When the biology, pedagogy and teaching standards come together

Adanela Musaraj, Dr
Faculty of Professional Studies, Medicine Department University of Durres, Albania

Abstract

Every day, scientific knowledge is growing exponentially and either researcher, nor students have the ability to keep up with literature. On the other hand, new generations of students have different views of information access from that of their older professors and no longer need to depend on professors to obtain information. However, sometimes they are unable to relate this new information to existing knowledge or to transfer it to solve novel problems. It is a challenge for medical educators to search for new pedagogical models that promote in their students the development of strong cognitive processes that allow them to select, integrate, and transfer the new learning and, therefore, to reach meaningful learning.

Meaningful learning occurs when the learner interprets, relates, and incorporates new information with existing knowledge and applies the new information to solve novel problems. Meaningful learning, then, involves building multiple representations (mental models) of knowledge.

In medicine, meaningful learning implies that knowledge acquired by the students makes sense in their future medical practice and allows them to solve different problems

In biology, meaningful learning means that the students are able to apply what they know about biology to novel situations, they are able to predict and explain the responses of a biological system if it is disturbed and sometimes to solve quantitative problems (calculate something).

This is easier in the clinical setting than during basic science instruction. During the latter, students receive a great amount of information, some of which does not have direct medical application. Thus, many students in the first semester use rote memorization to acquire a large amount of information that they will forget after the exams.

In this study, we addressed the following research question: does the concept mapping methodology, articulated with the mediated learning experience, increase meaningful learning in students attending to the cardiovascular module of a biology course?

Introduction

Teachers aspire to have all of their students learn. This aspiration of reaching all students spans disciplines, age levels, and all varieties of institutions. Most teachers do so out of a genuine love for their discipline and a desire to share the wonder of their chosen field with others. Science teaching is no different than other disciplines in this respect. However, try as we may in science, the lack of diversity apparent in the statistics of who chooses to pursue scientific disciplines professionally suggests that we still have much to learn about[1] how to reach all students. Although both formative and summative evidence is the currency of knowledge and decision-making for scientists in the laboratory, evidence of any systematic sort has played a comparatively minimal role for scientists in their teaching practice. In science classrooms, evidence is often employed only *summatively*, in the assignment of grades for an exam or course and as a necessary means to inform students of a final judgment of their learning. More rarely evidence in science teaching and learning is used *formatively*, in gauging student understanding, identifying confusions, and guiding instruction on a daily basis. Of all the arenas of learning in schools and universities, one would expect the sciences to embrace fully the culture of evidence, both formative and summative, in the practice of teaching. Yet this is often not the case. How can we as scientists not be driven by such questions as: What do we want our students to learn? How do our students think about biology?

Pedagogy

The pedagogy for this interdisciplinary science emphasizes how knowledge and techniques in two different subject areas can be used to solve real-world problems (1). The students learn the biomedical applications of inorganic chemistry and molecular biology, specifically in the development of new anticancer drugs, thus, enhancing their interest in learning both subjects. Interdisciplinary teaching has long been supported as a pedagogical practice[2]. It is emphasized in Stepien's work[3] which critiqued learning a subject in isolation: "It was segregated when it was acquired and hence is so disconnected from the rest of experience that it is not available under the actual conditions of life.

It is implied in Howard Gardner's Multiple Intelligence theories (1993). And it is suggested by James Banks[4], who claims that "a conceptual approach will facilitate the

[1] *Les déboires de la notion de pédagogie. Avanzini, G. 1997, Revue française de pédagogie, fv. 120, 17-24.*

[2] *Integrated biology and undergraduate science education: a new biology education for the twenty-first century? Labov J. B., Reid A. H., Yamamoto K. R. 2010, CBE Life Sci. Educ, fv. 9:10–16.*

[3] *Problem-based learning for traditional and interdisciplinary classroom. Stepien W., Gallagher S., Workman D. 1993, J. Educ. Gifted., fv. 16:338–357.*

[4] *Banks, J. A. (1981). The Nature of Multiethnic Education. In Banks, J. A. (Ed.) Education in the 80's: Multiethnic Education. Washington, D.C.: National Education Association.*

implementation of a multiethnic curriculum which cuts across disciplinary boundaries". In 1988 interdisciplinary education was identified as an issue of primary importance by members of the Association of Supervisio and Curriculum Development[5]. Further indicating a resurgence of interest among practitioners, in 1991 and 1997 two major teaching journals published entire issues on interdisciplinary education[6].

Teachers as mentors[1]

A science student is formally supported by two teacher-mentors during a school-based practical experience[7]. One of the mentors, the Professional Mentor, is a senior teacher within the school, per-haps a deputy head teacher, while the other is a science specialist. In both cases they will be experi-enced and successful teachers who have received initial training in their role by university tutors and other mentors[8]. However, teacher-mentors also receive on-going training as the nature of their role develops and opportunities to share good practice arise. Science mentors are expected to meet for-mally with their students at least once a week to discuss the student's progress and to review and set targets[9]. Thus the mentor plays an important part in the formative development of the student as a competent new teacher. However, they also have a key contribution to make in the summative assessment of the student[10]. This may be the most important factor in determining whether the student ultimately achieves qualified teacher status. In practice, many students also receive additional useful support and guidance from other teachers whom they work alongside in the partnership schools[11].

Assessment against the Standards

The success of student teachers in Albania is measured against the Standards for Qualified Teacher Status (hereafter known as The Standards"), as required by the Department for Education and Employment. These were first introduced for students completing courses in 1998 and represented a significantly more demanding set of

[5] *Transforming Undergraduate Education for Future Research Biologists. National Research Council. Washington, D.C. 2003, National Academies Press;*

[6] *Association, American Statistical. Guidelines for the Assessment and Instruction in Statistics Education (GAISE) Project. s.l. : American Statistical Association, 2005*

[7] *The Nature and Sharing of Teacher Knowledge of Technology in a Student Teacher/Mentor Teacher Pair. Margerum-Leys, Jon. 2012, Journal of teacher education, fv. 46-56.*

[8] *The Mentor Teacher as Leader: The Motives, Characteristics and Needs of Seventy-Three Experienced Teachers Who Seek a New Leadership Role. Zeichner, Ken. 2005, Teaching and Teacher Education, fv. 117–124.*

[9] *The development of preservice chemistry teachers' pedagogical content knowledge. Jan H. Van Driel, Onno De Jong, Nico Verloop. 2005, Science Teacher Education, fv. 572–590.*

[10] *Does teaching experience matter? Examining biology teachers' prior knowledge for teaching in an alternative certification program. Patricia J. Friedrichsen, Sandra K. Abell, Enrique M. Pareja, Patrick L. Brown, Deanna M. Lankford, Mark J. Volkmann. 2009, Journal of Research in Science Teaching, fv. 357–383.*

[11] *Mentoring New Teachers: Implications for Leadership Practice in an Urban School. Tillman, Linda C. 2005, Educational Administration Quarterly, fv. 609-629.*

requirements than any applied to preceding courses. Students have to meet all of the eighty six standards, as well as additional requirements specifying their level of subject knowledge, numeracy, literacy and ICT competence[12]. Most of the Standards can only be reached when the student demonstrates competence during the school-based phases[13]. Competence must be demonstrated in a consistent manner, it is not enough for the student to show their ability to perform acceptably against one of the Standards on one occasion. All of this means that the student and mentor need to build up a thorough base of evidence against the Standards and be able to justify judgements of standards met or not met[14]. As the person best positioned to judge a student's performance, the Science Mentor is expected to coordinate the school-based assessment of a student. In this task they will be supported by the Professional Mentor[15]. Assessment is carried out using a four point scale:

Level 1: Area of strength

Level 2: Area of competence

Level 3: Acceptable, but needing improvement

Level 4: Area needing further sustained effort to achieve competence

Students must achieve levels 1–3 in all standards by the end of the course.

The Standards are detailed and divided into four sections:

I. Knowledge and Understanding

II. Planning, Teaching and Classroom Management

III. Monitoring, Assessment, Recording, Reporting and Accountability

Other Professional Requirements

The Standards are widely regarded as demanding. When first introduced, most experienced teachers expressed considerable doubt as to whether they met the Standards themselves[16]. Certainly, the Standards should be seen as part of a wider, political drive to raise standards generally within education in Albania[17].

[12] *Analyse des perceptions du soutien d'un enseignant associé à la formation du stagiaire. Portelance, Liliane. 2010, Éducation et francophonie, fv. 21-38.*

[13] *Contribution critique au développement des programmes d'études : compétences, constructivisme et interdisciplinarité. Philippe Jonnaert, Johanne Barrette, Samira Boufrahi et Domenico Masciotra. 2004, Revue des sciences de l'éducation, fv. 667-696.*

[14] *Pédagogie et méthodes pédagogiques dans l'enseignement supérieur. Bireaud, A. 1990, Revue française de pédagogie, fv. 13-23.*

[15] *Les compétences professionnelles des enseignants : étude d'un référentiel officiel et conséquences pour l'étude des pratiques enseignantes. Rey, Bernard. 2012, Phronesis, fv. 84-95.*

[16] *Teacher Education in Light of a Few Principles, Theories, and Studies on Vocational Training and Adult Education. Mayen, Patrick. 2011, McGill Journal of Education, fv. 157-170.*

[17] *A View of Professional Learning Communities Through Three Frames: Leadership, organization, and culture. Schunk, Carol A. Mullen et Dale H. 2010, McGill Journal of Education, fv. 185-203.*

Despite the large number of individual standards set out, many require considerable interpretation and are therefore liable to be interpreted differently by different individuals or institutions[18].

As far as interdisciplinary education is concerned, there are relatively few references, perhaps reflecting the emphasis that has been placed on relatively narrow subject based approaches to thecurriculum in recent times[19]. However, there are standards that are relevant to the growing attention being paid to the importance of developing childrens wider life skills through subject studies[20].

Thus we find standards that include the following statements:

- Those to be awarded Qualified Teacher Status must, when assessed, demonstrate that they:
  - *... understand the contribution that their specialist subject makes to the development of key skills.*
  - *... plan opportunities to contribute to pupils' personal, spiritual, moral, social and cultural development.*
- Use teaching methods which sustain the momentum of pupils work and keep all pupils engaged through:
  - *... exploiting opportunities to improve pupils' basic skills in literacy, numeracy, IT and the individual and collaborative study skills needed for effective learning, including information retrieval from libraries, texts or other sources.*
  - *... providing opportunities to develop pupils' wider understanding by relating their learning to real and work related examples.*

Interpreting the Standards

Most of the Standards set quite high demands that are basically achieved or not achieved. In order to help students learn and progress, it is important that a system is used that allows them to plot their progress as a formative experience. To this end, university tutors and school mentors have worked to produce a series of level descriptors for each of the Standards, so that a student may know whether he/she has been adjudged to have just attained a standard or whether they are secure against that particular standard.

---

[18] Facteurs déterminant l'application de nouvelles tâches d'enseignement dans le secondaire supérieur. Vos, Ndella Sylla et Louis De. 2006, Revue des sciences de l'éducation, fv. 377-394.

[19] Points de vue d'enseignants de sciences au premier cycle du secondaire sur les manuels scolaires dans le contexte de l'implantation des nouveaux programmes au Québec. Abdelkrim Hasni, Christine Moresoli, Ghislain Samson et Marie-Ève Owen. 2009, Revue des sciences de l'éducation, fv. 83-105.

[20] La sémiotique postmoderne dans la pédagogie et la recherche interculturelles. Studies, International Journal of Canadian. 2012, Roger Parent et Peeter Torop, fv. 353-379.

Level descriptors for standards relating to the student's ability to contribute to a pupils' wider development are:

Level 1 contributes to a pupils' wider development as a matter of course

Level 2 has often created or taken opportunities which arise for contributing to pupils' wider development

Level 3 has, on occasion contributed to pupils' wider development

Note that the basic standard of competence required of the new teacher is set so high, that it is difficult to differentiate between different levels of performance. This is not the only problem with the use of standards for assessing student teachers.

Problems assessing against the Standards

As already mentioned, the Standards require interpretation. The interpretation that is placed upon a particular standard by a mentor will be influenced by their own teaching experiences, the nature of the school in which they teach and the nature of the pupils with whom they work. The mentor's own level of competence as a teacher will inevitably influence their interpretations and judgements. This is one reason why the University tutor's role is so important in the assessment process, because they possess a wider perspective, having seen the work of many more student teachers than the mentor and being familiar with a much greater range of schools in many different localities influenced by different socio-economic factors. Another problem with the Standards is the necessity to develop a comprehensive evidence base to support the judgements made during assessment. This places a great pressure upon thestudent to maintain a comprehensive and well organized paper-trail of all their planning, preparation and other activities. This requirement is quite challenging for some students, many of whom may show considerable promise as dynamic and even inspirational teachers, yet have difficulty organising paper work. There is a real risk that some potential new teachers my be deterred from their chosen path early on in their career by the apparently buracratic nature of the training process. It also places a considerable burden upon mentors, who also have to maintain comprehensive paper records in the relatively modest amount of time they are allocated for working with student teachers. Finally, a problem with the Standards is that they only refer to the measurable. The true worth of a new teacher may not be captured by a set of figures pertaining to the Standards. Some individual students will be undervalued by a standards only profile while others may appear more proficient than they really are.

Benefits of assessment against the Standards

Despite all the problems, there are also benefits to a standards-based assessment of student teachers. The Standards have made it clearer than ever before what is expected of newly qualified teachers. This makes it easier for student teachers, and also those responsible for their training, to feel secure about the aims of the course. The Standards can be used to generate regular feedback to students of an open nature based upon transparent criteria. They can also be adapted, in the ways described, to provide students with a structured system of targets during the course so that they can be motivated by a sense of progress.

Bibliography

1. *Les déboires de la notion de pédagogie.* Avanzini, G. 1997, Revue française de pédagogie, fv. 120, 17-24.
2. *Integrated biology and undergraduate science education: a new biology education for the twenty-first century?* Labov J. B., Reid A. H., Yamamoto K. R. 2010, CBE Life Sci. Educ, fv. 9:10–16.
3. *Problem-based learning for traditional and interdisciplinary classroom.* Stepien W., Gallagher S., Workman D. 1993, J. Educ. Gifted., fv. 16:338–357.
4. *Evolving strategies for the incorporation of bioinformatics within the undergraduate cell biology curriculum.* Bank J. 2003, Cell Biol. Educ., fv. 2:233–247.
5. *Transforming Undergraduate Education for Future Research Biologists.* National Research Council. Washington, D.C. 2003, National Academies Press;
6. Association, American Statistical. *Guidelines for the Assessment and Instruction in Statistics Education (GAISE) Project.* s.l. : American Statistical Association, 2005.
7. *The Nature and Sharing of Teacher Knowledge of Technology in a Student Teacher/Mentor Teacher Pair.* Margerum-Leys, Jon. 2012, Journal of teacher education, fv. 46-56.
8. *The Mentor Teacher as Leader: The Motives, Characteristics and Needs of Seventy-Three Experienced Teachers Who Seek a New Leadership Role.* Zeichner, Ken. 2005, Teaching and Teacher Education, fv. 117–124.
9. *The development of preservice chemistry teachers' pedagogical content knowledge.* Jan H. Van Driel, Onno De Jong, Nico Verloop. 2005, Science Teacher Education, fv. 572–590.

10. *Does teaching experience matter? Examining biology teachers' prior knowledge for teaching in an alternative certification program.* Patricia J. Friedrichsen, Sandra K. Abell, Enrique M. Pareja, Patrick L. Brown, Deanna M. Lankford, Mark J. Volkmann. 2009, Journal of Research in Science Teaching, fv. 357–383.
11. *Mentoring New Teachers: Implications for Leadership Practice in an Urban School.* Tillman, Linda C. 2005, Educational Administration Quarterly, fv. 609-629.
12. *Analyse des perceptions du soutien d'un enseignant associé à la formation du stagiaire.* Portelance, Liliane. 2010, Éducation et francophonie, fv. 21-38.
13. *Contribution critique au développement des programmes d'études : compétences, constructivisme et interdisciplinarité.* Philippe Jonnaert, Johanne Barrette, Samira Boufrahi et Domenico Masciotra. 2004, Revue des sciences de l'éducation, fv. 667-696.
14. *Pédagogie et méthodes pédagogiques dans l'enseignement supérieur.* Bireaud, A. 1990, Revue française de pédagogie, fv. 13-23.
15. *Les compétences professionnelles des enseignants : étude d'un référentiel officiel et conséquences pour l'étude des pratiques enseignantes.* Rey, Bernard. 2012, Phronesis, fv. 84-95.
16. *Teacher Education in Light of a Few Principles, Theories, and Studies on Vocational Training and Adult Education.* Mayen, Patrick. 2011, McGill Journal of Education, fv. 157-170.
17. *A View of Professional Learning Communities Through Three Frames: Leadership, organization, and culture.* Schunk, Carol A. Mullen et Dale H. 2010, McGill Journal of Education, fv. 185-203.
18. *Facteurs déterminant l'application de nouvelles tâches d'enseignement dans le secondaire supérieur.* Vos, Ndella Sylla et Louis De. 2006, Revue des sciences de l'éducation, fv. 377-394.
19. *Points de vue d'enseignants de sciences au premier cycle du secondaire sur les manuels scolaires dans le contexte de l'implantation des nouveaux programmes au Québec.* Abdelkrim Hasni, Christine Moresoli, Ghislain Samson et Marie-Ève Owen. 2009, Revue des sciences de l'éducation, fv. 83-105.
20. *La sémiotique postmoderne dans la pédagogie et la recherche interculturelles.* Studies, International Journal of Canadian. 2012, Roger Parent et Peeter Torop, fv. 353-379.