do achieve this goal, it is necessary to understand a key dilemma in any educational innovation: the need to integrate technology and pedagogy.

Keywords

Learning, Skill Tracker, System thinking, pedagogy, education innovation.

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Designed For Learning

Universities and other teaching institutions need to develop administrative systems that support the learning of students. Increasingly, institutions are being held accountable and are required to track and report on the outcomes being achieved (Biggs and Tang, 2007). Yet the systems that institutions develop can have a negative impact on the work being

done. Systems, while necessary, may act as obstacles to learning for students, or a cause of frustration for teachers. A system may meet the requirements of the university and those auditing student learning, yet achieve this in a bureaucratic manner that focuses the attention of staff and students on compliance rather than real learning.

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Learning is a natural human process (Ramsey, 2001), one that people can find engaging and satisfying (Gallwey, 2001). Yet many students experience learning as a process of compliance, where they engage in a compulsory activity, sometimes with little understanding of the purpose of the activity. Teachers may struggle to ensure that students are fully engaged in the process of learning.

When people experience frustrations with the learning process a common response is to blame others with whom they are interacting. Students may assume that a particular teacher is unskilled. Teachers may complain that students lack proper motivation or preparation. Rather than blame the other people involved, it is useful to consider the way the system of teaching is designed, and the behaviors and outcomes that naturally occur because of that design (Senge et al., 1990).

Anthropologist Bateson (1972) suggested that problems arise when there is a gap between “how we think” and “how nature works”. In other words, if we think that people should learn in a particular way, and then we design our educational systems accordingly, but in reality, people learn very differently to how we think, there is a mismatch between our thinking and nature. The greater the mismatch, the more problems we will experience. Experiencing problems, therefore, should prompt us to examine the assumptions we are making and the way these influence the design of our systems.

This article considers a case study of an educational system designed to teach and assess the attainment of clinical skills by New Zealand veterinary students. The system was created to provide greater confidence in student preparedness for skill assessment, describe the standard

required so that different assessors can be confident that the same standard is being met and greater confidence in confirming the identity of the assessor. The new system was designed to enhance student learning through the application of management and pedagogical principles and to more clearly meet the standards of accrediting bodies. This article will outline the guiding ideas that shaped the thinking of system designers, consider the challenges faced by the school in light of these ideas, and describe the design of the new system. Finally, it will conclude by considering what more is needed to ensure the system is able to provide sustainable outcomes for both students and the institution.

Context

Massey University’s veterinary school is the provider of undergraduate veterinary education in New Zealand. The program, which has been running for over 50 years is internationally accredited and teaches both domestic (government subsidized) and international full-fee paying students who comprise about 20% of each class. Accreditation by Australasian veterinary licensing authorities is essential so that graduates of the program can register to work in New Zealand and Australia. Further accreditation by the American Veterinary Medical Association Council on Education helps to attract both high quality staff and international students.

As well as learning relevant theory, veterinary students must also develop a wide range of practical skills including animal handling, clinical examination, sample collection, diagnostic skills and surgical techniques. These skills are recognized as day one competencies by accrediting bodies such as the Royal College of Veterinary Surgeons and the Australasian Veterinary Boards Council

(RCVS, 2011; AVBC 2016). The final year of the five-year BVSc programme is comprised of clinical rotations with only three weeks of lectures. The clinical rotations are a mix of core and specialist rosters where students can choose to gain further experience in different areas of practice (e.g. small animals, production animals, horses). The students also spend up to eight weeks observing and participating in practice in veterinary clinics outside the university; these can be in veterinary businesses in New Zealand or overseas as well as at veterinary operations at zoos, universities or research organizations.

Although there is an expectation that veterinary students graduate with a range of 'day one' skills, there is also an understanding from employers that new graduates will need to be supported by the practice for a period of time to further develop their skills, improve speed and accuracy, perform routine procedures with fractious animals or in more demanding circumstances and a recognition that not all cases will be straightforward. Time spent mentoring new graduates will benefit both the business and the new graduate. The first experience with employment and the level of support provided is known to be a "make or break" factor for many new graduate veterinarians (Gilling and Parkinson, 2009).

In addition to the usual assessment by written assignments, tests and examinations, the practice-oriented skills of the veterinary students must also be assessed. For a number of years, a paper-based system (the 'Red Book') was issued to students as they approached their final year of study. The book provided a list of skills with space beside each skill in which a teacher could sign to indicate that the student had successfully demonstrated the skill. As part of the final year clinical

rotations each student has to get all core skills signed off as well as those associated with their specialist or nominated area of study. Some of the skills were only able to be assessed and signed off by university faculty but most of the skills could be signed off by any registered veterinarian in New Zealand or overseas.

A number of potential problems with the 'Red Book' system were identified:

- Skills were listed in the book by title only: no indication was provided about the standard that students were expected to achieve.
- The focus was solely on assessment with no consideration for learning or preparing for assessment.
- Skills could be signed off by a range of people including practicing veterinarians with little or no experience with teaching or assessment.
- There was no space to further identify the signatory to confirm their identity. However, the students were advised that any skills signed off overseas had to be accompanied by a signed statement on practice letterhead.
- Skills could be signed off by new graduate veterinarians who had been in the class ahead of the final year students who could well have been their friends or previous flatmates.
- Students expressed concern that it was difficult to get some teachers to do the required paperwork, even though it only involved providing a signature.
- If a book was lost there was no record of the skills acquired, and students would need to repeat many of the procedures that had previously been signed off.

- The school had no way of identifying students who were struggling to achieve the needed skills unless the students advising them of their difficulties.

School executives decided to invest in an innovative effort to create an electronic system that would resolve the quality issues associated with the Red Book. However, to be effective its new approach would need to do more than smooth out the paperwork. Rather, it would be of real value if it had a positive effect on the quality of learning of students. For that to happen attention would need to be given to the principles of learning and management that guided its development.

Guiding Ideas

Many of the systems developed or adopted in organizations are not based on how people actually think and act, but rather on tradition. Understanding theories to do with learning and management provides designers with the opportunity to create systems that are more effective at delivering the desired outcomes. Two areas in which theory has advanced in recent years are in the understanding of the role progress has on the quality of people's inner lives, and the social nature of learning.

Research by Amabile and Kramer (2011) has shed light on factors that influence wellness at work. They initially established that employee's "inner life" can have performance benefits for organizations, with improvements in areas like productivity and creativity, and psychological benefits for individuals, including improved relationships with co-workers. The "inner life" of a person is that which is not immediately obvious to an observer: it refers to the degree

to which people are engaged with the work they are doing, feels positive about their colleagues and their organization, and experience positive emotions like satisfaction, optimism, and happiness.

When Amabile and Kramer looked for factors that influenced inner life, making progress stood out as critical. The progress that people make toward their goals was the most significant factor in a positive inner life and, correspondingly, setbacks to progress had the most significant negative impact on inner life. Further, the second most influential factor also related to progress. When people receive support for future progress there is a positive impact on inner life, whereas encountering obstacles to future progress has a negative impact.

The third most important factor was the quality of interactions people had with colleagues. Nourishing interactions can have a positive impact on our inner lives, where toxic interactions make our inner lives more negative. This finding signals that events experienced during work or learning may be complex. A student who does not achieve the required standard may be made to feel inadequate by the teacher or their peers, lose confidence and be reluctant to put themselves forward for assessment in the future or anxiety may further impair their performance in assessment situations. Conversely, someone who suffers a major setback while working toward an important goal may find that a colleague or teacher provides coaching that helps learn lessons that could make a difference in the future. This coaching, which is perceived as both a nourishing interaction and support for future progress, can turn what would have been a major negative impact on inner life into a positive impact.

These findings support concepts related to learning, change, and creativity that have been articulated by theorists such as Gallwey (2001), Blake et al., (1989) and Fritz (1989). These authors outlined the motivating power of a gap between the desired goal and the actual or current reality. People naturally experience tension when such gaps exist and work hard to close them. When a gap closes and reality finally matches the goal, people feel a deep sense of resolution, stimulating the desire to set new goals and start the tension-resolution process again.

The work of Amabile and Kramer (2011) suggests that designing a system to make progress evident will benefit both the performance of students and contribute to their psychological wellness. Another important view is that learning is both a social and a personal process. Learners set goals that are important to them. They practice exercises and complete assessments. They make decisions about resources they will use and ask questions. While other people such as classmates, instructors and practitioners who share knowledge are involved, these are experienced as secondary to the personal work of learning. For this reason, learning theory and practice are typically centered on the individual experience of the learner while social issues are treated as being on the periphery of the learning experience: the context in which it happens (Brown and Gray, 2008). There is an increasing awareness that our understanding of learning can benefit from shifting the focus to the social processes involved in learning.

Since the 1970s research has highlighted that much of what we learn occurs as a result of social processes, including imitation of role models (Bandura, 1977). The 1990s saw the emergence of the

concept of 'Communities of Practice', social groupings that have a fundamental influence on the learning processes of individuals and teams (Wenger, 1998). The situation could be compared to studies of animal behavior; a scientist might learn a great deal studying the behavior of individual ants but much more can be learned by switching attention to the behavior of a whole colony and viewing the system in which an individual ant is acting. Similarly, the behavior of individual learners makes greater sense when we take a community view of the processes taking place.

A community of practice has three basic structural elements (Wenger et al., 2002). There is a *domain*: the field of knowledge that gives the community purpose, defining the issues that its members have a shared interest in resolving. There is a *community*: the group of people who care about the domain. Finally, there is *practice*: the various tools, information, ideas and so on that the community share and which they build up over time as they learn to solve the issues they experience in the domain.

Individuals learn in connection with communities of practice. Young people enroll in Veterinary Science degrees, not because it will teach them all they will ever need to know as a veterinarian, but because it is a requirement of the professional community of veterinarians for anyone who wants to become a member. What the student may think of as a personal goal has a social motivation; the student wants to join a particular community. Learning about veterinary practice does not stop at graduation; often it accelerates as the graduate becomes more closely connected to others in the community who can share knowledge about practice. Practicing veterinarians do not share knowledge

indiscriminately with members of the public, but they will share what they know with veterinary students, whose enrolment in the degree legitimizes their participation on the fringe of the community.

Learning happens both formally and informally within communities. Conferences and training programs are organized to provide formal mechanisms for knowledge sharing. Informally, people form collegial and mentoring relationships. Processes that might be otherwise difficult to organize are facilitated by the existence of a community in which they naturally emerge (Lave and Wenger, 1991). Social processes are also a powerful form of influence on the choices people make and on their attitudes and behavior (Patterson et al., 2008).

While the basic purpose of a student assessment system may be to track individual progress and provide management information for institutions involved, the power of the system will be enhanced if it can encourage the healthy operation of relevant communities of practice.

Skill Tracker

The system developed for the Veterinary School (*Skill Tracker*) has a number of features designed to support student progress and engage the professional veterinary community in New Zealand, along with other communities relevant to student learning. The basis of the system is a 'library' of skills developed by the Veterinary School. Each skill has a title, and a description of the standard that a competent practitioner is expected to achieve when performing the skill. Accompanying the skill is a statement of 'purpose': an explanation of the skill's relevance to professional veterinary practice.

Skill Tracker is designed to reflect how skills are acquired through a staged process: (1) developing an understanding of what is involved in the skill with background knowledge of anatomy, physiology, animal behavior, medicine, and surgery; (2) observing the skill being performed by others as well as opportunities to practice the skill as part of a group of students or individually in a closely supervised situation; (3) reaching the point where the skill can be performed to the required standard, though this performance requires significant effort and concentration; and (4) reaching a level of mastery, where the skill can be consistently performed in a variety of conditions and without supervision. Thus, *Skill Tracker* allows the Veterinary School to specify the level students need to achieve. The student may only need to have a basic understanding of some skills and can expect to receive further training and supervision in these skills following graduation (e.g. those skills which might only be relevant to a particular area of practice such as passing a nasogastric tube in a horse). Other skills, such as injecting animals by a variety of routes, may need to be performed competently in a range of species and situations without supervision from a senior colleague right from the point of graduation.

Skill Tracker allows students to recognize their progress towards competence from level one to level four and also reinforces that students need to prepare prior to assessment. The student needs to request that an assessor observe their performance with a clinical skill and then an electronic request goes to the teacher with a link for the teacher to 'sign off' that the student has performed the skill satisfactorily. If the skill was not performed satisfactorily, the teacher will decline signing off the skill and is prompted to provide feedback.

This should reinforce what was said at the time by the teacher but provides evidence of feedback and a record of what the student needs to revise or focus on in future attempts. The system is designed so that students can post electronic evidence (reference to records, photographs, etc) to support their requests to be signed off, keep notes on important points to do with the skills, and access electronic resources that have been included in the system, that give guidance on how to acquire the skill. Inputting clinical case numbers as the evidence allows external auditors to satisfy themselves as to the validity of the process.

Student progress across all required skills is recorded on a database that can be accessed by the various stakeholders in the system. Students have a dashboard that shows them how far they have progressed through the set of skills they require, expressed as a percentage, and they can benchmark their progress against the class average as the year progresses. Teachers are notified of requests for sign off and reminders can be scheduled electronically according to either time elapsed since request or once there are a certain number of requests pending. Finally, the Veterinary School administration can track the progress of the student body. Over time the database will allow the School to identify areas where students struggle, providing valuable information that can be used to determine how best to allocate resources. Further, the data provide a basis for auditing and improving the quality of skills-based teaching, and managing the workload of the teaching staff.

The system can accommodate any number of skills within the library and it is planned that practical skills that are developed in the earlier years of the programme, particularly those for animal

handling or prerequisite skills for surgery such as scrubbing in for surgery, can be included and the students can visualize their progress towards competence from the start of their studies. Students can sign-off their own progress for level one (to have read about or reviewed information about the skill) and level two (to have participated in a group activity or demonstration of a skill) for each of the skills. For some of the skills, it may be more appropriate for a teacher to sign off level two competence. Most skills only require a level three sign-off prior to graduation meaning that the student has satisfactorily demonstrated proficiency in the task. Level four (mastery of the skill) may be a prerequisite for satisfactory completion of the course in some instances. Generally, it would be expected that graduates would work towards mastery of many of the skills after graduation in which case sign-off may need to be negotiated between the graduate and their employer or supervisor.

Like any organizational or management system, Skill Tracker seeks to be of value to a range of stakeholders, all of whom have differing interests. This could be a cause for confusion in the design of the system. Mourkogiannis (2006) points out that organizational 'greatness' depends on a clear sense of purpose that shapes how work is done: one of the bases for the purpose mentioned by Mourkogiannis (2006) is altruism: the desire to be of real value to others. In the case of Skill Tracker, the design needed to appeal to meet needs of administrators, teachers, and professional accrediting bodies. But the essential purpose guiding the design of the work was an altruistic concern particularly for students engaged in the process of learning, who want their education to help them transition smoothly into their chosen professional community. For that reason, the design of the system

deliberately incorporated guiding ideas relating to progress and communities of practice. By enabling them to have clarity about the skills they need to learn, Skill Tracker makes progress visible to students throughout their study. Further, Skill Tracker can act as a vehicle to encourage healthy relationships within the veterinary community of practice to the benefit of those entering the profession. The processes involved bring members of the community together in ways that allow teaching, learning and mentoring to take place naturally.

What Drives Innovation?

The development of Skill Tracker has been based on pedagogical concepts that, when applied, should enhance the experience of students. Yet when technology and pedagogy intersect, questions are raised as to which should be “in the driver’s seat” (Kohn, 2009). Some educational experts argue that technology always serve pedagogy, otherwise it tends to be aimless with little impact on learning outcomes (Fullan, 2011). Others suggest that the opposite is true: that technology evolves faster than pedagogical principles, and creates more opportunities that can amplify cognitive processes, including learning, in unexpected ways (Westera, 2015; Madiba and Mwamza-Simwami, 2008).

This debate appears to be framed as an unnecessary “either-or” choice, where in reality the introduction of a new initiative such as *Skill Tracker* involves an iterative process that aims to create an effective process that benefits users (Weller, 2011). Pedagogy informs the design of technology and provides the means of evaluating whether an application has been successful. And technological processes and opportunities challenge

and refine pedagogical concepts, while providing practical ways of putting them into practice.

One of the challenges that have faced implementation of Skill Tracker is that the technology involved makes it easy to turn off features of the system that is cumbersome, even when these are pedagogically beneficial. For instance, the initial design of the student dashboard meant that the system worked very slowly while it updated various calculations that were being fed back to users. The slowness of the system was particularly frustrating to students, and the temptation for designers was to remove the dashboard, even though this was a feature that provided students with the clear picture of progress discussed earlier. Instead of taking the easy approach of turning off the dashboard, more work needed to go into the design of the dashboard so that it was less complex while still providing the information students really needed.

Concluding Remarks: The Road Ahead

Skill Tracker is still in a relatively early stage of development and the Veterinary School is still exploring how it can be of greatest benefit to students, teachers and administrators. The library of skills developed by the school makes adoption of the system attractive to other universities that teach Veterinary Science, and may well be the basis for future collaborations.

Among the challenges to be addressed is the need to ensure that the system is also beneficial for the teachers involved. As discussed throughout, a key principle incorporated into the design of Skill Tracker is the need to make student progress visible, as that will enhance student motivation and possibly the quality of their inner life. This is achieved via the

dashboard that shows students how they are progressing with skill acquisition. At present, teachers do not receive indicators of their progress in teaching, apart from a list of the requests for 'sign-off' that are pending.

The development of an 'app' would also enhance the immediacy of the system in that teachers could authorize the sign-off at the time the skills was demonstrated if the standard had been met.

As discussed in the previous section, the process of designing a technology-based pedagogical innovation involves an iterative process in which pedagogy and technology complement and enhance one another. The road ahead for Skill Tracker will inevitably involve an on-going process of learning where the technology alerts system designers to learning theory that could be incorporated, and new learning concepts prompt the inclusion of extra features that enhance what the database provides.

Notes on Contributors

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