

# Learning Strategies and Styles in Vocational Education

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*Abstract: Vocational education in Hungary has seen significant changes over the past 20 years. However, the adaptivity of the system is largely aggravated by certain problems of content, compensation and selection. As a result, the success of Hungarian public education, as shown by PISA research, lags far behind its possibilities. In our present paper the adaptive model of vocational education is outlined first, where teaching and learning strategies appear as regulating agents with a formative influence on the educational process. The preferred patterns of learning and teaching strategies typical of the individual yield the learning and teaching styles. In the second part of the paper, the results of a longitudinal examination performed among secondary vocational school students in Budapest are presented. The answers to the following questions are sought: how much learning strategy and style can be regarded as an individual characteristic, how it changes with the progress of studies, and whether it shows any correlation with the gender or specialization of the students.*

*Keywords: learning theory; learning model; learning strategy; Kolb's learning style*

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## 1 Introduction

As shown by the findings of PISA examinations, the success of public education in Hungary lags far behind its possibilities. [1] [2] The reasons for this may best be summarized by the adaptivity weaknesses of the education system and the vocational educational subsystem within that. As an answer by education policy to the significant sociological and economic transformations over the past 20 years, fundamental changes have taken place in the structure (continuous specialization: vocational orientation according to specialization, professional team basic courses, acquisition of labour-market professions), content (curriculum frameworks in professional basic subjects, competence based and modular training programmes in vocational education) as well as output requirements (complex, two-level graduation examination in professional basic subjects, professional and examination requirements) of education. However, problems arising from a

selective school system have not yet been solved. Students of abilities different from former ones have appeared in vocational education due to the expansion of higher education. Vocational training has not fully been able to keep pace with these changes.

The adaptivity of the system of vocational education and the regulation of the educational process is largely made difficult by primary school achievement based further education (problem of selection), the application of methods less suitable to students' abilities (problem of compensation), and a decrease in the number of professional practices (problem of content). On account of these problems, the school is less able to balance the advantages and disadvantages originating in the differences of family background, which is reflected by students' achievements, too.

The conclusion to be drawn from PISA examinations is that the individual success of students is determined mostly by the social status of the family and the school, the frequency and quality of feedback on learning achievement, the amount of time allotted to and needed for learning, the relationship between teaching and learning strategies as well as the standards of self-regulated learning and motivation. These differences in achievement are already reflected by secondary school enrolment with students graded good continuing their studies at grammar schools mainly (the best ones at 8-year grammar schools), those graded fair at vocational schools, whereas those with a poor achievement and often of a disadvantage, suffering from difficulties in learning, behavior and integration, almost exclusively at vocational training schools (trade schools). This fact foreshadows the danger of differences in achievement at the primary school being deepened by secondary education. After that, it is not at all surprising that almost 20% of secondary vocational school students and more than 50% of vocational training school (trade school) students do not meet the standard requirements of competence necessary to adapt to a modern society.

To phase out this *problem of selection* is primarily the task of education policy. Difference between school types ought to be reduced on the basis of the principle of equal opportunities and equity, whereas that within the classroom increased in the field of learning achievement. This achievement is to be interpreted as an added value where factors not influenced by the school are also taken into consideration (e.g. family background, region of schooling).

The situation arising from the problem of selection may somewhat be helped by an incentive school microenvironment and innovative pedagogical activity, but teacher-centeredness still characterizes vocational education in Hungary. To solve this *problem of compensation*, a student-centered methodology that makes knowledge construction possible ought to take over methodology limited to imparting information. Child-centeredness, a better understanding of students, individual treatment and development, the need for compensation and differentiation focuses attention increasingly on the regulating agent of the educational process, where a diagnostic aspect and its necessary teaching and

learning strategies appear in an emphatic form. From this a need for the contents renewal of technical teacher training naturally follows, taking the specialities of vocational education more into consideration.

A fall in the number of practices causes serious concern mostly in vocational school training. The approximation of *training content* to that of comprehensive schools resulted in three *problems*. Firstly, the professional knowledge of certified skilled workers failed to meet the standards of the labour-market (competence deficit), secondly the over-theoretical contents and the needs for developed cognitive abilities of the training contrasted the more developed psychomotoric skills of the students (need vs skill), and thirdly, as a result of these, students' career orientation, attitude and professional value preferences changed (motivation deficit). The latter also manifests itself in only about 30% of qualified skilled workers finding work in their area after leaving school.

## 2 The Objective of the Research

In comparing students, their differences are in practice explored. Teaching is to be considered effective only if the teacher selects their methods, forms and means (teaching strategies) by taking the different characteristics of students into consideration, too. Adaptive teaching focuses on either the correction of students' lack of knowledge (corrective teaching) or on strategy selection with regard to students' strengths (compensating teaching). Whether it be correction or compensation, it is important for us to know those variables, as "conditions" (existing knowledge, abilities, competences, attitudes, learning strategies and styles, motivation, environmental variables) that have most influence on the efficiency of both learning and teaching.

Three types of learning are to be distinguished with respect to objectives. The objective of *externally directed learning* is firstly the acquisition of the cognitive forms of knowledge, secondly the development of abilities by it, and thirdly the formation of attitudes. The objective of *learning targeted at acquiring efficient forms of information acquisition* is the preparation of students for independent learning. The third level is *self-regulated* or *meta-learning*, when the student recognizes how to learn successfully depending on the character of the curriculum and on subject requirements and to achieve this he is able to select the appropriate forms, means and methods of information acquisition.

On the basis of all this, the responsibility of teachers is to thoroughly get to know their students' learning characteristics in order to be able to develop their cognitive and motivational self-regulation. In accordance with that the Hungarian National Curriculum mentions the development of efficient independent learning among essential key competences on the one hand and, on the other, treats the question of teaching how to learn among the high priority tasks of development.

The fundamental condition for efficient and independent learning is for the individual to recognize and understand his own learning strategies as well as the strengths and weaknesses of his abilities and expertise, whereas the role of the teacher is to give directions in connection with the acquisition and structure of as well as access to the syllabus, to have the effective methods and techniques of learning acquired by the student, and to become familiar with the particular learning methods, strategies, styles and habits of the students. [3]

The idea of a research series was delineated based on the above to focus on the reasons of success or failure in learning and to contribute thereby to the content and methodological development of technical teacher training.

Instead of a hypothesis test often applied in pedagogical research, research questions were prepared. The effect of variables in the research on success or failure is manifold. The simultaneously inquisitive character of both the longitudinal (the students taking part in the examination in a phasing-out system) and cross-sectional (each year in a particular year examined) examination models, focussing explicitly on vocational school students, would have limited research targeted at the acceptance or refusal of hypotheses. Therefore we arrived at several recognitions which transcend the boundaries of hypothesis justification and may be decisive from the point of view of our research topic.

Through the abilities and experience of the individual, characteristics and preferences are formed which will have an influence firstly on learning, secondly on problem-solving, thirdly on professional development and even on career choice. The most important question to be answered by the representative longitudinal research focussing on secondary vocational school students in Budapest is *whether learning style may be interpreted as a characteristically individual speciality, which, as a part of the personality, mostly expresses a relation to the acquisition and application of information, which in a word is learning.*

### **3 The Theoretical Background to the Research**

#### **3.1 Learning Theories, Learning Models**

In comparing learning theory and learning model (teaching theory, teaching model), learning is to be interpreted in the former as a behavioral, cognitive, social, etc. change resulting from a particular situation, while in the latter as a process made optimal by taking external conditions into consideration. Whereas learning theories are primarily micro-level (describing the results of short term and elementary activities), are based on organized hypotheses and deal with

learning in general, learning models are macro-level (describing the results of long-term activities) and focus in concrete terms on a practical aspect, for example on the characteristics of classroom learning.

The various psychological directions hold different views on learning, or rather, they emphasize or appreciate different essentials of it. These theories have undergone significant development during the past decades and still coexist. Should any of the paradigms be considered, it is true of each that learning is treated in general and interpreted as a relatively lasting change in behaviour, and its result is achieved through practice. This change may manifest itself among other things in the individual's theoretical knowledge, competences, abilities, behaviour and attitudes. So learning is interpreted as a change in associations between images by the representatives of associationist psychology, in behaviour by those of behaviorism, in mental processes by those of cognitivism, in personality development by those of psychoanalysis, and in incentives of the personality by those of phenomenology. [4] [5] [6] Therefore learning has an outcome and this is change itself.

The most relevant category of the research is the adaptive educational model and the one named after Carroll and Bloom is to be highlighted. [7] [9]

According to Carroll, learning achievement depends on existing knowledge, general learning abilities (the ability of self-regulated learning), the degree of comprehension (general intelligence, verbal skills), several environmental factors (e.g. family, friends), the quality of instruction (the selection of appropriate methods and means, how organized the curriculum is) as well as affective and cognitive dispositions (e.g. interest, motivation, level of standards, self-image). Learning achievement is best shown by the pace (speed) and quality (failure rate) of learning and the durability of knowledge (recallability, mobilizability). The efficiency of learning is to be expressed by a ratio where time allotted to learning is divided by time needed for acquisition. The former comprises the syllabus-based classroom time planned by the teacher and the home learning time of the student, while the latter comprises the quality of instruction and the time need determined by the talents of the student. [7]

In the late 1990s, Huitt developed Carroll's model. In his transactional model, time allotted to learning is dependent on the time of acquiring the material as measured during checking as well as of active participation in the learning process, together with the time spent on the successful completion of allotted tasks. [8]

According to Bloom's model learning achievement is substantially influenced by four factors, namely the existing knowledge of the student, their level of motivation, the duration of the teaching-learning process and the quality of instruction. Time need as a factor appears here, too, originating primarily in the existing knowledge and learning differences of the individual. That is why the other three factors are to be selected in such a way as to ensure the safe acquisition

of the material in each and every student's case; in other words, time allotted to learning should at least coincide with that needed for acquisition. [9]

Bloom and Carroll's teaching-learning models led the way to the model of mastery learning. [10] After the objectives of learning were carefully determined, syllabus content was broken up into small units and continuous feedback given on the level of acquisition, which made the necessary correction possible, thus ensuring even more time for each student to acquire the material with mastery.

The significance of model formation lies in helping to take into account the components of education as well as their interrelations. A process-based attitude contributes to the exploration of variables which determine the operation of the system. In view of these variables regulation may make the process optimal.

Based on the above, the conditions of model formation are to be determined.

- Competence clarification
- Determination of micro- and macro-environmental relations
- Consideration of all components of the complex system and their interrelations (holistic approach)
- Review of all variables from the system's point of view
- Consideration of the suitability components of regulation, thus the examination of the efficient and successful operation of the system, and an attempt at the optimal operation of the system (adaptivity)

As the suitability indexes of regulation, the following were introduced:

- *sensitivity* – at what difference between variable output value and expected value intervention occurs
- *time of intervention* – how long the real time need is

The precondition of adaptive education is for the system to be as sensitive as possible and the time of intervention as short as possible.

The following forms of adaptive education are to be highlighted:

- *correction* – if the student's abilities (existing knowledge, particular skills) are not sufficient for syllabus acquisition they need correction
- *compensation* – if educational methods, forms and tools are selected by taking the student's strengths in syllabus acquisition into consideration

The classified learning process (Fig. 1) and so learning achievement is determined by the following ("conditions"):

- student characteristics (e.g. existing knowledge, abilities, motives, attitudes, learning style)
- teacher characteristics (e.g. competences, attitudes, teaching style) [25]

- curricular educational objectives and requirements
- time needed for acquisition and time allotted to learning
- the student's micro- (e.g. school atmosphere, family background) and macro-environment (e.g. settlement, regional specialities, education policy)

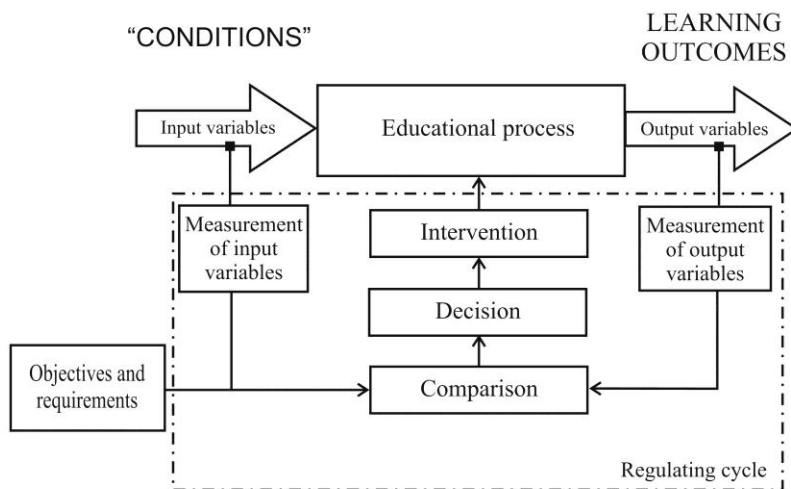


Figure 1

The adaptive model for the educational process

Depending on learning achievement there are three feedback, regulating agents within the system, one on the teaching process (formative effect through change in teaching and learning strategies), one on the student (the possibility of the development of a self-regulated strategy) and one on the teacher (teacher competences develop).

### 3.2 Learning Strategies and Learning Styles

The decisively significant corrective elements of the model in Fig. 1 are the quality of teaching and learning strategies (suitability to objective and syllabus), time to be allotted to learning (in class and at home) and the abilities related to the comprehension of the syllabus. The highest level of learning strategies is the self-regulated learning strategy, when the student, surmounting his own cognitive and affective characteristics, processes the material by choosing the learning methods and means most suited to the requirements. The teacher's direct guidance in this cannot apparently be dispensed with in the beginning.

Teaching, learning and self-regulated (meta-learning) strategies are inseparable and parallel variables of the educational process. Their significance, dominance and mutual effect depend on the educational objectives, the content specialities of the syllabus, the didactic tasks to be solved as well as the age group characteristics of the students (Fig. 2).

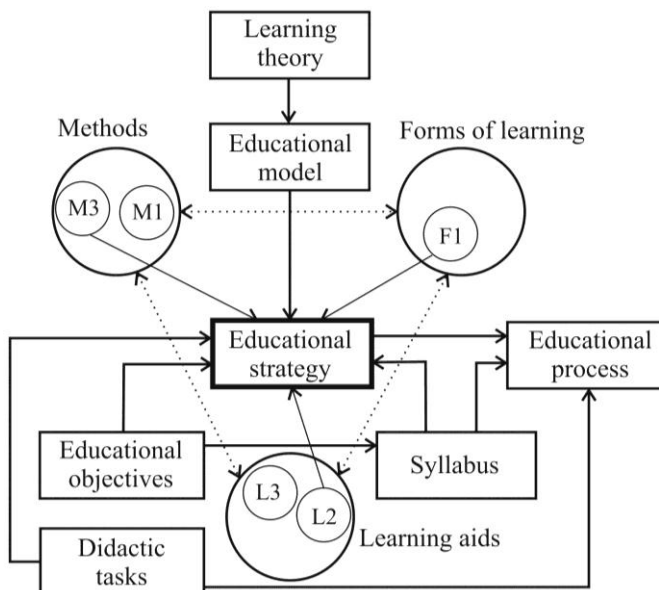


Figure 2

The interpretation of teaching and learning strategy

The dominance of teaching strategies is typical of teacher-centered, that of learning strategies is of student-centered situations of education, respectively, while the self-regulated strategy is typical of independent learning. In the case of teaching-learning strategies the selection of the combination of method – form – means is primarily the teacher's task, and in the case of self-regulated learning the student is capable of it. The teacher obviously makes the selection of the teaching and learning methods, means and forms most suited to processing the syllabus in a way that contributes to the development of the student's self-regulated learning strategy as well.

A common feature of theories of learning style is that students are classified according to their cognitive characteristics and learning strategies along one- or multi-dimensional bipolar (usually cognitive) scales. Conclusions as to the efficient learning styles, forms and means of the student may be drawn from the preferred strategies related to learning style. Teaching strategies which produce the most preferred learning strategies can also be specified, and these in turn serve as a starting point for designing the learning environment.



The common feature of several theories is that only certain cognitive and sometimes affective individual characteristics are integrated into their system, which, however, reduces to a great extent the scope of validity of the given approach. From this, it also obviously follows that neither theory is capable of typifying all the learning characteristics of the individual in the proper way and in proper detail. The existing 60-70 theories can be classified into five categories, according to which learning style

- is biologically determined, including for instance sense modalities and cerebral hemisphere lateralization (Dunn – Dunn, Gregorc),
- reflects the characteristics of cognitive structures, including for instance certain patterns of abilities, too (Riding, Gardner),
- is an element of a relatively stable personality type (Jackson, Myers-Briggs),
- expresses the flexibly stable learning preferences of the individual (Honey – Mumford, Kolb, Kolb – Kolb, McCarthy),
- should be ignored and interest focussed on learning approaches, strategies, orientations and conceptions of learning instead (Entwistle, Sternberg, Vermunt). [11]

From the point of view of our research, the theory examining the learning preferences of the individual is to be highlighted. The most significant theory in this group is associated with the name of David Kolb, who has been studying learning style for more than 40 years. His Learning Style Inventory (LSI) is one of the most widespread measuring instruments in the examination of learning styles. His experimental theory of learning amalgamated the relevant and decisive movements of the 20<sup>th</sup> Century (John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, Carl Rogers, etc.) [12]

His theory rests on six principles:

- Learning is interpreted as a relationship between the individual and the environment.
- Learning is interpreted as the holistic process of adaptation to the environment.
- Learning is to be regarded rather as a regulated process than an outcome condition.
- The student's existing knowledge and experience play a decisive role in processing new information.
- Piaget's adaptive theory is regarded as the basis of learning. Adaptation has two forms, namely assimilation and accommodation.
- Learning is a process of constructing knowledge, the result of which presents itself as a relationship between community knowledge and individual knowledge.

According to his theory, learning is a cyclical process where the stages of gaining concrete experience, reflective observation, abstract conceptualization and active experimentation can be well distinguished. Transition through these stages of information acquisition demands various abilities, attitudes and behavior from students, who vary in these fields. Kolb's LSI is able to show the dominance of these characteristics. In his two-dimensional polynomial system he distinguished learning styles according to the preferences of information acquisition (grasping concrete experience – abstract conceptualization; feeling – thought) and processing (reflective observation, comprehension – active experimentation, the application of acquired skills in new situations; observation – action). On the basis of preferences along axes he differentiated four kinds of learning style: Converger, Diverger, Assimilator and Accommodator. [12] [13] [14] [15]

At the end of the 1980s, Hunt and his colleagues extended the four-region model to a nine-region one by distinguishing four, so-called transitory (Northerner, Easterner, Southerner and Westerner) learning styles. [16] [17]

Later on Kolb and his colleagues determined the balancing style of learning. Students of this type show a considerable degree of balance along both dimensions. [18]

Harb and his colleagues attached an appropriate teaching style to each of Kolb's learning styles. In their opinion a diverging student needs a motivating teacher role, an assimilating one needs an expert, a converging one needs a trainer, while the accommodating one most of all needs a role which gives continuous feedback. [19]

Kolb's LSI served as a basis for the development of the measuring instruments of several further learning styles. Among them McCarthy's so-called 4MAT system may be distinguished ("teaching around the learning cycle"). The main objective was to create teaching situations, taking students' characteristics into consideration, which ensure the differentiated development of the individual. His theory combined Kolb's four learning styles with the cerebral hemisphere lateralization model. The stages of his learning process are the following: connecting to existing experience, observation, imagination, information transfer, practice, extension, refining, and performance. [20] [11]

Honey and Mumford developed their own theory also based on Kolb's model. [21] Experiential learning is regarded as a spiral cycle, with emphasis on continual development. The process starts with the stage of gaining experience, then continues with the stages of reflecting on the experience, critical analysis and generalisation, and planning the application of the newly acquired competence. At this point the cycle starts again but at a higher level. Students usually have a preferred stage, to which a respective learning style is linked: activist, reflector, theorist or pragmatist. Students with strengths at all four stages are seen as versatile or "integrated".

The question of sense modalities is echoed in several theories. They stand in the centre of the Dunn and Dunn theory for instance with the other variables, the circumstances of learning and the relation to them, being organized around it. [22] Stimuli are assessed by the human sense organs from four aspects: modality, intensity, location and duration. Based on sense modalities, Fleming distinguished learning styles, first the dimensions of visual – auditory – kinesthetic/tactile (VAK), then those of visual – auditory – read/write – kinesthetic/tactile (VARK). A visual student will primarily rely on images, the auditive one prefers learning through hearing, the verbal one will like to read the learning material and prefers written tasks, while the kinesthetic student will prefer movement, touching and action. [23]

## 4 The Methods and Means of Research

In the course of the vocational-pedagogical research the adapted version for students at secondary vocational schools of Kolb's Learning Style Inventory was used. In the questionnaire, students at each entry chose the one of four independent statements most as well as least typical of them, then they had to order the four statements into a hierarchy.

Our phasing-out system longitudinal examination was performed between 2007 and 2010, on paper in the first year and in an online form in the following three years (contribution by Attila Viola, teacher of engineering). The examination was performed with the participation of the Mérei Ferenc Institute of Education and Career Counselling (contribution by Judit Béky, consultant) at the request of the Department of Education, Children and Youth Protection, the Municipality of Budapest.

In the September of each academic year a preparatory class was organized for the teachers participating in the examination. They were also provided with a detailed printed measurement guideline. In addition, teacher identifiers were distributed by the help of which the measuring instruments could be given a preliminary try.

Measurement was carried out in the IT lab of the participating schools under the guidance of the teachers prepared. After the completion of the questionnaire students immediately received an assessment and an interpretation of the results, which largely contributed to the development of their own self-evaluation and the formation of their self-image.

Another feedback agent is the form-master, or the teachers working in the class who, on the basis of the results of the class, could acquire useful information in order to achieve their educational and teaching objectives with more efficiency. Therefore an online surface was created, where teachers could check their own class's results as well as their assessment and interpretation directly after the

measurement. This could largely contribute to the selection of the appropriate teaching strategies.

The students of 41 vocational schools in Budapest took part in the examination. 1,477 students from year 9, 1,206 from year 10, 1,242 from year 11 and 989 from year 12 participated in the examination considered representative as for the geographical position of the school and the gender and specialization of the students.

Table 1  
Examination models

Starting secondary vocational school	— Longitudinal examination model →				Cross-sectional examination model
	Date of examination				
	Autumn 2007	Autumn 2008	Autumn 2009	Autumn 2010	
September 2007	<b>Year 9</b>	<b>Year 10</b>	<b>Year 11</b>	<b>Year 12</b>	
September 2008	-	Year 9	Year 10	Year 11	
September 2009	-	-	Year 9	Year 10	
September 2010	-	-	-	Year 9	

Longitudinal research performed in the October and November of four academic years made the application of two examinations models (longitudinal, cross-sectional) possible (Table 1).

## 5 Results

### 5.1 Learning Strategies

In Kolb's model, the students' most preferred strategies are the acquisition of concrete experience and the active, practical application of acquired information. With respect to the type of information and its way of acquisition, besides an increasing deviation, a certain kind of stability (Fig. 3), while regarding the processing of information, besides a minimal change in deviation, a significant change of preference is to be observed (Fig. 4). With the progress of studies, the role in the learning process of practical application continuously increases, whereas that of observation, comprehension, though to a lesser degree, decreases. In this change the increasingly emphatic presence of technical basic subjects and chiefly of practical subjects has an apparent role to play, which demands a change in strategy of a particular circle of students. [24]

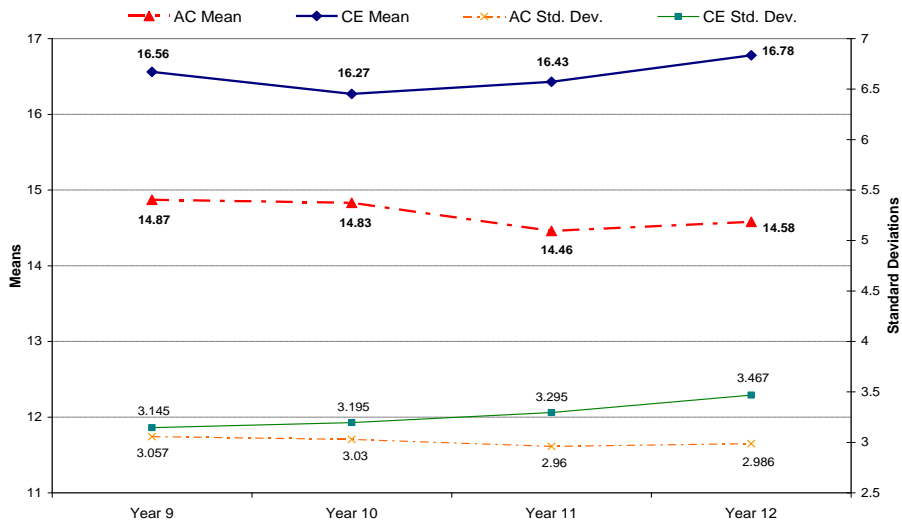


Figure 3  
Means and standard deviations of learning variables I

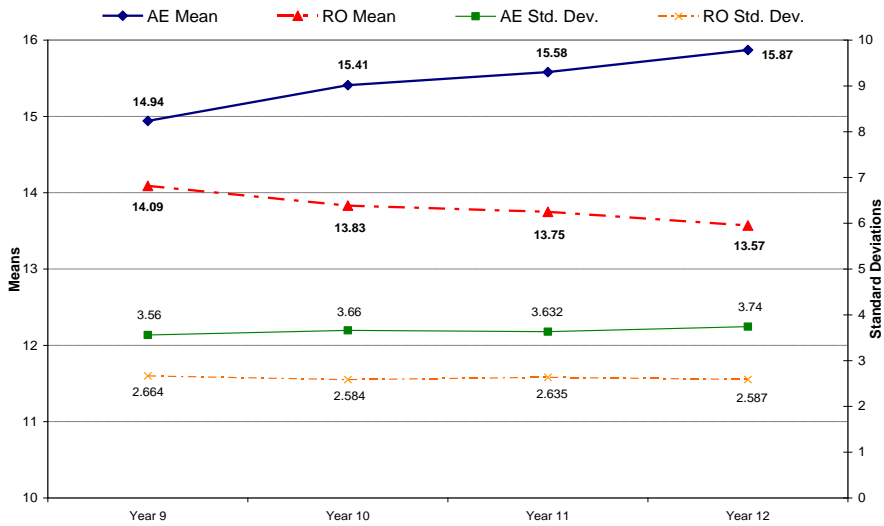


Figure 4  
Means and standard deviations of learning variables II

A stronger than medium negative correlation was measured among the learning variables (Table 2), which shows well the polarizing effect of Kolb's LSI.

Table 2  
Correlation between learning variables

Year 11 Year 10	2009 - 2010			
	AE	RO	AC	CE
AE	<b>0.283</b>	-0.400	-	-0.630
RO	-0.410	<b>0.203</b>	-0.205	-
AC	-0.132	-0.191	<b>0.251</b>	-0.345
CE	-0.450	-	-0.251	<b>0.255</b>

Note: Absolute value low correlation values are not given in the chart. In the horizontal examination model the values below/above the main diagonal of the tables show the intercorrelation coefficient of the results of the lower/higher years at  $p < 0.01$  significance level in the given sample. Correlation coefficients along the main diagonal in the chart were determined on the basis of students' results in two consecutive years (2009 and 2010) (vertical examination model).

Through factor analysis the existence of two difference variables was justified; thus it can be stated that the relation of particular learning variables was appropriate and they belong to the same dimension.

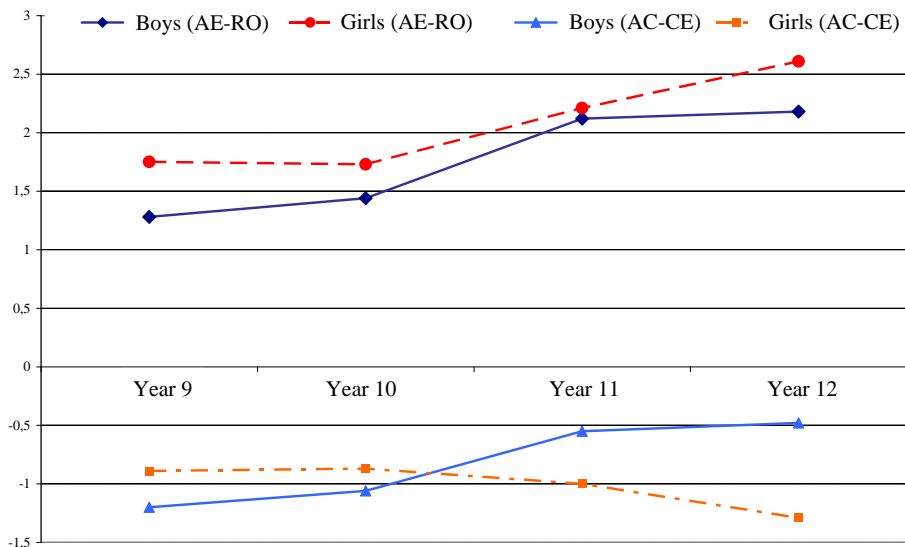


Figure 5  
The means of difference variables according to gender

Considering these learning strategies boys preferred generalization and conceptualization, while girls preferred the acquisition of experience. With the progress of studies there is an increase with both genders in practical application in new situations as well as observation and comprehension (Fig. 5).

In the dimensions of the type of information and the mode of its acquisition, there is a more significant deviation among individual students, which is mostly attributable to the gender and profession of the students. On account of the existence of professions chosen typically by boys or even more so by girls, it can be said that these two factors are related, i.e., that the most important influencing factor under examination in this respect is the gender of the student and, as seen earlier, their year. [24]

## 5.2 Learning Styles

Learning style can already be determined on the basis of learning variables. If learning style is interpreted in the four-region model, it can be seen that the assimilating learning style is the least typical one. 25.7% of boys have a converging and 23.8% a diverging, while 27.5% of girls have a converging and 22.4% an accommodating learning style. The rate of the assimilating style is a lot smaller with boys (17.2%) than with girls (22.4%); that is, highly critical thought and intuition is less characteristic of them. The high number of classification as converging is not surprising since it follows for the simultaneously preferred abstract conceptualization and creative application of the acquired information. The symmetry of the diverging style is quite high with boys, which testifies to strong imagination and problem sensitivity.

A more sophisticated and detailed image of students' learning process preferences was expected of the application of the nine-region model.

Before the interpretation of the results, we consider it important to confirm that the limit values of particular regions were always classified among the so-called transitional regions, whereas the ones along their borders among the balancing region. This can be seen well from the relative frequency distribution chart in the vertical examination model (Fig. 6). Apart from the minor decrease in the number of balancing style students, no significant change is to be observed; that is, the ratio of classification does not change in the two consecutive years. The number of students in the transitional region is significant. With regard to the number of students with high preferences in both dimensions, the least of them is classified as assimilating while the most as diverging.

Using the cross tab analysis, the learning style classifications of 2009 and 2010 were collated first, and as shown by Fig. 7, changes of significance scale are to be observed. Based on the measurements in the two consecutive years, it is to be established that the classification of only about 20% of the students remained the

same. Three cases were different. Only 13.3% and 13.9% of accommodating and assimilating style students, while as many as 27.2% of converging ones, got the same classification.

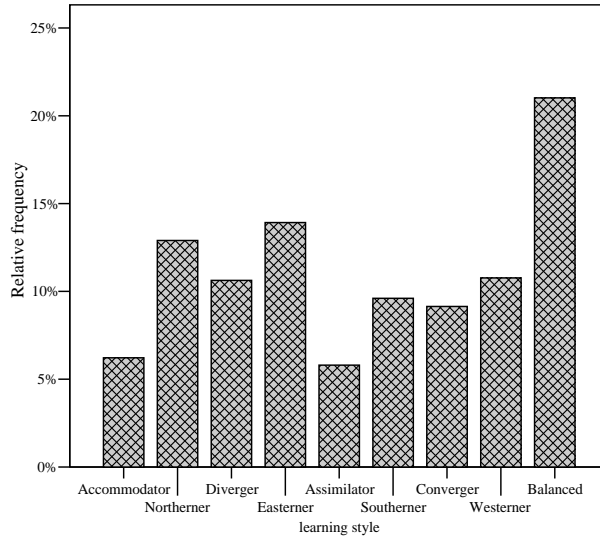


Figure 6

The distribution of learning styles in the vertical examination model

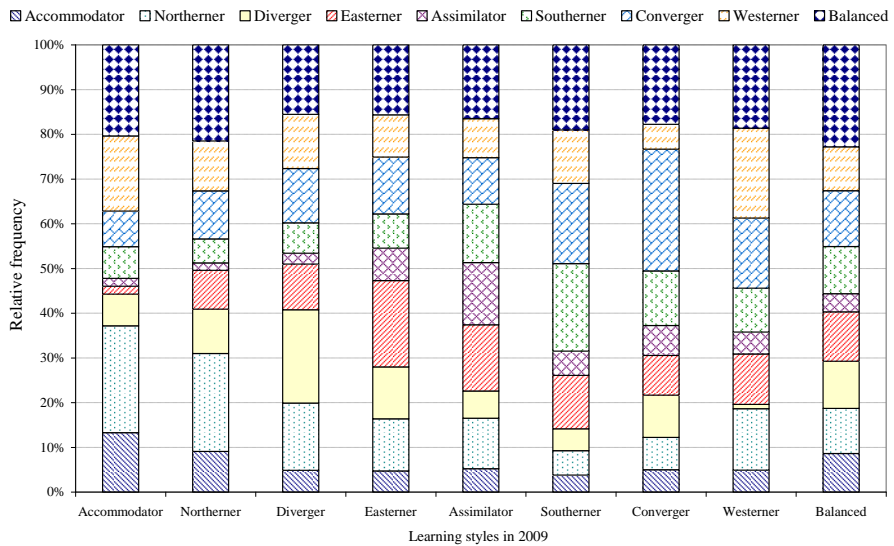


Figure 7

The distribution of learning styles in the vertical examination model



Therefore converging students can be said to have the most stable learning style while accommodating ones the most unstable one. The reason for this is the change in information processing preferences, because with students of this style, the role in the learning process of application in a new situation decreases and, simultaneously, that of reflection on experience (observation) increases.

Shifts were mostly observed with regard to neighbouring regions, especially in the direction of the balancing region. The number of shifts from the balancing region to the other eight was somewhat smaller. The “instability” of the transitional (e.g. westerner, easterner) regions is apparently the most significant. The classification of the learning style of students whose learning variable values fall on border regions changes the most. Significant changes are to be observed in the northern-eastern direction, too; that is, preference difference decreases with respect to the preferred syllabus content as well.

We were also interested to see whether there was any relation between the learning styles of 2009 and 2010 and, if yes, in what way and to what extent. The chi square test was applied in order to determine the relation between the two variables. Learning styles determined in the two consecutive years show a significant relation with each other ( $\chi^2=267.152$ ;  $df=64$ ;  $p<0.01$ ) and a medium relation is demonstrated (Phi coefficient: 0.371, contingency coefficient: 0.348).

Based on the 2010 vertical examination (Fig. 8), it can be seen that, with the progress of studies, in the nine-region model marked change occurs in the ratio of two styles. The rate of converging students doubles (7.0%; 15.7%) while that of the so-called eastern style ones decreases by almost 50% (17.3%; 10.7%). The proportion of balancing students is by far the highest, at around a stable 20%. It means that the ratio of those students is unchanged in the learning process, of whom the four stages have an equally important role to play. Learning style and year are significantly interrelated ( $\chi^2=78.734$ ;  $df=24$ ;  $p<0.01$ ), but this relation is quite loose (Phi coefficient 0.153, contingency coefficient 0.151).

In the course of vertical measurement the learning style classification of students in two consecutive years was also examined. Medium strong correlation between the results is demonstrated with the classification in 2009 having a minor forecasting ability for 2010. (E.g. with respect to years 9-10  $\chi^2=170.064$ ;  $df=64$ ;  $p<0.01$ ; Phi coefficient 0.513; contingency coefficient 0.456;  $\lambda=5.6\%$ ).

Learning style and specialization are significantly interrelated ( $\chi^2=53.302$ ;  $df=24$ ;  $p<0.05$ ); however, this relation is quite loose (Phi coefficient 0.113, contingency coefficient 0.112). It cannot unambiguously be established that there is one particular learning style among students which is primarily typical of one specialization only. Therefore we can only say that certain learning styles occur in greater numbers with a given specialization.

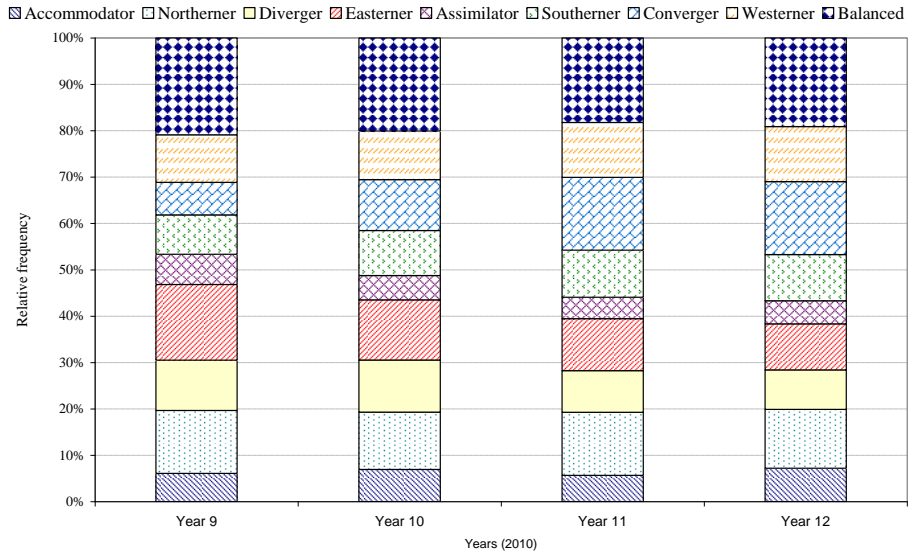


Figure 8  
Changes in learning style ratio with the progress of studies

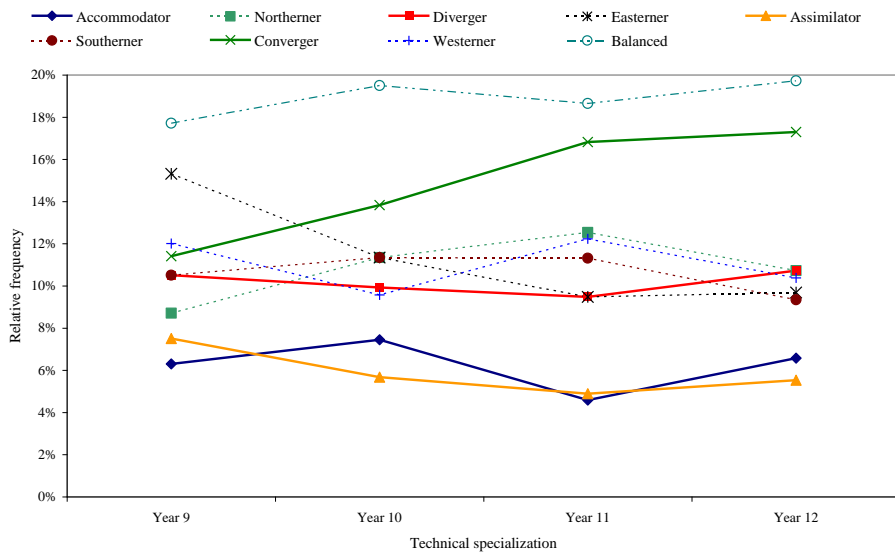


Figure 9  
Changes in learning style ratio with the progress of studies I

The horizontal measurement made it possible to compare the ratio of learning styles in particular specializations. Apart from the agrarian area in the case of the first three specializations, the majority of learning styles can essentially be characterized by stability, which reinforces its attitude-like quality. Their common characteristics are the increase in the ratio of the converging learning style and the decrease in the diverging one with the progress of studies (Figs. 9 and 10). Apart from the humanities, the ratio of the balancing learning style is the most significant, while it is the northerner style which is the most dominant there; in other words, concrete experiences rooted in one's own experience have a more decisive significance in the course of learning. However, no special preference has been established with students regarding the method of processing the syllabus.

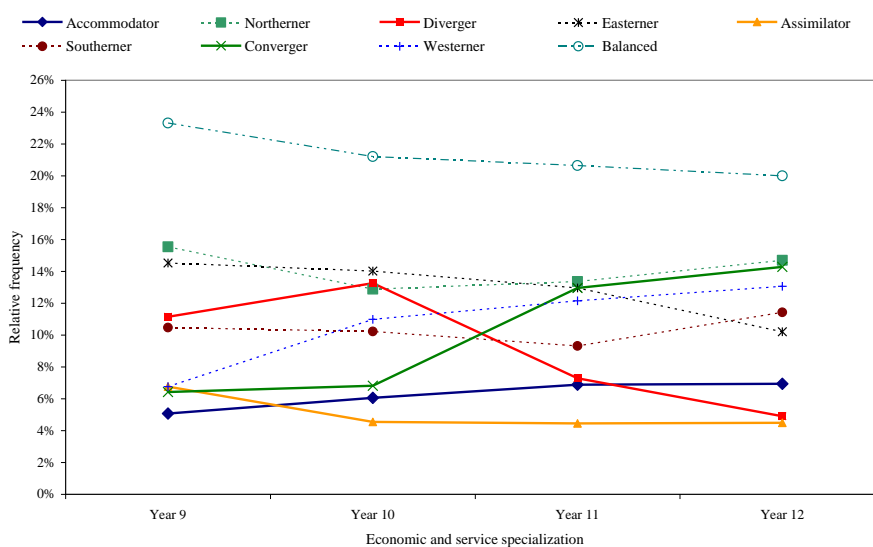


Figure 10  
Changes in learning style ratio with the progress of studies II

Since the number of students in the agrarian area is small for the necessary ratio of representation, the cross tab analysis of all the participating students in the area was performed (96 students in year 9, 78 in year 10, 44 in year 11 and 55 in year 12). Looking at tendencies, apart from the converging style, no significant deviation from the previous year was observed, except that the hectic quality typical of the small sample disappeared. It is still the diverging and accommodating styles that are the most characteristic in this area, contrary to the converging and assimilating ones. It can be observed here, too, that with the progress of studies, after year 9, the majority of styles becomes balanced to a certain extent. In other words, the learning style of students seems to settle according to the characteristics of syllabus-content acquisition as well as the teaching style of the teachers. It means that changes occur mostly in the regions around the axis.

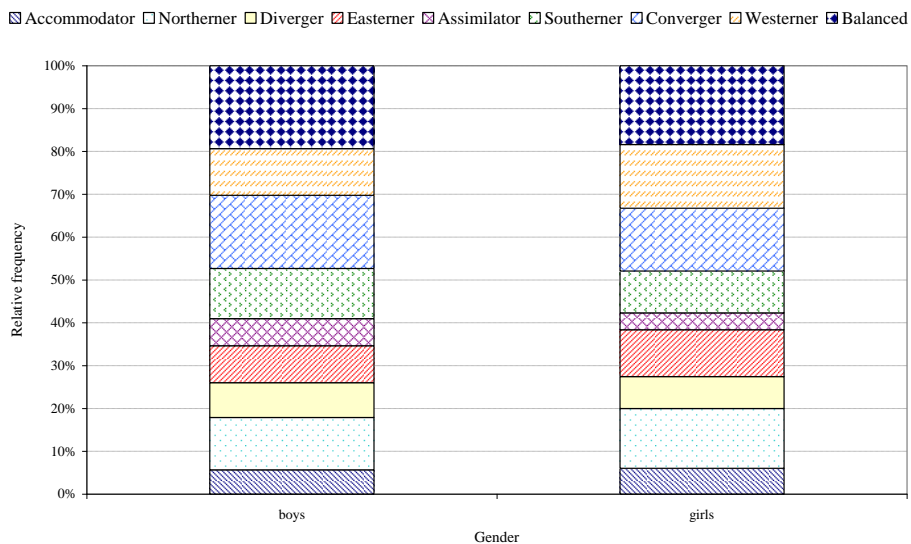


Figure 11

The ratio of learning styles according to gender (2010)

It is only in the technical as well as the economic and service specialization that significant correlation can be shown in connection with years and learning style ( $\chi^2=23.269$  or  $27.301$ ;  $df=24$ ;  $p<0.05$  or  $p<0.05$ ), however, this relation is quite loose (Phi and contingency coefficients at 0.203 and 0.218) and the forecasting ability of the year is also very poor here ( $\lambda=4.5\%$  and  $4.7\%$ ).

Comparing the distribution of learning styles according to gender, basically two differences are to be observed (Fig. 11). With boys it is mostly in the converging, assimilating and southerner regions, whereas with girls it is in the westerner, balancing and easterner regions that a more significant deviation from the similar values of the other gender can be observed. This is attributable to the different preferences of the two genders in the dimension of information acquisition. The ratio of balancing style students is the most significant, at 20%, with both genders. Despite all that no significant correlation between students' gender and learning style was shown in the nine-region model ( $\chi^2=10.057$ ;  $df=8$ ;  $p=0.261$ ).

## Conclusions

Learning strategy is to be interpreted as a complex system of procedures where methods, forms and means are united in an organic relationship. The particular preferred patterns of learning strategies typical of the individual are interpreted as learning style. With respect to learning, certain strategies (the method of information acquisition, sense modality) show some sort of stability while others (the method of information processing and its application) continuous change. Various characteristics are to be observed with respect to students' specialization

and gender. Due to the change in strategy preferences only about one fifth of the students may be said to have a settled and stable learning style. With the progress of studies shift mostly in the direction of balancing regions is to be observed.

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