

Junior College Utrecht: Challenging Motivated Upper Secondary Science Students

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In many countries special programmes for talented science students have run for decades including masterclasses (Adamczyk and Willson, 2004), enrichment projects (Taber and Riga 2006) and special science high schools (see e.g. Ngoi and Vondracek 2004). In the Netherlands such programmes are only recent and so far there is only one specialized *science-enriched* secondary school, Junior College Utrecht (JCU). It was established in 2004 and has an approach that is unique in several respects (Van der Valk and van den Berg 2006). In this study, the experiences of students during the first two years of its existence are evaluated.

Utrecht University initiated Junior College Utrecht in cooperation with several secondary schools from the Utrecht region (JCU partner schools). JCU has a dual purpose:

- to offer a challenging science education to talented students (grade 11 and 12)
- to create a laboratory for innovation of the science curricula and science teaching to the science sections of the JCU partner schools.

Schools have joined the network to give their talented students sufficient challenge. Many of those students get bored in high school and some may seriously underachieve (Peterson and Colangelo 1996). Partner schools are also interested in the science education laboratory function and in closer contacts with universities.

JCU students have to fulfil the requirements of the regular Dutch pre-university stream curriculum (Dutch acronym vwo), which is typically taken by 20% of the population of 16 – 18 year olds. Dutch vwo students do examinations in a variety of subjects, some basic for all students, some optional. JCU-students take the full biology, physics, chemistry and mathematics curricula in grade 11 and 12.

JCU characteristics

JCU education has two general characteristics that are different from regular VWO-schools: ‘selection of students’ and ‘lessons at university campus’; and three curriculum characteristics: accelerated pace, research-context focused and enriched programme.

Selection of students: Grade 10 students who want to apply for JCU indicate their interest to their school. Every partner school is allowed to nominate four candidates. The JCU-selection committee conducts interviews with all candidates and makes the final selection. It is based on academic potential, general ability (not just in science), motivation, and the desire to get a varied group in terms of student interests, boy-girl balance, and representation from different partner schools.

Two days a week at JCU-campus: JCU-students spend two days a week at the university campus to take the science component of the VWO-curriculum and they spend three days a week at their regular secondary school to take their non-science courses (e.g. languages, social sciences).

Accelerated pace: Teaching the topics from the national science syllabuses is completed in about 60% of the time needed by regular schools. Much time is gained by leaving trivia and details to the students to find out.

Research-context focused: Students learn about the research context of subject matter, e.g. by making excursions to university research groups. Much lesson time is spent doing lab work in university laboratory facilities. Moreover, students do investigations. Two major investigation

assignments ('pre-thesis' and 'JCU-thesis') are conducted, guided by researchers from Utrecht University.

Enriched programme: In grade 11 classes teaching topics beyond the syllabuses has the form of a seminar or a lecture. In the grade 12 classes, university specialists teach modules that elaborate issues at the front of research, such as molecular biology and nanoscience.

The research questions of this evaluative study are :

1. To what extent was JCU in its first two years of existence successful in attaining the goal to provide challenging science education to its students?
2. What JCU-characteristics were main determinants for its success and why?

Evaluation Methods

The experimental groups of this study were the 2006- and 2007-cohorts. The 2006 cohort was the first cohort of 23 students from 12 partner schools, admitted in August 2004. These students completed their final examinations in 2006. Their grade 11 and 12 experiences were evaluated. The 2007-cohort was admitted in August 2005 and counted 48 students from 26 partner schools. This study covers their grade 11 experiences.

The marks of students' examinations were collected. The students of the 2006-cohorts were asked to fill in several evaluation questionnaires: a general one and questionnaires on the modules and the thesis. Moreover, their written evaluative reflections were collected. The 2007-cohort students completed a questionnaire about their pre-thesis experiences. Moreover, they were asked to write a reflection on their grade 11 experiences. Three students from both cohorts were interviewed.

All data were analysed with respect to 'being challenged by JCU education'. Open answers and interviews were categorised using the two general and the three curriculum characteristics.

Results

After the 2004/05 and 2005/06 courses, all 23 2006-cohort students passed their examinations with medium to high marks, including their final examination. After the 2005/06 course, the 48 2007-cohort students also passed their examinations with medium to high marks. All 2006 and 2007-cohort students found that JCU-education was challenging. Most students reported that their interest in science increased, only some students said to have concluded that their future is not in science, but they nevertheless enjoyed to have studied at JCU.

Main determinants for the success were the general JCU-characteristics 'selection, 'research-context focused' and 'enriched programme'. The characteristics 'two days a week at JCU-campus' and 'accelerated pace' appeared to be conditional to the success.

Selection

Students reported that being a member of the selected group of JCU students contributed much to the challenge they felt. They enjoyed meeting their equals in talents and in interests from other schools.

The selection had not been perfect, for about 10% of the selected students dropped out after about two months of JCU education. Most of them had personal reasons, e.g. a student was selected for a national sports team. Other reasons were (a) not adapting the old working habits and (b) motivation for science not balancing the high demands of JCU.

Research-context focused

To the students, the embedding of subject matter in a university context was very challenging. They enjoyed doing practicals in university labs and having excursions to research groups very much. The excursion to the CERN in Genève and carrying out the prethesis/thesis investigations guided by university researchers were the highlights of their JCU-time.

Enriched programme

Students appreciated the enriched elements in the JCU-curriculum very much, in particular the modules in grade 12, taught by university specialists. However, they found that there was too little enrichment in grade 11.

Two days a week at JCU-campus

This characteristic was not a determinant for challenging education, but a condition for realising it. Students found that being two days a week away from their schools was demanding, but did not cause too many problems. No social problems were reported. Students reported that they could maintain their old friendships at school as well as establish new friendships at the Junior College. Main problems were timetable problems (e.g. missing non-science lessons) and increased travelling time. Students acknowledged that solving these problems had made them more autonomous persons.

Accelerated pace

Students found the acceleration characteristic a condition for realising the enrichment programme. However, they found that in grade 11, the emphasis was too much on acceleration. The start of JCU education was tough and they had to wait for the real interesting topics until the end of grade 11.

Conclusions and implications

It is concluded that, in its first two years of existence, JCU was successful in attaining its goal: providing challenging science education to its students. The main determinants were:

- ‘selection’, because meeting equal peers motivated and inspired the students
- ‘research-context focused’ as the research context provided a coherent motive for studying the science subjects
- ‘enriched programme’ as students wanted to go deeper into the sciences than the syllabuses.

Due to this success the University and the schools decided that JCU, started as a 3-years lasting project, will be continued for an undetermined period. Furthermore, based on the outcomes the JCU approach was developed further. To diminish the dropout of students in their first JCU-months, a coaching course focused on improving students’ working attitude was started. Elements of enrichment were included from the start of the grade 11 curriculum. Now we know the strengths and the challenges of JCU and its curriculum. JCU should not become a static institution, but keep to be a dynamic enterprise of teachers, students, Utrecht University and partner schools. The co-operation with the partner schools will be intensified. Innovative modules will be developed and implemented not only in the JCU, but also in the partner schools.

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Internet sites:

Junior College Utrecht (in Dutch) www.jcu.uu.nl

The Dutch school system: http://www.minocw.nl/documenten/eurydice_en.pdf