Developing Higher-Order Thinking Skills in Medical Students

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Abstract: This paper describes the approach I use for freshmen and second year medical students at the Hamamatsu University School of Medicine to introduce them to the concepts involved in higher order thinking and how it can be developed through classroom activities. Based on Benjamin Bloom's taxonomy of educational objectives (1956) my approach strives to engage students in the active development of these skills they will need in the future to be successful not only in their study program but in their future as medical practitioners.

Key words: thinking skills, higher order thinking, teaching methodology, educational objectives, class activities.

Introduction

The experience of 12 years of education prior to entering medical studies, e.g. "yutori kyoiku" (relaxed education), emphasis on tests, and cramming, is commonly found to have little prepared freshmen for the academic rigors and intellectual challenges of their six-year study program. Indeed, the Japanese Ministry of Education, Culture, Sports, Science and Technology (Monbukagakusho) clearly articulates this trouble in their own 2005 White Paper on the state of Japanese education:

"There are challenges with regard to children's Academic Ability, as children are not always sufficiently equipped with the ability to apply knowledge and skills they have learned, such as reading comprehension. In addition, it is especially concerning that Japanese children have a poor desire to learn and have not mastered good learning habits. We must foster Academic Ability for the children to master the basics so that they can learn to educate themselves, think for themselves, and have the ability to solve problems even better." (p.2)

Not surprisingly, my previous study on students' initial expectations of university life (O'Dowd, 2006) found a clash of lax expectations with the demands of the medical curriculum, making the adjustment period difficult for many. In addition, although students do manage to pass their courses, many students fail to adequately learn or absorb course content or forget what they learn in a relatively short time (i.e. after the examination is over). Students typically do not know how to engage in the types of thinking that makes syllabus content a permanent acquisition to their knowledge base. Such problems are aggravated

by the situation where teachers or doctor-instructors do not know how to facilitate that permanent acquisition. My past research into students' motivation, learning strategies, and multiple-intelligences (1996, 1999, 2003, 2004) has brought me to the conclusion that the missing element in this paradigm is the development of higher order thinking skills (HOTS). These provide the intellectual tools that students need to become truly successful learners. HOTS also give teachers a framework to make classes more beneficial to students in terms of building knowledge and skills.

I have therefore made a conscious effort in my English program classes to introduce freshmen and second year students to these skills so they can build their knowledge base, learning strategies, and thinking skills. In this paper, I will describe the basis for my approach for developing higher order thinking skills.

Why higher order thinking skills are needed

Simply, doctors need higher order thinking skills to meet the expectations of patients and society. An encyclopedic knowledge of medicine is of no practical use if the medical practitioner can't apply it to the health problems confronting them. It is therefore important for teachers at medical universities to have an understanding of medical thinking, medical decision-making and medical communication in the broadest sense as a key requirement for improving the effectiveness of medical education. For example, one of the medical practitioner's prime functions is to make a diagnosis. The word "diagnosis" is derived from two Greek words; dia which means "by", and gnosis, which means "knowledge". To make a diagnosis, a medical practitioner must first have the necessary medical knowledge built up over years of study and practice. Next, the doctor must be able to communicate effectively with the patient to collect all information necessary to make the correct decision about the disease; this is achieved by talking to patients, listening to their complaints, asking questions, performing physical examinations, doing tests, analyzing the results, and making a determination as to what the problem is (which disease). Finally, the doctor must have knowledge of the newest, most up-to-date treatment approaches in order to make a suitable treatment program that can then be implemented and monitored for success. It is therefore important that the mechanisms and skills required for these functions be central to the instructional process.

I believe the focus of Medical English instruction should not be simply on vocabulary development or passing tests on textbook content. Rather, that to fulfill the goal of the university, i.e. to produce competent medical practitioners, teachers need to focus on a wide variety of elements, especially, developing communication skills, higher order thinking, collaborative learning, problem solving, decision making, and shaping self-esteem as the most critical. Indeed, to boost the effectiveness of classroom teaching and learning, teachers need to explicitly recognize the necessity of implementing HOTS in their course programs. Inclusion of HOTS activities should be a must when teachers think through the framework and design of their teaching approaches and how the content can best be learnt. In short, teachers must recognize that teaching with such an approach is essential to:

1 advance reading, writing, speaking, and listening skills,

2 enable better reasoning within all subject areas,

3 assist faster decision-making and problem-solving,

4 make critical analysis and evaluation of student's own emotions and values,

5 make intelligent choices in human relationships and patient care.

Indeed, any well-conceived program that seeks to develop students' thinking skills requires the integration of all of these skills and abilities.

Why self-esteem is important

Healthy self-esteem emerges from a justified sense of self-worth, just as self-worth emerges from the development of competence, ability, and genuine success in life. Indeed, all the students who successfully passed the medical university entrance examination should be proud of themselves, just as their parents are proud of them, and this success naturally leads to an elevated sense of self-worth. However, when such an individual's behavior changes for the worst and they start resting on their laurels and still feel good about themselves, then they are either arrogant (which is surely not a desirable characteristic in a medical practitioner), or, alternatively, they have developed a dangerous sense of misplaced confidence. Some freshmen and second year students, for example, sometimes think so well of themselves for having passed the entrance examination that they operate under the illusion that they can safely take it easy for a year or two, skip classes, flout their teachers, postpone any serious study to just before final exams, and still expect to be given a passing grade by "generous" teachers whose only purpose is to shephard them along to graduation. They often regard their own competence much too highly while paying little heed to their limitations and failings. To accurately develop genuine self-worth and have the ability to separate it from any false sense of self-esteem requires higher order thinking skills.

Elements of thinking

Thinking is the result of complex processes of biological and neurological interactions that facilitate thought. Although thinking itself is still not fully understood, researchers have been able to establish several domains critical to thinking: the cognitive, psychomotor, and affective domains. In order to develop thinking skills in our students, teachers need to consider how to activate these domains in their classroom interactions with students. The following is a brief description of each domain.

The *affective domain* encompasses the way we react emotionally to our environment and our ability to feel another living thing's pain or joy. It centers on the awareness and growth in attitudes, emotion, and feelings. Listed here are the five levels in the affective domain, beginning with the lowest order processes to the highest:

Receiving - The lowest level: students passively pay attention. Without this level no learning can occur.

Responding - The student actively participates in the learning process, not only attending to stimulus, but also reacting in some way.

Valuing - The student places value on an object, phenomenon, or piece of information that catches their attention.

Organizing - Students can put together different values, information, and ideas and accommodate them within their own schema; comparing, relating and elaborating on what has been learnt.

Characterizing - The student develops a particular value or belief that now exerts influence on their behavior so that it becomes a characteristic.

The *psychomotor domain* describes the ability to physically manipulate a tool or instrument like a keyboard or a scalpel. Psychomotor objectives usually focus on change and/or development in behavior and/or skills.

The *cognitive domain* deals with knowledge, comprehension, and "thinking through" a particular matter. Traditional education tends to emphasize the lower order skills in this domain, in particular, remembering facts, names and terms, basic concepts, definitions, and general principles. However, this domain also extends to metacognition, where planning, assessing and monitoring one's own thinking skills are enacted.

In considering my approach to developing students' thinking skills, I looked to the writings of Benjamin Bloom (1956) who developed a classification of levels of intellectual thinking behaviors in learning. This taxonomy showed the cognitive, psychomotor, and affective domains overlapping as thinking skills developed in students. And within the cognitive domain, Bloom identified six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. I believe these domains and levels are still useful today in helping to develop the thinking skills of my students as they prepare for careers as medical practitioners.

Bloom's taxonomy

Benjamin Bloom created a taxonomy of educational objectives, now known as Bloom's Taxonomy, categorized in a hierarchal way. Each level of the hierarchy describes the stages of learning and thinking that students would engage in from basic factual recall to higher order critical thinking, and gives sample behaviors of that level. The taxonomy provides a useful structure in which to categorize student behaviors and enables teachers to determine whether or not students are studying with appropriate strategies. Bloom's classification also incorporates the areas of cognitive, psychomotor, and affective domains of knowledge. It can therefore be used to structure classroom activities to engage these elements and foster

thinking skills from basic knowledge recall (a lower order thinking skill) all the way through to synthesis and evaluation (higher order thinking skills). By doing so, teachers will be able to better understand where student's strengths and weaknesses are and determine ways to help them think at higher levels.

According to Bloom's Taxonomy, human thinking skills can be broken down into the following six categories:

1. **Knowledge:** remembering or recalling appropriate, previously learned information to draw out factual (usually right or wrong) answers. Key words and phrases include: how many, when, where, list, define, tell, describe, identify, etc., to draw out factual answers, testing students' recall and recognition.

2. **Comprehension:** grasping or understanding the meaning of informational materials. Key words include: describe, explain, estimate, predict, identify, differentiate, etc., to encourage students to translate, interpret, and extrapolate.

3. **Application:** applying previously learned information (or knowledge) to new and unfamiliar situations. Key words include: demonstrate, apply, illustrate, show, solve, examine, classify, experiment, etc., to encourage students to apply knowledge to situations that are new and unfamiliar.

4. **Analysis:** breaking down information into parts, or examining (and trying to understand the organizational structure of) information. Key words and phrases are: what are the differences, analyze, explain, compare, separate, classify, arrange, etc., to encourage students to break information down into parts.

5. **Synthesis:** applying prior knowledge and skills to combine elements into a pattern not clearly there before. Key words and phrases are: combine, rearrange, substitute, create, design, invent, what if, etc., to encourage students to combine elements into a pattern that's new.

6. **Evaluation:** judging or deciding according to some set of criteria, without real right or wrong answers. Key words are: assess, decide, measure, select, explain, conclude, compare, summarize, etc., to encourage students to make judgments according to a set of criteria.

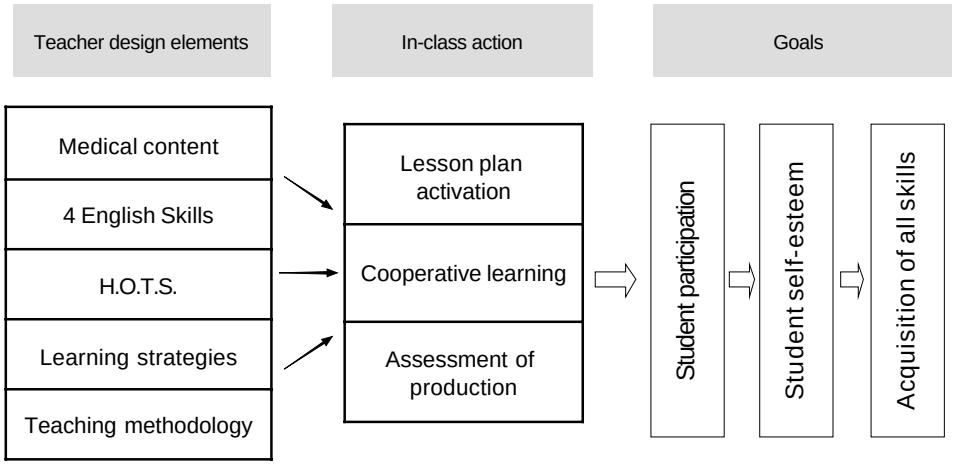
Reflecting the structure of this hierarchy, the psychologist Jean Piaget (1970) described studies of the cognitive development of children in the 1960's, which detailed how young children develop learning in four identifiable yet discrete phases as they grow. At first, young children are only able to process inputs that are concrete, such as small chunks of information; at this low level of knowledge building they are incapable of thinking at higher levels. As children grow and get formal education, the volume of input increases markedly with increasing opportunities to develop comprehension and application abilities. For students in Japan, the heavy emphasis on testing and examinations has resulted in teaching and learning

that favors memorizing and recall at the expense of other thinking skills. How then can students be expected to learn the necessary thinking skills for their medical studies? It is this question that I will now address.

Higher order thinking skills infused with content

The core of all educational programs is the teaching and learning of content. However, it is the quality of thinking that is the key to success of this substantive end: that is, the types of thinking students engage in to internalize the content and the thinking of teachers to make the internalization effective. In my approach, I endeavor to infuse higher order thinking skills in a mix of medical content, appropriate English skills, learning skills acquisition, and teaching methodology into a unified lesson unit. That is, I take what students are expected to know and be able to do and design a class lesson that allows students to use English skills, acquire new skills, and think their way to increasing their knowledge and abilities. The following chart illustrates the framework I have developed for my classes.

O'Dowd's Framework



In class, I would explain and model briefly what the students must learn and be able to do to be successful in HOTS thinking. For example, we would look briefly at what constitutes a reasonable basic understanding of the elements of thought, clarify common misunderstandings, and discuss the difference between basic and more advanced levels of higher order thinking. The goal of this approach is to develop a plausible foundation upon which to build students knowledge and skills. Students themselves also need to review each dimension of higher order thinking within their group in such a way that they can assess their approximate level of knowledge and skill and determine what they need to do to progress. In this process, at the very outset, students will begin to get a clear understanding of what they do and do not know about higher order thinking, what skills they have and what skills they have yet to acquire.

Implementation

Teachers cannot teach “thinking” per se, but can introduce students to thinking skills and raise their awareness of their inner potential through practice in particular sub-skills. Such sub-skills can include critical and analytical thinking, reasoning, problem-solving, and using their imagination, all of which are teachable and can help students build up confidence in their own ability. Promoting these thinking sub-skills to students may require the teacher to adapt their attitude and approach to in-class interactions by being creative and innovative in their teaching methodology. In particular, to foster a classroom environment conducive to the development of sub-skills and higher order thinking skills, I agree with and practice the twelve teacher behaviors proposed by Jerry Thacker (cited in Cotton, 1991). These are:

Setting ground rules well in advance

Providing well-planned activities

Showing respect for each student

Providing non-threatening activities

Being flexible

Accepting individual differences

Exhibiting a positive attitude

Modeling thinking skills

Acknowledging every response

Allowing students to be active participants

Creating experiences that will ensure success at least part of the time for each student

Using a wide variety of teaching modalities

I believe that students need to view university classes as different from those they have experienced previously and to feel that they must take more responsibility for their own learning processes. They must also see how these activities and behaviors work to help them to discover their own strengths and weaknesses, to test their abilities, to think about the content of classes in new ways that build their knowledge base, and to challenge them to develop these new skills.

In class time, with the activation of my lesson plan, I require students to work together cooperatively in small groups and learn how to make every class period an opportunity to participate, ask questions, explore topics, and add the wide variety of course content to their knowledge base. Following here are some of the types of activities I use in my classes to activate student awareness of HOTS and engage them

in using these skills. It should be noted that these activities are usually integrated or overlap and are not normally “stand alone” activities.

Brainstorming with bubble charts

Brainstorming with bubble charts is my most useful tool for introducing new topics to my classes. Brainstorming is a technique by which all group members attempt to spontaneously contribute some ideas or knowledge about a specific topic to amass as much information as is possible. It is a process designed to obtain the broadest range of ideas relating to a specific subject and teaches the ability to generate new ideas. Bubble charts are useful for visually representing the connections between ideas and aid the “free association” process of brainstorming. They can illustrate the links between facts and ideas and expands as exploration of the topic continues to stimulate the thinking and analysis of students.

Challenge the facts

How many facts are really facts and how many are just the most reasonable, educated guess based upon knowledge known at any particular time? It is very rare that any knowledge remains an undeniable fact for very long, especially considering the speed with which newly acquired knowledge is progressing. Medical knowledge in particular is in a constant state of change. Medical practitioners and medical students will both need to think differently as they gain knowledge and skills in thinking. Indeed, as knowledge and accepted practice changes from one generation to the next, what might be seen as a good practice by one generation could be seen as barbaric and harmful by the next. Technology and other inventions now change the world faster than most people can keep up with. How do you know that what you considered to be a fact in the past has now become inappropriate due to changes that have taken place more recently? The way to answer these questions is to challenge the facts. “Challenge the facts” asks students to consider what they think are facts and investigate what differences or new information could exist. Students are asked to first list the facts they have about a particular topic, share these with their group members to find any new facts, and then explore the library and internet for confirmation of these facts or discover new and additional information.

Circle of Knowledge

Circle of Knowledge is a strategy that provides a framework for developing effective group discussions. It involves posing a question to the whole class, then having the students work together in cooperative learning groups for additional examination of the issues, then back to the whole class to summarize their findings and engage in further discussion. This traditional teaching strategy engages all students in an interactive model.

Collaborative learning

Collaborative learning is achieved through my class group system of having students make small groups for class work. The groups are formed in the first class of the semester and from that day forth play an

important role in each and every class. Students work together, checking homework, sharing research and ideas, completing exercises and activities and keep a record maintained by the members of the group, with a different member assigned the task of being the record-keeper/manager for each class. Points are awarded to each individual student by the teacher but are recorded and tallied by the record-keeper. The group record sheet tracks each student's progress throughout the semester and provides each student with constant feedback on their performance. At the end of class, the record-keeper returns the group record sheet to the teacher, and at the start of the next class the teacher will hand the form back. Intellectual integrity is an important trait of the physician's mind, but it also needs other traits to complete it, such as intellectual courage, and intellectual perseverance. Without HOTS to help students develop these traits, collaborative learning is more likely to become collaborative inertia.

Compare and Contrast

The Compare and Contrast Strategy requires students to focus their attention on the analysis of similarities and differences. For example, students may be asked to examine the common cold verses influenza verses SARS. These are then carefully analyzed for similarities and differences. Students are then asked to share their findings, draw conclusions, make suggestions, and synthesize the information.

Concept Attainment

This is a strategy designed to teach concepts through the presentation of examples and non-examples. Students examine the examples provided, discuss the relevant elements, test and refine hypotheses about the concepts and principles underlying the examples and non-examples are presented. Next, they determine the critical attributes of the concepts that make it different from all others. Finally, the students will demonstrate their understanding by generating their own examples and non-examples.

Decision Making

Students are required to practice sound decision-making skills by making individual or group decisions about example cases. Students will study some background information, examine some decision-making data, establish alternatives, and analyze consequences before making a final decision. Students then communicate their decision, provide support for this decision, and analyze the decisions of others as well as practicing consensus building and debating skills.

Inductive Learning

The Inductive Learning Strategy is built on the natural processes of inductive thinking. This strategy enables students connect new content with their prior knowledge. For example, students may be asked to select one of the textbook topics for further research; students have examine information, select which data is relevant to their needs, order the data, and summarize it for presentation to their group members. Through these processes the students learn by discovery, which should not only stimulate their motivation to learn but also their ability to retain and later apply what they have acquired.

Metaphorical Expression

The Metaphorical Expression Strategy uses direct analogies and personal analogies to teach new concepts or to deepen students' understanding of already known concepts. Teachers can use an analogy or metaphor of some situation to illustrate how similar situations are solved in other fields. Using these types of metaphors to look at content simply gives students a new and/or different perspective on the material.

Analogies are very good for discovering things you had not realized about your own situation and thus enable you to develop solutions based upon them. The first step is to make up an analogy: (1) what does the situation remind you of, (2) what other areas of life/work experience similar situations, and (3) who does similar things but not in your area of expertise? Often an analogy will include the words "... is like ..."; examples could be (1) Running a clinic is like managing a business, (2) Eating healthy foods is like putting the correct gasoline in your car, (3) Selling drugs to patients can be like being a second-hand car salesman who sells what is on the lot rather than what the patient actually needs, and (4) Human skin is like the shell of an egg. I use such analogies often as a stimulus to the content being taught as well as a bridging idea to help students make wider connections. Students can then see how they can apply this new idea in their own situation.

Problem Solving

Problem solving is the process by which a situation is analyzed and solutions are formed to solve a problem and when steps are taken to remove or reduce the problem. The set problem and situation are analyzed, potential solutions are generated and a workable solution is determined that can then be implemented. The goal of problem solving is to produce actual improvements or changes in the situation.

The problem-solving process comprises many different elements that can be used in varying degrees depending on the problem to be solved. Typical elements are:

Problem definition

Situation analysis

Idea generation

Analysis of ideas

Decision making

Determining the next steps to be taken to implement the solution

Different problems need different uses of these elements and often in different orders and quantities. The structure of the problem-solving process can be very different for different situations. For example, students may need to have many tries at first defining the problem before they can establish the real

challenge they face.

Students also need to be made aware that problem solving is not the same as decision making. Decision making is one process of problem solving and is only concerned in deciding between different existing ideas. Problem solving includes the actual formation of those ideas and can involve varying degrees of problem analysis and solution generation elements compared to the decision-making part.

Role Play

In role play, students have the opportunity to change their perspective by exploring the differing roles in medical communication (i.e. doctor-patient, doctor-family members, doctor-doctor, doctor-nurse) and practice how they would approach each situation. When students' engage in role play, they need to think about each particular role and how their role-identity would think and react to their situation. In particular, they would need to think about a wide variety of elements, such as:

How would their role-identity think?

How would they see the problem from their angle?

How would they explain their problem?

What information is required?

What questions should the doctor/other ask?

Is there a solid basis for the diagnosis?

What differential diagnosis should be considered?

What action would they take?

How would they react to the doctor's response/ diagnosis/treatment options?

With role play, students can examine and think about the many different ways they can approach medical problems and possible solutions and experience face-to-face interaction in a safe learning environment.

Student Assessment

It is necessary for teachers to link curriculum and syllabus goals with student output. To do this, teachers must design appropriate assessment tasks. As I use a continual assessment system, students are assessed on all the work they do in each class as well as the weekly homework assigned. I check their individual course notebooks at the beginning of each class and award points based on production. Students are continually encouraged to "go the extra step" for which they reap rewards. Half way through the semester, the students collate the points they have accrued and their numerical score is posted on the

blackboard so they can individually determine their ranking in the class and then decide whether or not they are on track to achieving their desired goal or if they need to improve their performance in the remainder of the semester.

Student-centered Integrated Learning

I believe it is very important to integrate individual learning styles, interests, needs, and abilities of each student with appropriate learning strategies and tools. To do this, it is first necessary to become familiar with the different learning styles and assess the learning styles that students are currently using. Teachers also need to look at how we teach our classes to determine what kinds of learning strategies we favor, and then implement task rotation in which content is presented in ways designed to reach students with different learning styles. This will also expose students to new ways of learning. What runs through all these activities is that they encourage independent thinking and learner participation.

Conclusion

The traits of a good doctor are the traits of a well-cultivated thinker. Therefore my goal in implementing thinking instruction in my Medical English program is to enable students to learn to think like doctors think. To achieve this, I have made developing higher order thinking skills an integral part of my teaching. I infuse it on three levels: to plan daily lessons and course-wide objectives, by modeling good thinking practices in front of my students, and by creating activities that foster thinking skills in the students themselves. What Bloom's taxonomy offers to both teachers and students is a model of thinking and education as a process that strives to realize the full potential in each student.

I firmly believe that instruction in thinking skills promotes intellectual growth and fosters better academic achievement. To this end, it is important that I continue involving students in the process of learning, exploring new ideas and unlocking their potential.

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