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Major Differences in Education Systems – Is it Time for the US to Change?

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Introduction

The US higher education system has been recognized as one of the best educational systems in the world as thousands of international students come each year for graduate education and a higher percentage of US students go to college for baccalaureate degrees than anywhere else in the world. The majority of universities in the US are similar to each other in their educational, financial, and administrative approaches. Aalborg University (AAU) in Denmark is significantly different in their educational, financial and administrative approaches to the operation of the university. Some of these differences are unique to AAU, but many are common to the Danish educational system and others to the European educational systems.

After visiting Aalborg University (AAU) in Denmark for two sabbaticals of one semester (1985, 1992), a two month visit on another sabbatical (2001), and a few additional short visits, major differences between the typical US and Aalborg Educational systems were observed. Aalborg University was established in 1974 as an experiment in higher education starting with 2,200 students from three different schools. It is the newest university in Denmark of the 6 universities and institutions of higher learning and now has more than 13,000 students. It was established to use the project-based educational approach to overcome some of the problems of the traditional course-based educational system.

Discussions with Poul H.K. Hansen (one of the two faculty members on the Aalborg University Senate), Sven Hvid Nielsen and Erik Pedersen who have been with Aalborg University since it started and are active advocates of the project-based system, and with the Rector, Sven Caspersen, have been essential in gathering information about the Aalborg University System. These leaders have contributed greatly (and are still contributing) to the success of the project-based system at AAU. The university will have grown approximately 6 fold in its first 30 years. Few doctorate institutions can claim this degree of success, and AAU is one of only two technical universities in Denmark, which grant the doctorate degree. The four main goals of the project-based system are[1,2]:

1. Reduce the waste as observed in the traditional educational programs by reducing student attrition rates and making the program requirements such that most students graduate on schedule.

2. Increase student's self-confidence, flexibility, creativity, and communication skills as well as increasing their ability to work in teams.

3. Emphasize integrated problem solving, considering the social, economical, and political aspects as well as the technological aspects.

4. Improve faculty leadership abilities to direct student project teams to solve interdisciplinary problems, as project advisors become more of "coaches" rather than lecturers.

The three major differences between Aalborg University and the traditional US university are: 1) Project-Based education versus Course-Based education; 2) Democratic University Administration versus Autocratic University Administration; and 3) Government Funding versus University Business Operations. Each of these differences will be presented in detail.

Project-Based Education

The US system of education can be described as a course-based educational program in which the students pass a set of required courses and are awarded their bachelor's degree. Some courses have pre-requisites, but most courses are separate islands of knowledge. Programs attempt to integrate these separate islands of knowledge with a "Capstone" or "Senior Design" courses, but these are 1 or 2 courses and, out of the total program, they represent a total of 1/6 to 1/3 of a single semesters work or 3-5 percent of the total program. These courses may be team projects, but often are individual projects. One senior design course requires a large number of other activities, such as mentoring and peer advising of sophomores, community service projects, report writing and presentation skills, professional ethics, and etc. – and all of these activities, which may be "good" activities, do not help the student integrate the "islands of knowledge" into the "capstone project". Other senior design courses have formal team projects with competition between teams from different universities. Few, if any, of the teams have offices on campus or coordinated class schedules to provide a time or place for the team to work together on the project as a full team. Teams with equipment may have a workshop space, but usually not secure office space for discussion, for planning, and for personal equipment storage such as computers and printers. A typical student will work on one major project before completion of his/her bachelor's degree. For those few students who obtain a Master's Degree, which seems less than 3 percent of the US students, they will have another major project for their thesis or research problem report, but this is usually an individual rather than a team project. Thus, most US students have had only one integrated project before they start their professional practice, and frequently it is not a team project.

Many US universities have Problem-Based Learning (PBL) as part of their program, but this is NOT Project-Based Education. Problem-Based Learning (PBL) is a technique which utilizes problems in specific courses (modules, courses, programs, or curricula), but typically in courses at the undergraduate level to promote active learning[(3)]. These problems are to cause application of the materials presented in the course and are in a team setting to promote discussion and alternative solutions. The problems, often called projects, are only portion of the individual courses and thus only a small portion of the total undergraduate program.

Project-based education at Aalborg has major projects throughout the program. The freshman year has three projects and one of the primary goals is for the students to learn how to do group project work and work in teams. The projects after the basic year (freshman year) are evaluated at ½ of the total semesters work, or equivalent to eight or nine semester credits. The student will have four of these semester projects (or seven semester projects if a Masters Candidate) before starting the final comprehensive project, which represents the total effort of the final semester (equivalent to 30 modules or 16 to18 credits). Thus in the project-based education program, at least one-half of the total program work is project based work in comparison to one or two courses. The sophomore projects at AAU are approximately equivalent to many senior projects in the US. The final projects at AAU generally exceed the MS thesis and problems reports in most US universities. Employers in Denmark[4] have indicated that the AAU graduates are better prepared and more productive as they begin their professional careers.

The differences between project-based and course-based systems and some of the reasons for better projects at AAU are: 1) Students do several team projects, not just one. 2) Students have offices on campus and are expected to be in their office when not in class. 3) Students have a common class schedule and typically have at most one course difference. 4) Each project has a project advisor. 5) One half-day a week is set aside for project work during the 10 weeks of classes as a minimum prior to the intensive project period. 6) Students have a 5-week intensive project period each semester to focus on the project with no classes. 7) The project evaluation occurs two weeks after the project report is completed and the evaluation takes 3-6 hours. 8) Student have two weeks to prepare for their final presentation and the evaluator has two weeks to read the project report. 9) Project evaluators are outside evaluators for the final comprehensive project and two of the other projects (the US rarely uses outside evaluators). and 10) Student teams have often worked together on several major projects during their program instead of only one, which is typical in the US programs.

There are differences in addition to the team projects. Many of the major educational differences observed between AAU and the typical US University are presented in Table 1 and some are discussed in more detail. The class scheduling is done at the department level and if a professor has a trip planned, his class may be rescheduled before the 5-week period begins to avoid make-up classes. It is extremely difficult to schedule make-up classes because of the numerous individual schedules in the US, but when students have common schedules they also have common free periods. The common schedules also make it easier for scheduling plant visitations for either course work or project work.

A one-module course meets for five weeks and represents one class period of four hours and one hour of work outside class each week. Typically the professor lectures for one hour, has a break, then lectures with illustrative problems or laboratory exercises, and then gives the students an assignment. The students work as a team in their office on the problems and the instructor goes to the student's office to check on their progress and clear up any difficulties. Students may visit the professor after class if they still have difficulties, but it important to note that the professor goes to the student's office to provide help. The classes typically have 25-35 students, with a maximum of 40 students and 4-6 teams. A few large classrooms are used for special courses, guest lectures, conferences, and other special activities.

Table 1. Educational Program Differences[5] between Aalborg (AAU) University and the Typical US University.

Item	Aalborg University	Item	US University
1.	Project-Based Education	1.	Course-Based Education
2.	Course – 1 Module(0.5-0.6 credits/course) - 30 Modules per semester - 15 Modules Course Work, 15 Modules Project Work - 7-8 Modules Study Courses - 7-8 Modules Project Courses	2.	Course – 3 Credits - 15 to 18 Credits per semester - Most credits study courses - Some 1 credit laboratory courses
3.	15 different modules/semester	3.	5-6 different courses/semester
4.	15 modules project work/semester (1,400 to 3,000 hours/project)	4.	Project work part of course (50 hours for individual projects, 100 hours for term projects)
5.	Final Project – 30 Modules (16-18 credit hours, 2,800 to 6000 hours/project)	5.	Final Project i) Undergraduate(3 credits per semester, 6 credits maximum) Individual Projects– 75 to 300 hrs Team Projects - 500 to 1,500 hrs ii) MS Thesis or Project(6 credits) Individual Project – 300-500 hrs
6.	Final Project – Use External Evaluator	6.	All Projects – Internal Evaluators, but may occasionally use some external input.
7.	Semester – 20 weeks 4 five week periods 2 five week periods have course emphasis 1 five week period has project work emphasis 1 five week period for evaluation emphasis	7.	Semester – 16 weeks 15 weeks course work emphasis 1 week evaluation(finals)
8.	Team Office on Campus for Project Work	8.	No Team Office
9.	Course Scheduling Emphasize common schedule and project work time At Department Level & Flexibility to avoid conflict and can be easily changed	9.	Course Scheduling Emphasize individualized scheduling At University Level – Minimum Flexibility
10.	Students – Most are in-phase with program schedule	10.	Students – Most are out-of-phase with program schedule
11.	Can “retake” final project defense or study course exam after failure during semester break before next semester starts	11.	Must “retake” course after failure
12.	One final project – student does either a BS or a MS project, not both	12.	Students must do a final project for the BS and a separate project/thesis for the MS degree

The students complete the first 6 semesters and if they want a BS (Academic) Degree, the 7th semester is their final comprehensive project. If they want a MS (Civil Engineering) Degree, they take courses during the 7th through 9th semesters and the 10th semester is their final comprehensive project. Thus they obtain either a BS or MS Degree, not both. This also greatly reduces the number of comprehensive projects for evaluation. The students general select the MS program, and 70-80 percent of the students on the project-based system obtain a MS degree versus less than 3 percent of the students in the US course-based system. One reason for the 5 year program is that the government funding for a student for higher education is for 6 years and thus it is essential that most of the students to complete their program on time. Nearly 80 percent of the students graduate within 5 years at Aalborg and most of these are MS students.

The project evaluation is a rather unique process. The students give the project evaluator the report at least two weeks before the project defense. This gives time for the students to prepare for their defense and the project evaluator time to thoroughly review the project. The defense starts with each team member preparing a part of the oral presentation, which takes a total of one hour. After the oral evaluation, the project evaluator gives the project an overall grade while the students take a break. The evaluator goes over the report and the project course materials and asks the students individual questions, and depending upon their responses will raise or lower their grade from the overall project grade. This questioning takes at least two hours and often three to five hours before the evaluator makes his final decision on the individual grades. The students take a break while the evaluator discusses his evaluations with the project advisor. The students come back and the evaluator tells the students their final grade and responds to any comments the students may have.

The system does have some problems. The office space for students is becoming an issue and some teams now share space, especially in the social sciences and humanities areas. Although Aalborg University (AAU) practices the project based system throughout the program, it most likely would be implemented for the final two years in the US on a trial basis because of space limitations; however, the ability to have four major projects would be a significant improvement over the existing system.

University Administration

The second major difference is the administration of the university. The typical US University has an autocratic government system with the University President in-charge of all financial decisions and policies, and the faculty responsible for providing the instruction for the various programs and directing research projects. The Danish system is a democratic government system, with the President (Rector) elected for a term of 4 years from among the permanent full time faculty[(6)]. These differences in administration lead to major differences in operation and interaction between the administration and the faculty, staff, and students. Many of these administration differences are listed in Table 2.

In the US system, the funds for instruction are controlled by the university administration with little or no input by the faculty. The only safeguard for opposition by the faculty to administrative issues has been the "Tenure" concept, but university administrations are trying to eliminate tenure to "get rid of the dead wood" or "troublemakers" in order to streamline the

process. The faculty senates at most US Universities are advisory and can only approve or disapprove educational program matters. Since new programs cannot be started without funding, the administration indirectly controls which new programs are to be developed by controlling the financial support for the new programs. Although the University Board of Trustees must approve major decisions, only the programs approved by the administration are presented to the board for approval. The President is selected by the board from a short list of candidates approved by the search committee, which may contain more administrators and outside people than faculty, staff, and students. Once appointed, the president remains in office until he retires or leaves for another position; it is only in extremely rare instances that the board of trustees will remove the president. It is also extremely difficult to remove incompetent deans, department chairs, or other administrators in the US system.

Table 2. Administrative Differences between Aalborg University(AAU) and the Typical US University

Item	Aalborg University(AAU)	Item	US University
1.	Democratic System	1.	Autocratic System
2.	President is Elected	2.	President is Appointed
3.	Elected for 4 year term, can be re-elected	3.	Appointment is not limited
4.	Senate must approve budget and long term planning and development decisions	4.	President makes all financial decisions, budget decisions, and long term plans in which faculty have no input.
5.	Senate consists of administrators, external representatives, faculty, technical/staff, and students. Elections are for 3 year terms for faculty and technical/staff, and 1 year terms for students	5.	Senators elected by faculty but consider only courses and programs decisions. Technical/staff have a separate organization to represent them
6.	Deans and Department Chairs are Elected every 3 years	6.	Deans and Department Chairs are Appointed
7.	Education is considered a profession with all permanent faculty on 12 month appointments	7.	Education is considered a business and faculty are on 9 month appointments and must get research for summer funding
8.	External members serve on senate and college boards for operations	8.	No external members on senate and college administrative committees for budgets and internal affairs

At Aalborg the President is elected by the faculty (50% vote), technical and staff (25%), and students (25%). The president has the formal responsibility for the management of the institution and the day-to-day running of the institution. By being elected, the Danish University Rector (President) has far superior communications with the faculty, staff, and students than a US University President.

The senate is the supreme collegiate body of the institution[(6)] in Denmark. It establishes the long-term planning and development, approves the budget, and governs the institution in

matters relating to education and research. The senate consists of 14 members and the President (Rector) is the ex-officio chair of the senate and a non-voting member. Two of the 14 members are from outside the university and must be competent in research and higher education matters. At Aalborg University the 12 other members consist of the three college deans, the associate rector, the associate dean for science and technology, two faculty members, two members of the technical/staff, and three student members. The faculty members and technical/staff members are elected by their groups for a three-year term, and the students are elected for a one-year term. It is important to note that the faculty, technical/staff, and students make-up one half of the senate, and thus they have considerable input in all of the university decisions. The rector, associate rector, three deans, and associate dean are permanent members of the senate.

Similarly, the college deans are elected from among the permanent full-time academic staff. A college faculty council establishes the long-term planning and approves the budget of the faculty, similar to the senate at the university level. The college faculty council also includes two members from outside the university.

At the department level, the department faculty elects the department head. A department board is elected which approves the planning and budget at the department level. The program of study is determined by a study board, which consists of five teachers and five students. The study board controls the funding for the programs and works with the department head to determine the course instructors. For courses outside the department, the study board purchases services. Since the study board can hire instructors from outside the university, the instructors obtained for the service courses are perform well or they will not be rehired in the future. The Production Department has three study boards for undergraduate programs for Industrial Engineering, Manufacturing (Process) Engineering, and Export Engineering. There is also a Management of Technology board for the Management of Technology Graduate Program.

Aalborg they have been extremely fortunate to have a President who will have been in office for nearly 30 years when he retires. His positive interaction with the faculty, staff, and students permitted him to be continually re-elected. In one instance, he came to the department Christmas Party and talked with the various faculty and staff for approximately 2 hours. When he left the party, he went through the buildings and stopped at the student offices where students were working on their projects and briefly talked with two or three groups. In another instance, when the US University had finally approved the exchange agreement, a gift was taken to his office to celebrate the exchange approval. He was not in that day, so the gift was left with his secretary. The next day he came to the faculty members office to express his appreciation for the gift. In contrast, few, if any, US university presidents have visited faculty in the faculty members office. A democratic administration can have a very favorable impact upon the faculty, staff, and students as it requires a more considerate president to be and better recognizes the importance of faculty, staff, and students. It is somewhat sad that nearly all higher education academic administrations in the US are autocratic administrations. It is rather interesting that a socialized country practices democracy in its university governments, whereas the most noted democratic country practices autocracy in most of its university government systems.

Educational Finances

The financial funding in the US comes from a variety of sources, whereas the main source of funding for Aalborg University is from the government. There is no tuition for citizens in Denmark, but in the USA tuition can range from $6,000 to $15,000 per year at state universities. The total financial picture in the US is difficult to obtain since most universities have foundations, which are private and do not disclose publicly how funds are spent. Although tuition increases recently have outpaced inflation, tuition is only one of several income sources. State funding, however, has decreased as a percentage of the total university budget. Some of the other sources for income are presented in Table 3.

Faculty members at the Danish Universities are on 12-month contracts, that is, the government considers education a full-time position. The academic year is closer to ten months (40 weeks versus 32 weeks plus breaks of 4-5 weeks for both systems) and everyone has one month vacation. Thus, one summer month is used to prepare for classes and focus on research while there are no regular classes in session. However, in the US, higher education frequently awards only 9-month contracts and faculty members are expected to obtain funded research to support themselves during the summer. The administrative and staff appointments are 11 or 12-month appointments and this does create a poor relationship between the faculty and staff. Although the average faculty must spend time in the summer advising graduate and undergraduate students and performing other office activities, the faculty member is not funded for these activities. If one does not visit the office in the summer, one must spend days opening the mail and answering the various telephone and mail items which have accumulated in the summer, many of which have been sent by the 12-month administrators. This leads to focusing on obtaining summer support, rather than concentrating on teaching during the academic year. In addition, the faculty member is at a disadvantage if he/she does not get summer support as the work done counts towards his/her promotion and tenure record. Thus, the academic system forces faculty to obtain summer support even if one has the means to otherwise support himself/herself.

There are differences in the funding of students in the different programs at AAU. The funding per student for a semester is approximately 61,000 Kroner ($7,200) for Science and Technology Majors, 42,000 Kroner ($5,000) for Social Science Majors, and 24,000 Kroner ($ 2,800) for Humanities Majors. In addition, the government gives a lump sum grant to the institution for the university to make its own priorities between the different departments and between education and research. The university also seeks external funding for research, but it is not a primary focus. The projects done by students in companies often result in company funding and support. There are little differences in the funding of undergraduate programs at a US university, but one major difference is in laboratory fees as some programs have few laboratory courses and others have several laboratory courses.

The financial pressures to obtain external funding, in addition to the teaching performance evaluations and research pressures of publishing, make an academic career in the US very difficult. This prevents innovative and creative thought on new approaches to teaching and instruction, as one must focus on funding opportunities.

Table 3. Revenue Sources in Addition to State Funding and Tuition at US Universities.

1. Athletic Department Revenues – Football and basketball (major sports) ticket sales, television contracts, and program and food sales at events generate large revenues and high profits for successful athletic programs. Minor sports (low revenue generating sports) such as baseball, wrestling, gymnastics, and etc. have lower ticket prices and generate less revenue. There are no university athletic teams at Aalborg University as the towns and clubs sponsor the teams, so one does not need to go to a university to participate in athletics.

2. Merchandise Sales – Profits from royalties on various clothing items and souvenirs generate high revenues and also encourage new designs to promote more sales. Aalborg University has few souvenirs and does not market them as a high revenue source.

3. Book Store Operation – The bookstore is a profit center in the US and national booksellers are operating the bookstores for many universities on a contract basis selling not only textbooks and supplies, but also large amounts of clothing items and souvenirs. The bookstores at Aalborg focus mainly on selling textbooks and supplies and have very few souvenirs. The main source of souvenirs was in a single display case in the administration building at Aalborg.

4. Food Service Contracts – Contracts are given to various private companies to have franchises on campus. Beverage contracts with a major beverage company for exclusive rights as the sole supplier have recently gained acceptance as a major revenue-generating source.

5. Research Contracts – Research contracts have overhead rates, depending upon the university from 40 to more than 100 percent, for funded research contracts. This overhead rate pays for many of the overhead expenses of the university.

6. Royalties and Fees – Universities are doing more patent processing to be able to obtain fees from royalties and licensing.

7. Fund Raising Campaigns – Universities are having frequent fund drives to obtain monies from alumni, students, and friends of the university. These campaigns have goals in excess of 100 million dollars and occur about once every 5 years.

8. Naming Campaigns – US Universities will, for a significant donation, name a professorship, classroom, laboratory, department, or building after you depending upon the amount of your donation. Department names for two engineering departments at two different universities had a $ 5,000,000 donation requirement during the 1999-2001 period. This is another indication that money, not educational service and excellence, is the primary focus.

Summary and Conclusions

The project-based educational program at Aalborg University has been very successful and the system could be successful at a US University, but it would require committed leadership

and support. Aalborg started as a project-based system and this was a great advantage as everyone was committed to this new approach, and in the US it would require change and many faculty, staff, and administrators would find this difficult. Education must take a higher priority and become a 12-month profession to attract quality faculty and allow them to focus more on education rather than generating additional revenue sources. Longer semesters should improve the knowledge acquisition and application by students.

The financial approaches of US universities has made them multi-faceted businesses and education is no longer appears to be the primary driving force. At the major research universities, tuition and state funding have decreased with respect to the total financial funding of the university during the last thirty years and this has forced new revenue sources to be created. One effect of lowering the taxes has been that higher education funding has decreased significantly as a percentage of the total state budgets.

The creation of a democratic administration would lead to improved relationships between staff, students, faculty, and administrators. The incompetent and ineffective administrators could be removed more efficiently from their positions of authority. In addition, the involvement of external members, faculty, staff, and students on the planning, development, and budget decisions as well as the administrators will lead to more support and better execution of the programs and policies of the universities.

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