Submission to the House of Representatives Committee Inquiring into Teacher Education

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Abstract

This submission argues that the student's most important learning is the learning of skills, the skill to acquire knowledge and apply that knowledge. A proposed set of sub-skills for the acquisition and the application of knowledge are contained in the work of Bloom et al and are discussed below. This submission also argues that the current curricula are design for information transfer and if the most significant learning is skills training then changes are required to the current curricula in teacher training courses and in our learning institutions.

Both employers and tertiary teachers have commented on the lack of 'thinking skills' in relation to secondary school graduates. The starting point for this submission is the argument that the present school curricula emphasise the learning of factual information at the expense of the development of the skills required to understand the significance of factual information and its use in problem-solving, what might be referred to colloquially as 'thinking skills'. This submission argues that there is little comprehension of educational psychology in most teachers and this has led to the present factual information bias. The submission therefore relates to point 5 of the Terms of Reference of the Inquiry;

Examine the educational philosophy underpinning the teacher training courses (including the teaching methods used, course structure and materials, and methods for assessment and evaluation) and assess the extent to which it is informed by research.

In particular I wish to argue that:

(1) Teachers complete their training without a clear vision of what their role is in the learning of their students;
(2) To comprehend their role in students' learning student teachers need to have a psychological model of how their students learn; and
(3) Teachers need to recognise that children starting school will have strengths in their learning skills and that they will rely on those strengths in preference to developing their less developed learning skills without a planned skills development program.

This submission is based on formal research described in the publications of B.S.Bloom and associates, ***Bloom's Taxonomy of Educational Objectives: Cognitive Domain*** and ***Bloom's Taxonomy of Educational Objectives: Affective Domain*** and on my experience as a teacher and a student for over thirty years, teaching mainly at the tertiary level, but including limited experience teaching science to upper primary level students and extension chemistry courses to Year 12 students. I taught first year Chemistry to B.App.Sci. students in the Department of Applied Chemistry of RMIT University for 31 years. My formal qualifications are PhD, Graduate Diploma in Education, Graduate Diploma in Applied Statistics, and Bachelor of Commerce. I was an active participant in the activities of the

Education Unit of the University and I acted as a mentor for lecturers undertaking Graduate Diploma in Education studies. My submission is motivated by years of interest in improving the learning of the less successful students.

It is my firm belief that a teacher must relate learning processes and psychological problems associated with the teaching and training of students to a psychology model. Although teacher training courses include discussion of educational psychology theories, in my experience the graduates don't appreciate the applicability of these theories to their day-to-day teaching. In fact many express the view that studying educational psychology is a waste of time.

The most productive advances in the modern world are built from models. The advances in science and engineering have always commenced with a model. The model is tested and refined until the best representation of the real situation is arrived at. The model provides a point for comparison and the criteria for achieving the best results. Models will always be limited, particularly where complex systems are involved, for example, economic modelling. Psychological modelling also involves a complex system, the human mind, but the teachers' role is to maximise learning and as practitioners they are in the best position to refine the educational psychology models. It is obviously difficult for student teachers with no or very little teaching experience to understand the applicability of the education psychologies but they can draw on their experience as students. The teacher training lectures need to recognise this limitation and interpret the models as they may apply in the classroom situation. It is a large leap from the textbook descriptions of educational psychological theories to the classroom applications, one that many students seem to fail to make. Having passed the theory examination most students seem to regard educational psychology as theoretical nonsense. This is a characteristic student method for dealing with material that they have difficulty with and is an excellent example of type of problem that our teachers need methods to handle.

The research discussed in this submission is based on practical experience. Practical experience has led to the realisation that the topics 'taught' have a bearing on the skills the students learn and that best learning is achieved when the teacher speaks less and the students talk more. I want to argue that the teachers' role is to develop student skills and that in training teachers we are ignoring the experience in the areas of human achievement that are best

known for the development of skills; the arts, sport and trades, particularly the handcraft trades.
When teachers are asked what their role in the classroom is, most will respond in terms of their subject discipline. I want to propose that there are three domains of learning that teachers at schools and tertiary institutions should see as their role to develop in their students. They are:
(1) Knowledge skills, the ability to memorise, arrange, recognise, and recall information;
(2) Academic skills, the ability to comprehend, apply, analyse, synthesise, and evaluate; and
(3) Manipulative skills.
These three domains can be seen as defining the attributes required for all human endeavours. The community has come to realise that education does not end at the completion of secondary or tertiary training but continues as life-long learning. Formal training should provide the basics in these three domains. Knowledge is obviously discipline specific but Academic and Manipulative skills are generic and apply to a wide range of disciplines. It is vital that teachers see their role as assisting students to increase their competence in all these three domains rather than only being responsible subject factual information.

B.S.Bloom et al. used these three domains of learning as the basis of a system of defining learning objectives in the 1950s. The work is described in two volumes titled ***Bloom's Taxonomy of Learning Objectives Cognitive Domain and Affective Domain***. The system was devised so that courses in different universities could be compared through clearly defined learning objectives rather than broad course syllabuses. The system has always been controversial and appears to have never been widely accepted in Australia although I understand it is still used in a small number of schools in Victoria. My reason for introducing the concept of these three domains is not to suggest the system of learning objectives should be adopted, but that the development of Knowledge, Academic, and Manipulative skills is recognised as essential for productive learning.

Knowledge or subject factual information provides the factual basis for the application of Academic skills and Manipulative skills. Knowledge is skill-based, the most obvious skills being recognition and recall. Recognition and recall presumably have their basic development prior to schooling in the acquisition of language skills. Bloom's taxonomy defines Academic skills as comprehension, application, analysis, synthesis, and evaluation. The Bloom

group considered that the skills increased in complexity and abstract mental levels in the order listed; however I don't believe they can be isolated from each other completely. Secondary students in Year 12 would be expected to be competent in comprehension, application and analysis. Amongst the current secondary school graduates, apart from the best students, this generally is not the case. This leads to the often heard complaint from university staff that 'students can't think'. In fact the very good university entrants can 'think' but the less able students do not have the level of Academic skills required at tertiary level. It has always been so, but with increasing numbers proceeding to tertiary education the problem is an increasing one. With the increased complexity of non-university tertiary courses students with poor Academic skills are also disadvantaged.

Learning in all areas of human endeavour can be seen as requiring aspects of each of these domains. For example, the study of history requires Knowledge and Academic skills. Sports, at the other end of the spectrum, have a major Manipulative skills component but knowledge of rules of the game and tactics are just as important, and the best competitors often stand out because the 'thinking, judgement, etc', that is their Academic skills. The ability of surgeons and other health professionals, dentists, veterinary scientists, depend as much on their manipulative skills as their knowledge and academic skills. Chemists, biologists, perhaps to a lesser extent physicists and engineers, all require levels of manipulative skill to be practicing professionals. Music provides an excellent example of the importance of the all three domains, Knowledge, Academic skills and Manipulative skills. A similar argument can be made of competence in trades, most obviously in the traditional trades where knowledge of materials, an understanding of their characteristics, and craftsmanship, are all significant to the production of a quality product. Everybody is aware that manipulative skills are learnt by practice and repetition, with feedback by a teacher or coach. This is the normal way of teaching sports, trade skills, and musical instrument playing. In fact, this way of learning is essential to all skill development and although it may not obvious it is the way good students develop their Academic skills.

Knowledge requires the skills of recognition and recall which in themselves require sub-skills. Most children commence their development of these skills in their pre-school years in the process of learning verbal communication. It is clear that the language skills of pre-school children are dependent on their time interacting with adults who can provide the practice and repetition.

Some adults have highly developed skills of recall built on the complex sub-skills for storing information. ‘Rote learning’ could be considered a Knowledge skill where the learner can recall information but has very little understanding of the significance of what has been learnt. However it probably is an important skill in reading by the ‘whole word method’ as it is the means of recognising words and recalling their spelling and pronunciation.

There may be those that argue that Bloom’s taxonomy portrays a precision that is unreal, but it is beyond dispute that there is more to education than the accumulation or rote learning of knowledge. In earlier times the trade apprentice learnt by rote how things where done and practised achieving high levels of manipulative skills. In those times the majority of tradesmen carried on their trade as their masters had. The advancement of knowledge through innovation was the result of the thinking skills of a relatively small group of individuals and therefore innovation was slow.

The argument that I want to put before the committee is that thinking skills are like any other skill and are best developed through practice and feedback. If this argument is accepted then this must be reflected in the course content. Courses need to include topics that provide the opportunity for unemotional debate, where students can demonstrate their comprehension of topics by responding to questions which have unambiguous answers. The sciences, particularly Chemistry, Physics, and Mathematics, provide these topics. Mathematics is learnt by practice from the basic level of solving equations to applied problems. An incorrect answer provides the opportunity for feedback either by encouraging the student to think again or by discussion with a teacher. When asked how they learnt their mathematics, most mathematically skilled people responded that it was by doing as many problems as possible. In mathematics it is relatively easy to provide large numbers of problems and their answers. Enthusiastic students can resolve many of their difficulties knowing the correct answer and thus determining where they are in error. Chemistry and particularly Physics require competent mathematical skills but they also require the students to master concepts if there is to be any depth to their study. The comprehension of concepts is best achieved by dialogue with the students, encouraging them to explain their understanding of the concepts. The teacher asks questions and provides immediate feedback. The same process in written work means the student response must be marked and by the time the students get the feedback they have forgotten the detail. A syllabus

design to provide skill development will, at least in part, be determined by the need to contain appropriate concepts for such discussions. The degree of difficulty of each concept rather than the information, should determine the stage at which it is introduced.

In the middle 1970s there was concern about the small number of students undertaking school science subjects and that the syllabuses of the later secondary science subjects were devised by the universities to prepare the students for university entry. It was considered that many students dropped out of science subjects at an unacceptably early stage because they found them too difficult. The content of the subjects was changed to remove the difficult topics, which turned out to be the concepts, to encourage an increase in the number of students studying secondary school science. The subjects have become an exercise in rote learning. The concepts that were removed from the curriculum were the topics that provide the opportunity for the development of new skills. As a result a large number of the students graduating from secondary school science show little understanding of science. The development of Academic skills suffered as a result. An alternative approach would have been to recognise the difference between learning facts, requiring Knowledge skills, and understanding concepts, requiring Academic skills, in the curriculum design and acknowledge that different teaching methods will be required to have the students understand concepts.

In some subject areas, such as history, geography, literature, and social studies, knowledge of particular facts is seen as essential by the community. In the sciences this concern is less apparent and there is ample opportunity to provide important information and spend time practising Academic skills. The curriculum designers have few limitations on their choice of topics. Experience shows that the rote learning of facts in science is of little value to the students. Every text book on memory shows that there is rapid loss of memorised material if it is not refreshed by use or frequent revision. The students' aim is to pass the assessments. Once that is over their recall of the facts deteriorates rapidly. Students who have the skills to understand the relationship or concept that links the facts retain that information because of the mental 'picture' they have developed and this is built on as they progress through their study. There is a natural revision each time they consider the relationship between what is being studied now and what was learnt previously. Assembling a jigsaw puzzle provides a useful analogy. The pieces of the jigsaw are the facts. Assembling them correctly requires

analysis of the individual pieces and their relationship to the whole puzzle. Discussion with the teacher helps to clarify their relationship and correct any misconceptions. The immediacy of the feedback is important as the correct positioning of each piece is dependent on comprehending its relation with the progressing puzzle. There is a concept in the puzzle and comprehending the concept of the completed puzzle makes clear the relevance of each piece. Similarly understanding scientific concepts is dependent on the ability to comprehend the relationship between facts, and that Knowledge is retained much more strongly than individual facts. The process of comprehending the relationships between facts and a concept is a skill and requires practice in the same way as a student learning a musical instrument needs to practise, and the more immediate the feedback the better the learning. This teaching method, which is almost certainly used by many secondary teachers, can be effectively implemented with the class sizes that currently exist in our schools. My concern is that the current curriculum content doesn't maximise the opportunities to practise Academic skills but is driven by other, less important considerations.

There is an ongoing discussion as to whether students, particularly boys and girls, learn in different ways. Some understanding of the differences comes from considering learning in the Bloom group's terms. Above I have put the view that the first learning is learning a language and that language requires recognition and recall skills. All children who have normal conversational patterns will start school with recognition and recall skills and it seems logical to presume that their level of skill will depend on how advanced their language skills are. In this regard there may be differences between boys and girls but since the difference is not genetic I think further discussion is more productive if the gender issue is removed.

My experience has convinced me that apart for the very top students, there are two broad groups of learners; those that rely on their ability to rote learn and those, who probably have poor rote learning skills, who are prepared to work on their academic skills. Rote learning requires discipline and it may be that students who don't rote learn don't have the discipline it requires. The ability to rote learn is a valuable skill, however very few students have sufficient skill to give perfect answers and because the rote learning student often doesn't comprehend the logic of the argument they make errors that demonstrate their lack of comprehension. These students will obtain their best results in the subjects that are based on learning facts but in subjects that require thinking skills they either develop thinking skills or they have

less success. Mathematics is the real test. It is possible to rote learn how to solve different equations but when it comes to problems it is necessary to understand the problem and its relationship to the equations that need to be solved. It may be possible to use students' success in mathematics as an indicator of how they learn.

The second group of students relies on trying to understand the concepts or theories. Students with this predilection will, with encouragement, develop better Academic skills but since this development also relies on knowing the facts, they need to learn the facts as well. They need to spend time pulling the facts and theories together. In most cases this doesn't seem to be a hardship and the students blossom as they realise their success. If they don't they are unable to provide convincing explanations. Unfortunately these students, who are keen to offer answers and ask questions, can lose self-confidence if they are not encouraged and supported. The loss of confidence leads to disinterest, lack of effort, and sometimes disruptive behaviour. On the other hand if they are encouraged they will respond positively and apply themselves to learning the facts and develop into excellent students.

The best students have the discipline to learn the facts and the Academic skills to comprehend their relationship with the concepts and theories. Currently, students with good rote learning skills but undeveloped Academic skills succeed in the secondary system. At the tertiary level, where teaching is by lectures and large, if any, tutorials, there is little opportunity for teasing out student misconceptions. While the textbooks and the teachers will provide the argument that links the facts to the theory it is only when the students have been through their own mental analysis of the facts that they are able to provide a convincing explanation of their own and are in a position to apply their new knowledge. Students who learn the textbook explanation by rote are rarely in a position to do this. When students are in the workforce their value will be determined by their ability to provide solutions to unique problems, logically based on facts not just knowing how to do things.

The development of academic skills is not just important for university students but equally important for students involved in other tertiary training such as apprenticeships and workplace training. The development of these skills in all students is vital to Australia's future. Students at all stages of the secondary school system will have different abilities in Knowledge and Academic skills and they will tend to favour their strength at the expense of

their weakness under the pressure of needing to succeed. In most cases at secondary school level the successful students will be rote learners and poor rote learners will not succeed. The curriculum must recognise the importance of Academic skills as well as Knowledge skills and include topics which are designed to develop these skills.

Summary

This submission argues that student teachers need to be convinced that their role as teachers will be to develop skills, the skills to gain knowledge and the skills to use that knowledge as described in the publications of B.S.Bloom and associates, ***Bloom's Taxonomy of Educational Objectives: Cognitive Domain*** and ***Bloom's Taxonomy of Educational Objectives: Affective Domain.***

If this argument is accepted then the design of curricula will need to be changed. The interaction between the teacher and the students will be much less a time of information transmission and much more a dialogue between the teacher and the students. The dialogue will be designed to determine their skill to comprehend concepts and theories and how they might think to apply their understanding to new situations. There is an avoidance of concepts in the current science curricula because students have found them difficult in the past. The reason for these student difficulties lies in the way they are taught rather than the subject material itself. The Bloom thesis provides a model for a way forward.

I have argued that student learning behaviours at secondary and tertiary level can be understood in terms of the educational psychology model proposed in the work of Bloom et al. If this view is accepted, better student performances will be achieved by assessing a student's Knowledge and Academic skills, weaknesses and strengths, and designing a program to improve these weaknesses.