TEACHING TOPICS
INTEGRATION

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This teaching topic is about integration, in a broad sense. Focusing on integration of knowledge, skills and attitude, integration of different subject areas in an educational program and integration of knowledge on a basic level and application level. Integration is a concept that is difficult to grasp, but it can be stated that the more aspects are being integrated the harder to discern these aspects.

WHY SHOULD YOU USE INTEGRATION IN YOUR EDUCATIONAL PROGRAM?

Project-based learning and integration go together[1]. In a project-led system where integration is at the root, it seems that students achieve deep learning and understanding of the topic[2]. Students are motivated, and it is more likely they regulate their learning in such a system[3].

In addition, students are more capable of putting theoretical knowledge into context, and have a better retention of their knowledge in an integrated project-led system than in a separated-discipline system[4, 5].

Also very important is the fact that integration stimulates collaboration between teachers from different disciplines, in undergraduate education but also within research[1]. Nevertheless, it is acknowledged that integrating aspects takes time and work in planning, organization and execution, and also needs to be free of rivalry between departments[1].

INTEGRATION IN EDUCATION

In response to the complex challenges students face today, education is focusing on offering integrated educational learning settings[6]. Settings where students learn to combine theories, concepts and methods in a single context[7]. The goal of this approach is to deliver students who are able to solve problems and who can create solutions in different kinds of authentic situations[1].

But what exactly is integration?
Integration is; interdisciplinary, multidisciplinary, transdisciplinary, thematic, integrated, connected, nested, se-quenced, shared, webbed, threaded, immersed, networked, blended, unified, coordinated, and fused. In other words, it is still an elusive concept[8]. However, full integration can be seen as a blended form where separate parts are indiscernible[9]. As Czerniak[8] states:

'The tomatoes in a tomato soup cannot be distinguished from the water or other ingredients in the soup. In contrast, in noodle soup you can still distinguish the broth, chicken and noodles, which can be defined as interdisciplinary.'

INTEGRATION OF MATH & PHYSICS
BY JASPER HOMMINGA

Jasper Homminga and Ruud van Damme integrated math & physics in their course at ATLAS. By creating challenging real-world problems they covered the different aspects of math & physics at the same time. They experienced that being flexible is very important. The benefits of integration are evident according to Jasper. But what are the benefits for a teacher? What were successes? And with which aspects were they confronted? Watch the video to know more about it.

▶ *http://tinyurl.com/Homminga*

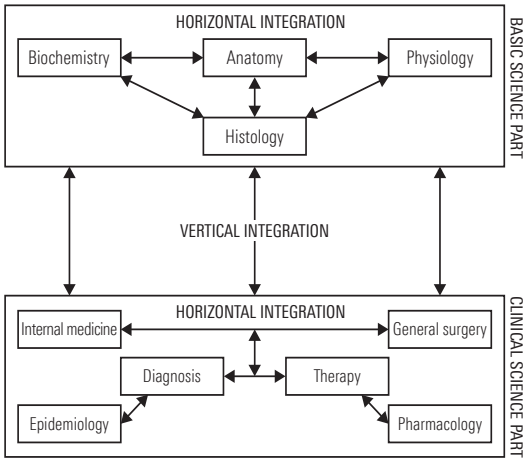
VERTICAL AND HORIZONTAL INTEGRATION

In Sweden, at the Faculty of Health Sciences in Linköping (FHS), their holistic educational approach contains two elements of integration; vertical and horizontal integration[1].

Horizontal integration means that different subjects from different disciplines are taught at the same time. So for subjects in health science this means that students deal with aspects like physiology, chemistry and anatomy at the same time[1]. Vertical integration in health is focusing on the basic science and clinical science at the same time.

Earlier, the curriculum was structured in the way that basic science was preparatory material for the clinical science, but nowadays students use authentic patient histories to approach the problem and use their basic sciences to get a deeper understanding of the clinical data of the patient[1].

In other disciplines this kind of integration takes place as well, but is maybe not so consciously present or expressed. For example, in TOM module 10, *'Lab on a Chip'* of Electrical Engineering, students have to go back to basic knowledge about manufacturing when making a prototype.



Horizontal and vertical integration. Adapted from[1].

INTEGRATION IN PRACTICUM OF INDUSTRIAL DESIGN & MECHANICAL ENGINEERING

BY PETER BOLSCHER & THOMAS ZIJLSTRA

http://tinyurl.com/practicalredesign

Peter Bolscher and Thomas Zijlstra are practicum supervisors who observed that the ID-students were not very motivated by only manufacturing without getting a final product. They came up with a new design to better connect with the interests of their students and prepare them for future projects. What is the difficulty when you want to redesign your educational content, in this case your practicum? According to Thomas one thing is very important: 'keep on developing your education'. Watch the video to know more about it.

LEVELS OF INTEGRATION

Baartman & de Bruijn[3] distinguish between three levels of integration: low-road, high-road and transformative integration. Although the research has been conducted in vocational education, it does provide you some insights into the student's learning process when they transfer, combine or rethink their knowledge, skills and attitude.

Low-road integration
Low-road integration happens when a student applies something practical he learned and then automates it. So for example, a student learns to use certain materials, uses them in practice and thereafter uses them without conscious thought. The student knows 'how' but does not include necessarily the knowing 'why'.

High-road integration
In high-road integration the student is reflecting during or after his action. In contrast to low-road integration, it is not possible to execute the task without thinking. Students know 'why' they are doing something in a certain way.

Transformative integration
In transformative integration students do not only know 'what' and 'how', but also question their own theory. They are critical of their own mental model. In this level of integration social and emotional processes are also included in the learning process.

SKIPPY
THE ADVENTURE OF TWO QUIRKY STUDENTS AND A SKIPPY BALL

There we stood, two eager students, and our physics teacher just told us that we should analyse some kind of movement, any movement. Not sure what to do, we asked: "What kind of movement should this be?", to which our teacher replied: "Just make something up, like throwing a skippy ball off a Tower!". Obviously, things couldn't sound more exciting, so we chose to run up the Carrilon Tower.

Using some computer software, we thoroughly analysed the ball's movement in the video we made, and compared this real world movement with an ideal movement (free fall) and investigated air resistance and its effects. Still, we felt that this relatively cumbersome assignment did not convey the enthusiasm we had experienced in what was undoubtedly our most exciting physics assignment ever.

Therefore, we decided to spice up the assignment, by putting our adventure into an actual story. By integrating storytelling and physics into one assignment, we hoped to get our passion for physics across to all audiences. The proof of our passion? We'd say the picture says it all!

EXPERIENCES AND TIPS

From literature

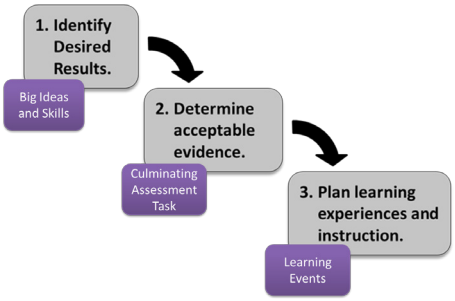
1. Use backward designing: start with the learning goals[10].
2. Working together? Start by making a mind map together, some area's may be naturally integrated[1].
3. Integration can be facilitated by: strong leadership, faculty development programmes, vertical integration groups (students with experts) and a reform of the reward system[1].
4. Assessment should be part of the (re)design of the curriculum and courses, in order to achieve the intended goal of integration[11].

From our teachers and experts

1. List main subjects that you want to integrate and align what is naturally connected (Jasper)
2. Release the fixed frameworks in which your course is normally taught: be flexible to switch topics around. (Jasper)
3. Look for a connection with the interests of students. (Peter & Thomas)
4. Keep on developing your education. (Peter & Thomas)

SUPPORT IN INTEGRATION

If you are interested in using more integration in your education, contact our CELT advisors: *www.utwente.nl/celt*.



Backward design[10].

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COLOPHON

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Program Office of Educational Innovation
University of Twente
Postbus 217
7500 AE Enschede
0031 53 489 9111
www.utwente.nl/en/tom

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Yanick Brezet

UNIVERSITY OF TWENTE.