Principles of adult learning: the learning process

A.L. Jensen

Department of Basic Animal and Veterinary Sciences, Faculty of Life Sciences, University of Copenhagen, Groennegaardsvej 7, stuen, DK-1870 Frederiksberg C, Denmark
E-mail: alj@life.ku.dk

Summary
Learning involves adding to the knowledge and skills of a student, and can be divided into a 'process' and an 'end product' or 'outcome'. In formal teaching, the focus is on pre-defined end products and it is hoped that the improvements in knowledge and skills are relatively permanent. However, this is not always the case, which is why it becomes important to examine the concept of 'transfer' more closely. 'Transfer' describes how well the knowledge and skills learned in one context can be applied by the student in another context. Several factors influence transfer. This paper describes the ways in which specific factors related to the student, the content of the course and the learning situation itself can influence the learning of new knowledge and skills. Furthermore, it examines how particular methods of learning can enable the knowledge and skills thus gained to be more easily applied in other circumstances.

Keywords
Adult education – Curriculum – Education – Teaching – Transfer of knowledge.

Introduction

In universities, and other schools and colleges of higher education, many resources are used to plan, execute, maintain, improve, evaluate and accredit veterinary education and teaching, the ultimate goal of which is to prepare the students for their future role in the veterinary profession. To make the best use of the resources available, insights into various aspects of learning may be helpful in properly analysing and diagnosing practical learning problems and suggesting practical solutions. Learning involves adding to the knowledge and skills of the student. The process by which this change occurs is referred to as 'the learning process', and the end result, i.e. the increase in the knowledge and skills of the student, is the learning 'product'. In formal education, such improvements in knowledge and skills have a predetermined aim, and efforts are made to direct these improvements towards this aim. The learning product thus becomes the target of the endeavours of both teacher and student and is referred to as 'the learning objective'.

When this change in knowledge and skills is the result of planned teaching, hopefully the learning objective is reached and the associated change is more or less permanent. However, this is not always the case. As an example, students may not be able to easily apply what they learned during an anatomy course to a clinical or pathology course. This problem is described as a 'transfer problem'. 'Transfer' involves how effectively the knowledge and skills learned in one context can be applied in another context. This is not a simple problem and it always includes (at the very least) these four components and the interactions between them:
– the content
– the student
– the learning situation
– the situation in which the learning is applied.

This paper will focus on these four components, extrapolating some general principles of learning which can be used to devise practical solutions.

Content

What a student learns can be divided into:
– knowledge
– skills.

Skills can be further subdivided into, approximately:
– 'thinking skills'
– 'manual skills'
– 'social skills'.

Thinking skills are acquired through studying a body of knowledge, and are often divided into:

– lower-level thinking skills (e.g. rote learning without understanding, enumeration, description, paraphrasing)

– higher-level thinking skills (e.g. learning how to learn, problem identification, problem solving, evaluating, hypothesising and critical thinking).

Higher-level thinking skills and social skills can be used in different subject areas and contexts and are often referred to as 'generic skills'. In generic skills, there are typically no conclusively right or wrong answers or ways of doing things. Other skills, such as motor skills (e.g. how to perform an operation or laboratory experiment) can basically be performed either in a right way or a wrong way, and are often founded on rules and objective facts.

How then should learning objectives be described? Descriptions of the learning objectives are used as 'road signs' on the desired pathway of changes. In the overall curriculum, the learning objectives can be formulated in general terms, for example, as goals or aims, whereas in course curricula they must be more specific so that students know exactly what to aim for. The only way that people can appreciate that learning has occurred in another person is by observing an improvement in the ability of that person to do, say, write, perform or act. In other words, a teacher can only appreciate that a student has learned something when the teacher notes a change in the observable behaviour of that student. It therefore appears logical that a description of the learning objective should define the type of observable behaviour to be expected as the end result. Useful aids in this process can be found in Biggs (1) and Ferris and Aziz (5).

The student

In their five-stage model of human skills development (2), Dreyfus and Dreyfus describe the way in which an adult progresses from a novice state, with analytical and rule-following behaviour, to an expert state, with intuitive behaviour based on accumulated concrete experiences and an unconscious ability to relate new situations to remembered ones. So it would seem that people with increasing experience move along a continuum from recognising and applying facts and standard rules to being able to develop and test new forms of understanding and action when familiar ways of thinking and acting fail (4).

A second personal factor concerns how performance is affected by the ability to cope. A key component in coping is the amount of energy that a person possesses to meet new situations. The theory of 'margin' (7) conceptualises this in a simple way, by noting that margin (M) is the balance between load (L) and power (P). The more power, or lesser load, the more margin to participate in learning. Load includes such factors as: available time, presence of family and friends, workload, personal aspirations, hopes and desires. Power includes such factors as: external support, economic circumstances, social abilities, motivation and acquired skills that contribute to effective performance. From this, it is easy to appreciate that there is a limit to how much new learning can be achieved in a certain time.

An important study by Marton and Säljö found that students adopt either a surface approach or a deep approach to studying (8). Students using a deep approach focus on understanding and sense-making. To achieve this, they must adopt higher-level thinking. Students using a surface approach typically concentrate on memorising details and facts without understanding, which generally requires only low-level thinking. Newble and Cannon suggest a third approach (9). They suggest that many students adopt a strategic method of studying, in which they use both surface and deep approaches to achieve varying levels of understanding, depending on course requirements and assessment. Students who adopt a surface approach often have less 'margin' or are motivated by fear of failure, anxiety and a concern to complete the course. As Biggs notes (1), their intention is to 'get the task done' with a minimum of trouble, while hopefully meeting course requirements. Students using a deep approach have more 'margin' or are motivated by an interest in the subject and a need to understand and 'make sense' of it, so that they can engage in the set tasks meaningfully and appropriately. Students using a strategic approach are motivated by the desire for high marks and competition with others .

The learning situation

Numerous learning theories have been presented, focusing on cognitive, emotional, social and individual aspects of learning, and it is impossible to cover them all here. However, a simple yet comprehensive model (Fig. 1) has been proposed by Illeris (6). The strength of this model is that it combines cognitive, emotional, social and individual dimensions (cognition, emotion and environment), whereas traditional learning theories are often only concerned with one or two dimensions. For learning to occur, Illeris believes, a personal acquisition process and a social interaction process must both take place. The interaction process is where the learning process begins, with one of five stimuli:
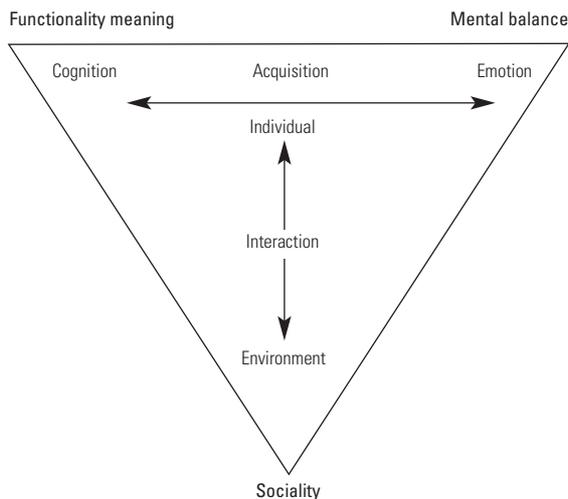
Rev. sci. tech. Off. int. Epiz., **28** (2)

833

Fig. 1
Illeris model of the three dimensions of learning
Learning has an individual cognitive and emotional dimension and an external environmental dimension (6)

– a perception of the raw material, i.e. a sense impression that is not mediated or structured by any other person

– transmission, i.e. another person structures and transmits specific sense impressions, e.g. in lectures and instruction or through questions

– experience, in that the student acts as well as receives, thus benefiting from the interaction

– imitation, in which the student copies the behaviour or actions of another

– participation, in which the student is engaged in goal-directed activities, often with others.

When the learning process is initiated by the interaction process, the personal acquisition of knowledge and skills is achieved through cognitive and emotional dimensions. In the model proposed by Illeris, cognition and emotion are closely intertwined mental processes that interact simultaneously, e.g. when a student learns to perform a surgical procedure, he or she may be afraid of hurting the patient. The inclusion of the emotional dimension in the model is important since this explains the influences of motivation, anxiety and level of confidence in one's own abilities (i.e. self-efficacy) on learning. It also offers a way to explain resistance to learning if the student is not interested in or does not understand the relevance of the subject.

The result of the cognitive and emotional processes, i.e. what is learned, is stored in mental structures. The formation of a totally new structure is called 'cumulative learning'. Adding to an existing structure is called 'assimilation', while the dismantling of existing mental structures and reconstruction of new ones is called 'accommodation'. These types of learning are illustrated in

Figures 2, 3 and 4. An extreme form of accommodation is 'transformative learning', where multiple cognitive and emotional structures are accommodated simultaneously.
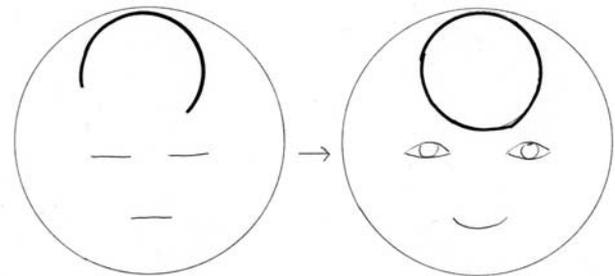

Fig. 2
An illustration of cumulative learning, showing the development of a completely new mental structure

Fig. 3
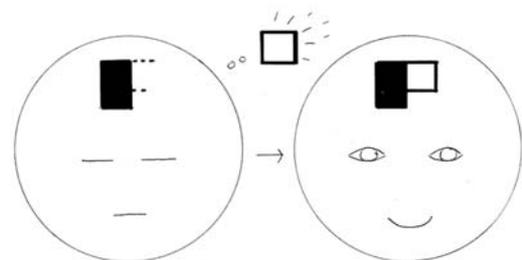**An illustration of assimilative learning, in which an existing mental structure is amended**
This form of learning is perhaps the most common. In the purest form, it is a slow and peaceful process in which the person adapts to new situations by remodelling existing mental structures. The association with the original learning situation remains unbroken, and this can make it difficult to use the resulting new knowledge in contexts that do not resemble this learning situation
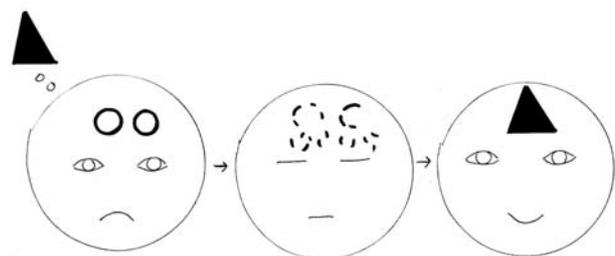

Fig. 4
An illustration of accommodative learning where existing mental structures are broken down and a new mental structure is developed
Accommodative learning is a demanding process but, because it also demolishes the association with the original learning situation, the resulting knowledge is not fixed to the original context and can thus be used in different circumstances. This makes accommodative learning useful for developing knowledge and skills that can be used in different contexts, e.g. the ability to identify, describe and solve ill-defined problems

Not all mental constructions are valid and misunderstandings or flawed knowledge constructions will occur, just as, in the same way, no motor skill employed for the first time will be perfect. The mental constructions behind invalid knowledge and imperfect skills must be amended or fine-tuned by assimilation or rebuilt by accommodation. Usual ways of achieving this include questioning students to demonstrate whether their conclusions are valid and giving corrective feedback.

Accommodative and transformative learning contrast with cumulative and assimilative learning, in that they are not closely connected to the learning situation and thus can be used in new contexts that do not resemble the original learning situation. The reason for this is that accommodative and transformative learning deconstruct established mental structures and therefore also demolish the original association with the learning situation. Accommodative and transformative learning are thus closely related to the development of knowledge and skills that can be applied in different or unknown contexts. Accommodative and transformative learning are therefore relevant when learning generic skills, such as problem solving and critical thinking. On the other hand, cumulative and assimilative learning seem to be relevant for lower-level activities, such as rote learning, enumeration, describing, following rules, applying manual procedures and automatically performing specified procedures.

Cumulative and assimilative learning tend to be a steady progression, adding new knowledge to existing knowledge in an evolutionary manner. In contrast, accommodative learning is more demanding and takes much more effort than cumulative or assimilative learning, because it deconstructs already established mental structures, both cognitive and emotional. Transformative learning is even more demanding, since multiple mental structures of both a cognitive and emotional nature are broken down and then built up again. It is quite common for a great deal of energy and emotion to have been used to develop the mental structures that are now being broken down and rebuilt. The difficult and intense nature of transformative learning is illustrated by the quotation in Figure 5. Essentially, it is far easier for a student to undertake cumulative or assimilative learning – even more so, if the student does not have a sufficient 'margin', is not adequately motivated or is not confident in his or her own ability to deal with the learning situation.

External factors also influence the kind of learning that students undertake. Factors that favour cumulative and assimilative learning include:

– a heavy workload

– a traditional, discipline-based curriculum with limited integration of different subjects

– set teaching hours, lectures, closed questions and assignments with fixed, pre-planned outcomes, all directed by the instructor

– rote learning without understanding

– structuring the content of the learning so that it is connected to existing knowledge (e.g. using concept maps).

Some of these factors also favour a surface approach to studying, in which students concentrate on memorising facts and details without understanding, usually because they do not have a sufficient margin, or are motivated by fear of failure, anxiety and a concern to complete the course. Teaching techniques that favour accommodative learning include problem-based projects, self-directed learning and open questions. Reflection is another way of engaging in accommodative learning. For example, the teacher could demonstrate for the student the thinking process that an expert in the field uses to analyse and solve problems. Another useful approach is asking the student about what was learned, why a certain action or approach was taken and why the chosen action worked or did not work.

Application

It is well known that knowledge and skills must be used to be remembered. A person may learn a foreign language but, if it is not used, it is forgotten. Another typical example is the clinical expert who becomes an administrator and, slowly but inevitably, gets 'rusty' in their clinical skills and knowledge, sometimes to the point of no return. This is also true for students and it means that what a student has learned in one course should be used and built upon in their other courses or professional work life.

It has been some challenging years. I have undergone more than one transition. From a blank piece of paper to a crumpled, coffee stained paper, filled with paragraphs, scribbles, sticky notes and 'to do's'. I have had to face my own prejudices and rearrange the puzzle.

Three years of conflicting emotions.

But I came out stronger and wiser, definitely knowing a lot more about my self.

Fig. 5
An example of transformative learning
Excerpt from the preface of a doctoral thesis (10)
'It is evident that, during this PhD study, significant transformative learning has occurred, in which multiple deep-rooted cognitive and mental structures have been broken down and rebuilt.'

Rev. sci. tech. Off. int. Epiz., **28** (2)

835

Acquired knowledge and skills can be applied in many ways in subsequent courses of study or during working life. It is important for the transfer of knowledge and skills that the student can perceive some identical elements between the learning situation and the circumstances in which that learning is applied (9). Obvious elements, such as concrete superficial similarities, are easier to identify than underlying principles. This concept is reflected by Eraut (3), who identifies four forms of transfer:

– replication
– application
– interpretation
– association.

In essence, the circumstances of application can be described either as a situation focusing on concrete action, in which there are many concrete or obvious identical elements between the learning situation and the situation in which that learning is applied (i.e. replication and application), or a situation where there are no obvious identical elements, requiring understanding, evaluation, comparison and judgement (i.e. interpretation and association).

Obviously, there will be many circumstances in which the learning situation and the application situation share identical elements. Thus, cumulative and assimilative learning are both vital components in the learning situation. On the other hand, when there are no obvious identical elements, the student must be able to identify and understand the new situation or context, and this process requires accommodative learning.

General discussion

From the points raised above, it appears that lower-level thinking and many motor skills are best learned by cumulative and assimilative learning, while higher-level thinking is best learned and developed by accommodative learning. The decision on which level to aim for (that is, the learning objective) depends on many factors, some of which may be governed by demands outside the actual learning or application situations, e.g. the requirements of accreditation bodies, governments, etc. Most learning objectives are, however, formulated locally. To aid in developing such objectives, useful insights can be gained from theories on learning and transfer.

The subsequent application situation may require acquired knowledge and skills to be applied through concrete actions – a process which often corresponds to cumulative and assimilative learning. On the other hand, the application situation may call for the student to apply their knowledge and skills to understand, evaluate, judge and/or compare different situations, a process which corresponds

to accommodative learning. So, some knowledge into where and how the acquired knowledge and skills are to be applied will indicate the kind of learning required and indicate potential teaching techniques.

Furthermore, it emerges that the Confucian dictum, 'A journey of a thousand miles begins with a single step,' also applies to learning. This means that, in novices, a new mental structure has to be constructed (cumulative learning) to which new knowledge can be added (assimilative learning); or existing mental structures must be amended (assimilative learning), in order to adjust or fine-tune knowledge and skills. For example, students know how to use a knife and this can be the starting point for learning how to use a scalpel. Novices depend on facts and rules, and they need a task to be split into smaller units, with detailed instruction, corrective feedback and opportunities to try again. To develop higher-level thinking skills, students have to use accommodative learning, and ways of encouraging this include problem-based projects, self studies, reflection and observing a teacher while he or she demonstrates the thinking process of a more experienced person.

For the student, a key factor is motivation. If the student is not motivated, it is very difficult to learn generic skills (accommodative learning), since there is a great risk that a surface approach (cumulative and assimilative learning) may be taken. The student may even resist or actively defend themselves against learning. Moreover, motivation is necessary to increase the sense of self-efficacy, which is essential if the student is to learn and perform a new skill. It is sometimes said that motivation is the responsibility of the student and not the teacher. To some degree this is correct, in the sense that it is only the student his- or herself who can make the necessary emotional changes and become motivated. However, motivating the student should also be a concern of the teacher, if not for the sake of learning then for the sake of the side-effects of non-motivation. Such side-effects may include:

– decreasing numbers of students passing a course
– lower course grades
– increasing drop-out rates
– students taking a longer time than predicted to complete the programme.

Such indirect measures of lower motivation are likely to be noted by the faculty or at least by those who accredit or fund the teaching programme, which may have deleterious effects upon the teacher.

There are several ways in which a teacher can try to maintain or increase student motivation. For example, the teacher can act as a role model, by:

– presenting the desired or required learning outcomes in advance

836

Rev. sci. tech. Off. int. Epiz., **28** (2)

– explaining the relevance of a certain learning outcome

– allowing the student to become involved in planning the learning activities

– increasing confidence by breaking tasks down into smaller tasks that can be more easily handled and mastered, step by step, wherever possible

– allowing failure and encouraging the student to learn from it.

Other key factors are time and workload, both of which affect the 'margin' of the student and thus their ability to cope with new learning. It is not uncommon to hear teachers and students say, 'There is simply not enough time.' To a large extent, this is correct, simply because the knowledge base within veterinary medicine, and in society in general, is increasing dramatically and this, together with the relatively fixed maximum duration of a veterinary curriculum, creates a conflict which anyone involved in curriculum revisions has experienced. There are no easy ways to resolve this. Part of the solution includes defining essential curricular subjects and essential 'day-one' competencies at graduation. An increasing use of teaching/learning activities that focus on accommodative learning, i.e. problem-based or problem-oriented learning, will also contribute to the solution. However, as the veterinary knowledge base and the need for new and complex skills continue to increase, the time may have come to consider changing the entire model of veterinary education.

■

Les principes de l'éducation des adultes : le processus d'apprentissage

A.L. Jensen

Résumé
L'apprentissage est l'acquisition par un individu de connaissances et de compétences nouvelles ; il peut être considéré sous deux aspects, en tant que processus et en tant que résultat. Dans l'enseignement formel, l'accent est mis sur des résultats d'apprentissage prédéfinis, en misant sur le caractère relativement permanent de l'amélioration des connaissances et des compétences. Toutefois, cela n'est pas toujours le cas ; il est donc important d'examiner de plus près le concept de « transfert ». Le transfert désigne la capacité d'utiliser des connaissances et des compétences acquises dans un contexte particulier afin de les appliquer dans d'autres contextes. Plusieurs facteurs déterminent les possibilités de transfert. L'auteur examine l'influence que certains facteurs spécifiques, liés à l'étudiant, au contenu des cours et à la situation d'apprentissage, peuvent exercer sur l'acquisition de compétences et de connaissances nouvelles. Enfin, il explique pourquoi certaines méthodes d'apprentissage facilitent le transfert dans d'autres contextes des connaissances et des compétences.

Mots-clés
Didactique – Éducation des adultes – Enseignement – Programme d'enseignement – Transfert des connaissances.
■

Rev. sci. tech. Off. int. Epiz., **28** (2)

837

Principios del aprendizaje en la formación de adultos

A.L. Jensen

Resumen
La enseñanza, que supone una transmisión de conocimientos y competencias a los estudiantes, puede subdividirse en un "proceso" y un "producto final" o "resultado". La formación convencional se centra en la obtención de productos finales predeterminados y supone que los estudiantes mejoran sus conocimientos y competencias de manera definitiva. Pero como no siempre es así, la noción de "transferencia de conocimientos" debe analizarse con mayor detenimiento. El término "transferencia" significa que los estudiantes podrán aplicar los conocimientos y competencias adquiridos en nuevas circunstancias. Varios factores inciden en la transferencia. En este artículo se describen los distintos factores relativos a los estudiantes, el contenido de los cursos y las circunstancias de aprendizaje que pueden influenciar la asimilación de nuevos conocimientos y competencias. También se expone la manera en que determinados métodos de aprendizaje pueden facilitar la aplicación de los conocimientos y competencias adquiridos en otras situaciones.

Palabras clave
Educación – Enseñanza – Formación de adultos – Plan de estudios – Transferencia de conocimientos.

■

References

1. Biggs J. (2003). – Teaching for quality learning at university, 2nd Ed. Society for Research into Higher Education & Open University Press, Buckingham, United Kingdom.

2. Dreyfus H.L. & Dreyfus S.E. (1986). – Mind over machine. Free Press, New York.

3. Eraut M. (1994). – Developing professional knowledge and competence. Falmer Press, London.

4. Ertmer P.A. & Newby T.J. (1993). – Behaviorism, cognitivism, constructivism: comparing critical features from an instructional design perspective. *Perform. Improvement Q.*, **6**, 50-70.

5. Ferris T.L.J. & Aziz S.M. (2005). – A psychomotor skills extension to Bloom's taxonomy of education objectives for engineering education. *In* Int. Conference on engineering education and research (iCEER): exploring innovation in education and research, 3 January, Taipei, Taipei China. iCEER, Taipei.

6. Illeris K. (2002). – The three dimensions of learning. Samfundslitteratur, Frederiksberg, Denmark.

7. McClusky H.Y. (1970). – An approach to a differential psychology of the adult potential. *In* Adult learning and instruction (S.M. Grabowski, ed.). Educational Resources Information Center Clearinghouse on Adult Education, Syracuse, New York, 80-95.

8. Marton F. & Säljö R. (1976). – On qualitative differences in learning: I – outcome and process. *Br. J. educ. Psych.*, **46**, 4-11.

9. Newble D. & Cannon R. (2001). – A handbook for medical teachers, 4th Ed. Kluwer Academic Publishers, Dordrecht, the Netherlands.

10. Øvlisen K. (2008). – Animal models of haemophilia: pathogenesis and treatment. Doctoral thesis. Copenhagen University, Copenhagen, Denmark.