Car·2·Lab

Curriculum for a learning module on vehicle telematics

for use in training for automotive professions

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1. Introduction

The aim of this output is to develop the concept for designing the curriculum for vehicle telematics in vocational training. The HTW contributed to the IO 01 in the form of various discussions with teachers of the motor vehicle guild. At the same time, the results of this output serve as preparation for the development of curricula within the framework of the Bachelor of Automotive Engineering at the HTW (IO 04). Support was provided both in terms of learning objectives and content. Furthermore, the level of knowledge of trainees and students regarding vehicle telematics should be determined via surveys (**analysis**). With regard to monitoring learning progress, suggestions were made on how to monitor learning success during and after the module.

Here it is also necessary to determine how much "system knowledge" on the functions and applications of vehicle telematics is adequate for the VET level and what belongs more to the higher education sector.

Methodology/Didactics: How should the learning process be designed, how should the telematics kit be used and which other learning aids should be used?

2. Analysis of the actual state at the HTW

2.1 Basic knowledge

In the Bachelor of Automotive Engineering at the HTW Berlin, no automotive telematics knowledge is taught up to and including the 4th semester. This is due to the fact that the first three semesters are reserved for basic subjects and the fourth semester is devoted to vehicle technology. Knowledge of general vehicle technology and internal combustion engines is conveyed here. Other areas are taught only from the 5th semester onwards in the form of compulsory and elective subjects. Previous knowledge relevant to vehicle telematics is taught in the modules Computer Science, Mathematics and Mechatronics 1 and 2 and Quality Engineering/Measurement Technology.

The actual state of knowledge about vehicle telematics contents is therefore purely based on private interest and cannot be assumed as a generally valid knowledge base for the module to be developed. To assess the interests and knowledge, students of automotive engineering were interviewed in the 2nd and 3rd semesters. The results of the survey are documented.

On 10.05.2017 an interview took place with lecturers of computer science, who teach the mentioned module in the 1st bachelor semester automotive engineering. The following statements could be made from the interview:

- Students are often of the opinion that they are IT savvy because they are able to operate laptops and smartphones.
- Surveys carried out every semester by the lecturer with the students show that the desired content in the computer science subjects is the tuning of control units. Students generally have no idea of the complexity of ECU software.
- The students are not aware that ECUs in the vehicle are highly complex computer systems that perform different software functions at different levels.
- The general interest in information technology topics is hardly pronounced among automotive engineering students in the 1st semester.
- Within the scope of the current education in the module Computer Science, the number of hours is not sufficient to provide students with sustainable knowledge in the field of software engineering.
- Due to the two-week cycle of the course, learning progress is very slow.

On 12.04.2017 a survey among 24 students of different semesters took place within the elective module Matlab/Simulink. Normally, the programme is aimed at Bachelor students in the 5th semester. Matlab/Simulink is software that is extremely popular with OEMs and automotive suppliers. About every second job advertisement in the field of vehicle system development requires knowledge of Matlab/Simulink. The following statements can be derived from the survey:

- Almost without exception, the students have no experience both with the program and with programming tasks in general.
- Basic constructs of programming languages are not known (e.g. for-, if- and while loops, data types, programming methods etc.).
- The students secretly hope that Matlab/Simulink can be a valuable help in solving engineering problems on a day-to-day basis, without having to provide programming services themselves to solve the problem.
- The main motivation for choosing Matlab/Simulink as an elective subject lies in the frequent demands made in the job applications.

2.2 Comparison with the contents of the unit "Traffic Telematics" in the Master's program

In the Master's programme in Automotive Engineering, traffic telematics in connection with transport economics and transport logistics is offered as an elective subject. According to the lecturer, the following aspects will be addressed in the course:

- Importance of traffic telematics for efficient traffic management (Introduction)
- Satellite navigation (function, different systems)
- breakdown service systems and remote vehicle diagnosis (rudimentary only)
- parking guidance systems
- Road toll systems
- Car2Car/Car2X (could still be very interesting for a project)
- Potentials and obstacles of individual traffic telematics systems

The list of topics clearly shows that the field of vehicle telematics is only dealt with in passing. Only remote vehicle diagnosis addresses this issue.

The focus of the vehicle telematics module to be developed is therefore primarily on technical and less traffic-related topics. In addition to the technical content, application-related case studies will be developed. Data analysis and evaluation are particularly important in this context.

2.3 Survey of Bachelor Students

A total of 55 students from the 2nd and 3rd semesters were interviewed (using a standardized questionnaire) to determine the level of interest and knowledge among automotive engineering students.

In the "Knowledge" section, the answers were evaluated for all students and selectively for students with mechatronics training. This results in the following results:

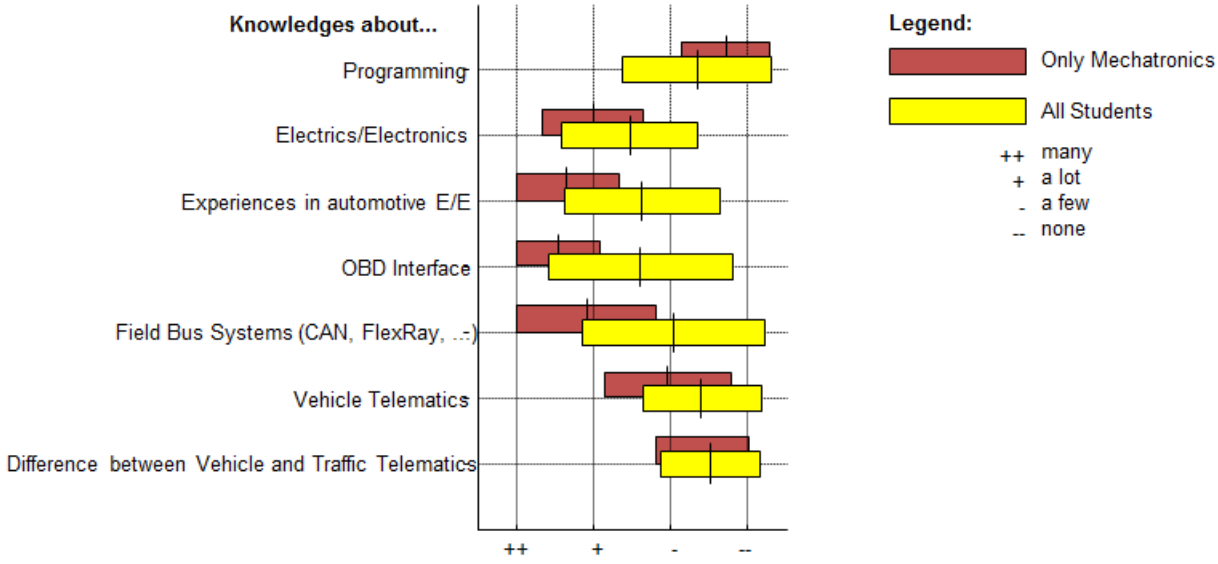

Fig. 1: Evaluation of questionnaires regarding previous knowledge for the group of all students with previous mechatronics training

The graph shows that students with previous education assess their knowledge in the areas of E/E and fieldbuses much more knowledgeably than the sum of all students surveyed. The diagram also shows, however, that there is practically no difference in the level of knowledge in the areas of programming and vehicle telematics, which can be attributed to the fact that these contents are not taught within the framework of training as a vehicle mechatronics technician.

In the "Interests" section, the answers were evaluated for all students and selectively for students with mechatronics training. This results in the following results:

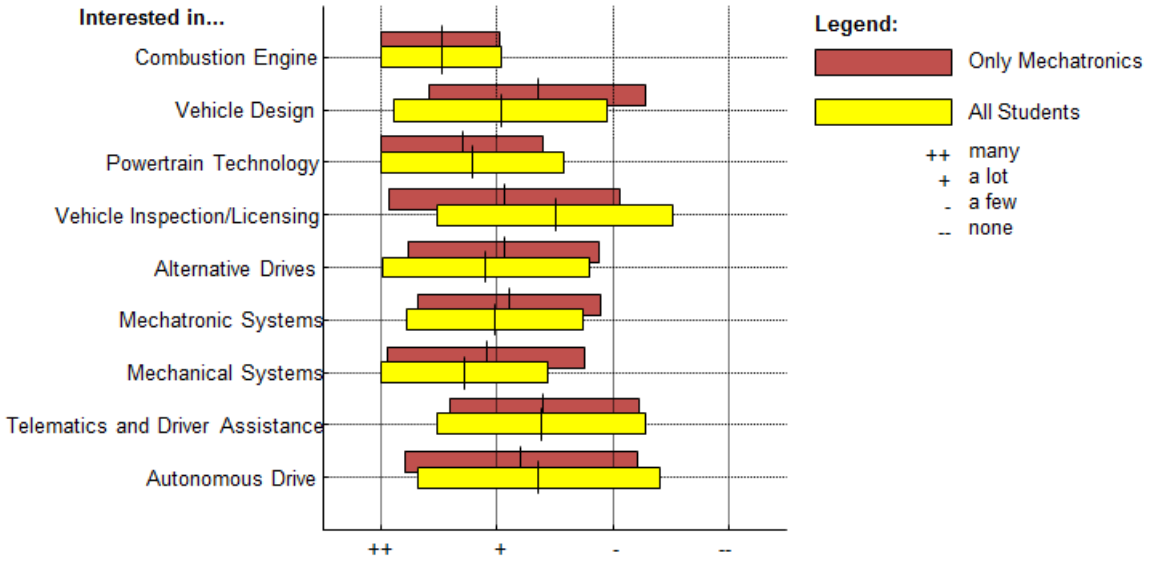

Fig.2: Evaluation of questionnaires regarding thematic/technical interests for the group of all students with previous mechatronics training.

The graph clearly shows that there are hardly any major differences in the subject-specific classes between students who have trained as vehicle mechatronics technicians and all students as a whole. Only the subject of peer review is given higher priority by students with an education than on average.

It also shows that combustion engines, powertrains and mechanical systems are the top three topics. Telematics and autonomous driving occupy the rear seats.

The focal points of the knowledge and interests can be illustrated even better by plotting the frequencies of the answers as bar charts:

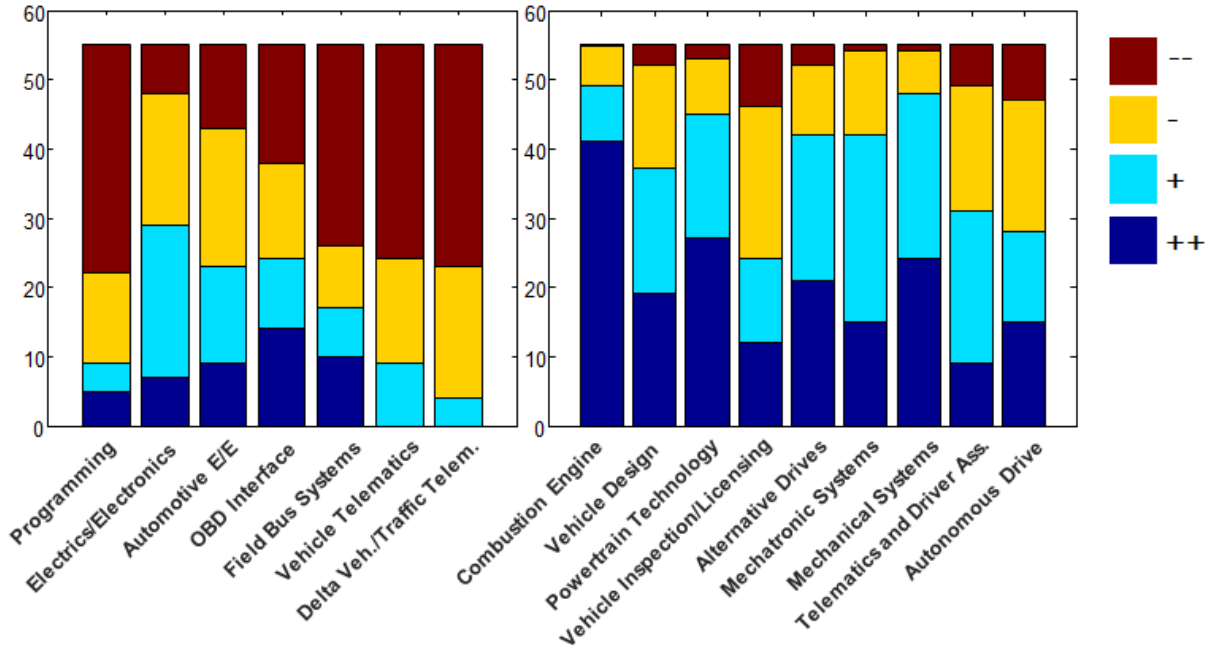

Fig. 3: Knowledge and interests of all students divided according to the frequency of answers given

The knowledge (left diagram) shows that there were no ++ answers to the telematics questions, i.e. knowledge in these subject areas was judged to be the least pronounced.

The interests include expert opinions, telematics and autonomous driving (related to +- and ++-answers).

3. Learning objectives and content

3.1 Telematic Box Functions

The telematics box is the heart of the development of the telematics module. The box represents the connection between the target vehicle and the simulation station. It records the data of the vehicle and sends them via a SIM card to the server of the telematics service provider. Via an Internet connection, the data can be displayed on a graphical user interface or downloaded directly in the form of an Excel file.

3.2 Derivation of learning objectives

The functions of the telematics box result in corresponding learning objectives. After completing the telematics module, students should be able to

- to understand the functionality of GPS positioning,
- to be able to understand the function of the CAN bus,
- to name the possibilities of the OBD interface and the manufacturer-specific differences,
- to install the telematics box on the simulator and in the real vehicle,
- to test the function of the telematics box independently,
- to configure the telematics box for given measurement tasks,
- to connect to the server,
- download the data from the server or display selected data,
- to demonstrate the possibilities of vehicle telematics.

4. Learning progress checks

Achievement of the learning objectives shown under 0 is achieved with appropriate learning progress controls. This includes the following measures:

- The students have to prepare selected topics in their own work and then present them to the entire group of students.
- The practical fields of action are examined in individual projects: The students are divided into three groups and have to conceptualize and solve a telematics-specific problem in a project block of approx. 12 hours. The groups are in direct contact with the course instructor and must present their concept proposals and solutions to the group every six hours. The goals of the individual development stages are set in advance by the supervisor.
- All topics will be examined in a final exam. The handouts and presentations created by the students during the course serve as learning materials. Handouts and presentations are checked and questioned for correctness by the supervisor in advance.

5. Comparison with the vehicle telematics curriculum VET

The topic of "vehicle telematics" had so far received little attention in vocational training in Germany, both in the training framework plan and in the learning fields at vocational school. Other IT-related topics such as data transmission, computer-aided system diagnosis or maintenance and diagnosis of networked vehicle systems have already been integrated into the inter-company training courses or are also dealt with in theoretical lessons at the vocational school.
In the higher further training courses such as motor vehicle service technicians or master craftsmen for motor vehicle technology, IT topics are naturally deepened further, and the use of electronic calculation and accounting programs rounds off the "digital" instruction. The subject of "vehicle telematics" is normally not addressed here, as in initial training.

The application of the telematics kit can be very well modularly realized in the practice-oriented training. In the initial training as an automotive mechatronics technician, topics such as installation, commissioning and maintenance of the telematics systems are conceivable as work tasks. The integration of a work station (on a real vehicle) into the inter-company training course K6/15 (linked vehicle systems) is recommended, since the main topic of this inter-company instruction (vehicle networking) correlates well with the subject area "vehicle telematics".

For the trainees with the focus on "system and high-voltage technology", more in-depth work tasks, e.g. on data interpretation, are also desirable.
In the training of technicians and master craftsmen, rather profound and complicated topics are interesting, e.g. diagnosis of systems or use of online vehicle data for just-in-time maintenance and repair offers. The foreman or technician would use the telematics systems for diagnostic purposes in the workshop, the mechatronics engineer would rather assemble and commission them or retrieve the data online.
In the vocational school the box could be used in the laboratory lessons without vehicle in the simulation mode supplementarily to the theory lessons in order to solidify and test the learned contents promptly at the "model".

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