

The Role of Providing Structure in a Family Medicine Curriculum for Undergraduate Medical Education

Die Rolle der Kursstruktur in einem allgemeinmedizinischen Curriculum in der universitären Lehre

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Background

This paper explores the role of providing structure for students within a new blended-learning family medicine curriculum at Saarland University. This study intends to clarify the role of different structural elements for different learning approaches (deep vs. structured vs. surface learning).

Methods

This study is based on a mixed-methods approach. Fifth year medical students' (n = 84) learning approaches, measured by a shortened version of the ASSIST questionnaire, were correlated with students' academic performance in state exams and the family medicine exam. Based on learning approaches and age, participants were purposefully sampled into two semi-structured group interviews with seven participants each.

Results

Although surface approach learning weakly correlated with lower performance in the first state exam ($\rho = 0.231$), surface approach learning did not correlate with lower performance in the family medicine assessment. Based on qualitative results, the structural design of the curriculum seemed to have a high impact on students' satisfaction and motivation to learn. The reduction of extraneous cognitive load was identified as effective in motivating students to study. Deep-learning students highlighted the positive effects of curriculum activities that foster germane cognitive load through schema-based learning.

Conclusions

Especially for surface approach learners it may be important to provide structured guidance and provide a clear alignment of course content in a blended-learning curriculum, even in higher education. Deep and structured approach learners also benefit from a clear course structure that keeps extraneous cognitive load low and fosters schema acquisition.

Keywords

learning approach; cognitive load theory; undergraduate medical education; family medicine

Hintergrund

In dieser Studie wird die Rolle der vorgegebenen Kursstruktur für Studierende beleuchtet. Die Studie ist eingebettet in das neue Blended-learning-Lehrkonzept der Allgemeinmedizin an der Universität des Saarlandes. Es wurde insbesondere auf die Bedeutung der einzelnen Strukturelemente für die unterschiedlichen Lernansätze (Tiefen-, strukturierter und oberflächlicher Lerner) der Studierenden eingegangen.

Methoden

Diese Studie basiert auf einem Mixed-methods-Ansatz. Der Lernansatz von Medizinstudierenden des fünften Jahres (N = 84) wurde von einer gekürzten Version des ASSIST-Fragebogens erfasst und zu den Leistungen im Staatsexamen und der Allgemeinmedizinklausur korreliert. Von den 38 gezielt nach Lernansatz und Alter eingeladenen Studierenden nahmen jeweils sieben an den zwei semistrukturierten Interviews teil.

Ergebnisse

Der oberflächliche Lernansatz korrelierte schwach mit schlechterer Leistung im 1. Staatsexamen ($\rho = 0,231$), aber nicht mit schlechterer Leistung in der Allgemeinmedizinklausur. Die qualitativen Ergebnisse deuten darauf hin, dass das strukturelle Design eines Curriculums zur Zufriedenheit und Lernmotivation der Studierenden beitragen kann. Die Reduktion der extrinsischen kognitiven Belastung konnte als motivierender Faktor identifiziert werden. Tiefenlerner hoben die positiven Effekte von Curriculum-Aspekten, die die lernbezogene kognitive Belastung durch Schemata-Akquise fördern, hervor.

Schlussfolgerungen

Vor allem für oberflächliche Lerner scheint es, bezogen auf ihre akademische Leistung, von Vorteil zu sein, Lernstruktur, auch in der universitären Lehre, vorgegeben zu bekommen. Tiefen- und strukturierte Lerner scheinen ebenfalls von einer klaren Kursstruktur, die die extrinsische kognitive Belastung reduziert und die lernbezogene kognitive Belastung durch Schemata-Akquise fördert, zu profitieren.

Schlüsselwörter

Studentischer Lernansatz; Theorie der kognitiven Belastung beim Lernen; Medizinstudium; Allgemeinmedizin

Background

Family medicine (FM) education is a good example for the importance of continuously independent lifelong learning and knowledge expansion. In higher education, it is known that introducing self-directed learning can promote lifelong learning [1]. Self-directed learning expects students to organize their learning structure independently [1]. Studies show that this does not always work well for every individual [2]. Some students find it hard to keep up with the curricular learning progress in times of restricted on-site learning activities [2]. Today's teachers may wonder how to best provide structure and curricular guidance that is helpful for everyone when full time on-site learning may no longer be possible. It is known that online learning requires a higher sense of responsibility in learners [3].

The process of self-organization and creating one's own learning structure can be described as a new, additional cognitive load. The Cognitive Load Theory (CLT) calls this extraneous load (EL), as this load is generated by the arrangement of the subject or content. Whereas the intrinsic-load (IL) arises from the complexity of the subject itself [4]. The third form of cognitive-load, the germane-load (GL) is generated by the effort that is needed to mentally grasp and understand the learning material. According to CLT the human cognitive capacity is limited. It is therefore important to keep EL as low as possible to guarantee increased capacity to deal with GL, which is needed for schema acquisition and effective learning [5].

Tait and Entwistle differentiate between three main studying approaches: the deep, strategic and surface approach [6, 7]. Deep learning is characterized by personal engagement and by trying to get a deep understanding of the field of study [8]. Deep learners relate old knowledge to new one, proceed logically and critically in their learning and are able to apply their knowledge easily [7]. Students with this approach usually perform high [7]. Strategic learning describes highly organized studying with a focus on

time management and academic achievement [7]. Strategic learners are very flexible: If they have enough time, they will use a deep approach as the appropriate tool, if time is short it is likely that strategic learners adopt a more superficial approach, depending on time and exam format [7]. The surface approach is characterized by superficial learning and often accompanied by a struggle to find purpose in the field of study [8]. Students with this approach often learn notes off by heart, with little reflection. They often perform less well [7]. Surface approach learners often do not aim for a deep understanding of the topic, but the completion of the learning tasks without going beyond the minimum requirements [7]. This brief explanation is a broad generalization, but most educators may recognize these different learning styles from their own teaching experience.

In October 2020, a competency-based blended-learning curriculum in FM was implemented at Saarland University (UdS), Germany. It provides students with a learning structure and a clear alignment between on-site and online activities. The curriculum's overarching learning objective is to develop procedural skills to manage a patient in a FM practice: from clinical presentation, clinical assessment, diagnostics to clinical follow-up or referral. Successively, during the semester, students learn the management of three typical FM associated health problems (modules), namely abdominal pain, febrile infection and back pain. Theoretical content is provided on the curriculum's homepage (<https://amuh.amboss.com/amuh.html>). The provided cognitive content deals with different diseases and symptoms that are important in each module. It contains links to accompanying AMBOSS®-articles (digital medical reference site which is widely used by German medical students). Every link is accompanied by brief FM specialist-commentaries that clarify the relevance of the content for FM practice. Besides the cognitive content, the website provides digital formative assessment opportunities, eg. writing a prescription or multiple-choice as-

sessments, based on a State Exam database (IMPP, the German institute for medical and pharmaceutical exam questions). At the end of every theoretical block, students simulate a patients' workup in a FM practice with simulated patients in class.

To date, several studies have related learning style to performance in education. However, it is unclear to what extent the provision of structure helps to maintain learning progress and performance improvement within a blended-learning curriculum in FM [9–12].

This study aims to find out more about students with different learning styles and their relation to performance in the blended-learning curriculum in FM at UdS. This study intends to qualitatively explore the attitude towards different structural elements for different students' learning approaches.

Methods

Study Design and Data collection

A concurrent mixed-methods approach was used with quantitative and qualitative results influencing each other regarding sampling and specific data analyses. The Approaches and Study Skills Inventory for Students (ASSIST) was developed to measure the level of expression of the three main studying approaches in students [6, 7]. Nine single validated items of the second section of ASSIST (three sections: A: conceptions of learning, B: approaches to studying, C: preferences for different types of learning and teaching) were used to quantitatively assess the different learning styles [8]. This section, also called RASI, revised approaches to studying inventory, which is often used on its own, has four subscales for the each of the approaches strategic and surface and five subscales for the deep approach [8]. Each subscale consists of four items. In total, there are 52 items. Internal consistency data (Cronbach's α) of the main approaches are displayed in table 1. Validity was confirmed by Byrne et al. through factor analysis on data from Irish and US-students [8, 13].

Item number ASSIST	Item	subscale	approach	Cronbach's α
49	It's important for me to be able to follow the argument, or to see the reason behind things.	Use of evidence	deep approach	0.618
52	I sometimes get 'hooked' on academic topics and feel I would like to keep on studying them.	Interest in ideas		
43	Before tackling a problem or assignment, I first try to work out what lies behind it.	Seeking meaning		
31	I work steadily through the term or semester, rather than leave it all until the last minute.	Time management	strategic approach	0.548
10	It's important to me to feel that I'm doing as well as I really can on the courses here.	Achieving		
41	I keep an eye open for what lecturers seem to think is important and concentrate on that.	Alertness to assessment demands		
3	Often, I find myself wondering whether the work I am doing here is really worthwhile.	Lack of purpose	surface approach	0.616
32	I'm not really sure what's important in lectures, so I try to get down all I can.	Unrelated memorising		
8	Often, I feel I'm drowning in the sheer amount of material we're having to cope with.	Fear of failure		

Table 1 Items used, their original item number in the ASSIST survey and their Cronbach's α (by approach)

All ASSIST-items were translated into German and adjusted from a five point (as proposed by Entwistle, McCune and Tait) to a seven-point Likert scale (1 = does not correspond at all, 7 = corresponds exactly) [8]. For each approach a score between 3 and 21 can be reached. The higher the score, the higher the expression of the learning approach for the participant. For purposive sampling, a simplified allocation strategy was developed, as we did not have sufficient data for quantitative allocation strategies (e.g.: cluster analysis). Participants were allocated to one approach when their score in one approach was above 12.5 points and at least two points above the other two approaches. Interview sampling is displayed in figure 1. Sociodemographic data and self-reported performance were collected. Performance was assessed by self-reported grades in the first state board exam (multiple choice-based exam after 2 years of medical studies in Germany) ranging from 1 = very good to 4 = sufficient and participants' score in the year 5 FM exam at UdS (multiple choice exam, maximum of 60 points).

Based on purposive sampling, 38 prospective participants were invited

via e-mail for one of two qualitative group interviews. Sampling criteria were based on learning approach and age. The aim was to include two participants of each learning style, one

participant above 25 years and one participant under 25 years in each of the two group interviews. For each interview, participants of each learning approach and age range were in-

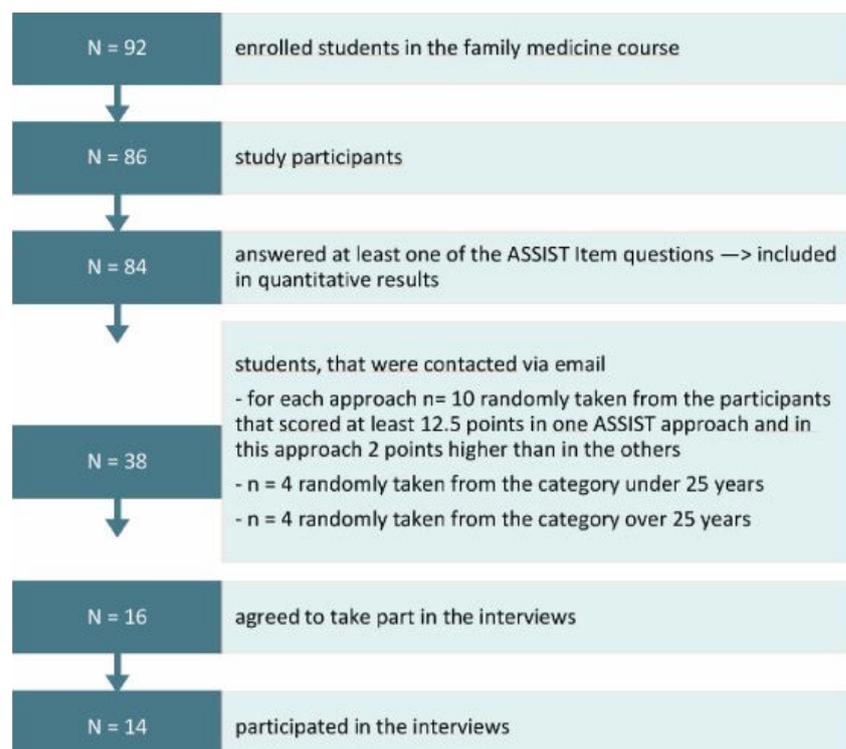


Figure 1 Flow chart describing the sampling of interview participants

cluded based on a first-come, first-served basis. Based on a semi-structured interview guide, designed by CB, a focus was set on identifying motivational aspects in the FM curriculum. The interviews took place online on Dec 18th, 2020, and Jan 7th, 2021, using Zoom®. In the first interview, seven interviewees joined the conference, one of the under 25 years old students missed the event. In the second interview, only one student from the subgroup surface approach learners joined the online interview. Consequently, seven participants were interviewed in each interview. Interviews were held by CB and AS as a co-moderator. All participants verbally agreed to the videorecording of the interviews. A short summary was presented by the co-moderator and interviewees had the possibility to correct misunderstandings (first member checking).

Participants and Setting

Study participants were medical students in their fifth academic year that took part in the compulsory FM curriculum at UdS in winter semester 2020/21 (N = 92). Students who consented digitally to study-participation as well as data processing and storage were included (N = 86).

Data Analysis

Quantitative analyses were performed using Jamovi (Version 1.6). Cronbach's α was calculated for internal validity of the study approaches deep, strategic and surface. Descriptive analyses included mean, median, standard deviation and interquartile range. Shapiro-Wilk-test was used to check for normal distribution of all analyzed continuous variables. Associations between the deep, strategic and surface approach and between learning approaches and performance were investigated using either Pearson's correlation or for non-parametric and ordinal variables (for example grades) Spearman's correlation (table 2). For all analyses, the significance level was set at $p \leq 0.05$.

The qualitative interviews were transcribed verbatim, followed by a content analysis [14]. In a first step, analysis was done inductively by CB

		grade in 1 st state exam	Score in family medicine exam
Deep approach	Spearman's rho:	-0.139	0.017
Strategic approach	Spearman's rho:	-0.295**	0.273*
Surface approach	Spearman's rho:	0.231*	0.072

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; State exam grade range 1: best, 4: passed; (grades 5,6: [not passed] were not reported, as students were successfully enrolled in year 5, where pass-grades are a prerequisite), score in family medicine exam: (0–60 points)

Table 2 Spearman's rho correlation coefficients of performance parameters (State exam and FM exam) and students' learning approaches

using a line-by-line, open-coding strategy. Within two investigator-triangulation coding-sessions, course structure was identified as an unexpected important category by all three researchers (CB, AS, FD). This led to the hypothesis that course structure plays an important role in the learning process of students. Consequently, interviews were coded again deductively by CB with a focus on the category curricular structure. Following the analysis, results were again presented to two of the participants to re-evaluate their correctness (second member checking).

Results

Quantitative Results

In this study N = 84 medical students participated. 60.7 % were female and 39.3 % male. Their mean age was $26.2 \pm SD 4.5$ years.

The median for grades in the state board exam was 3.00 (IQR: 1.5). Out of a maximum score of 60, student's median score in the FM assessment was 53 (IQR: 5.0). Students' mean ASSIST score in the deep approach was $15.0 \pm SD 2.85$, in the strategic approach $13.7 \pm SD 3.46$ and in the surface approach $12.4 \pm SD 3.61$.

The deep and strategic approach correlated positively ($\rho = 0.271$). Surface approach learning correlated with lower performance in the first state exam ($\rho = 0.231$). Surface approach learning did not correlate with lower performance in the FM exam ($\rho = 0.072$). Strategic learning correlated weakly with better performance in the first state exam and higher scores in the FM exam ($\rho = -0.295$; $\rho = 0.273$).

Qualitative Results

Out of 14 students participating in the interviews, five were male and nine were female. Structural curricular elements seemed to have a high impact on students' satisfaction and motivation when studying.

The role of structural elements in curriculum design

The interviewees voiced four important curricular elements that are important for their learning progress:

1. Interdisciplinary uniform course infrastructure
2. Clear structure within the course
3. Focus on relevant topics for exam and clinical life
4. Imparting knowledge via process- and schema-based learning

1. Interdisciplinary uniform course infrastructure

Participants complained about the inconsistency of course infrastructure between different subjects. One participant said: *'Some [subjects] provide their information via [Microsoft] Teams, others via their own website or via the LSF [platform]. (...) This makes it incredibly complicated for students to stay on top of things and it would be helpful if they could all use the same platform.'* (Transcript, interview 1, pos.107)

2. Clear structure within the course

Concerning the internal organization of one course, students all highlighted the flexibility within blended-learning curricula as an important benefit. Time- and location-independent media such as podcasts were highly appreciated by participants. At the same time, live events were seen

as a helpful external rhythmization during the learning process. One interviewee said: *'(...) I always study at the last minute, so for me it is better to have some live events (...). Because you have fixed dates.'* (Interview 2, transcript, pos.66). Participants highlighted the allocation of topics into three modules (abdominal pain, febrile infection and backpain) and their adjacent subtopics. One participant explained, why she finds learning in stages motivating: *'(...) in contrast to other courses, it [the FM content] is not endless, with endless information. (...). And it is an incredible relief to know, I just finished with something. I think, this provides a lot of motivation.'* (Interview 2, transcript, pos. 124).

3. Focus on relevant topics for exam and clinical life

Students expressed their wish to focus their learning on relevant topics for clinical life as well as exam preparation. Students ascribe a lower priority to rare diseases when it comes to course learning outcome selection. One participant stated: *'(...) when you learn for different subjects, you can get lost in all these rare disease patterns (...). And then, I think you forget a lot of basics (...) and that's why I am happy to have the FM course (...) where you really focus on one disease pattern (...)'* (Interview 2, transcript, pos.29). Another student added: *'it shouldn't be ok that you see the exam and think: "oh, I did not expect this!"'* (interview 1, transcript, pos. 251)

4. Imparting process- and schema-based learning

One statement showed the impact that the promotion of schema-based learning has on students' learning experience: *'when we had to manage the patient [in the simulation], I realized, that it needs more than just the clinical knowledge.'* (Interview 1, transcript, pos.47). One student claimed that he misses this way of whole task- and schema-based learning when using AMBOSS®: *'I think it is hard to learn how to proceed in a real-life situation when you only have a diagnostic guide and the things on the learning cards.'* (Interview 2, transcript, pos.49) The same student stated what he liked



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about the clinical traineeship: *'(...) sitting next to a professional who has gone through the procedure a hundred times and meanwhile you say to yourself: What would be my next step? (...)'* (Interview 2, transcript, pos.56). Both comments originate from deep-approach learners.

Discussion

Quantitative results reveal that surface approach learning is correlated with lower performance in state-exams. At the same time, surface approach learning is not correlated with lower performance in the FM exam, while still using state exam questions. This may suggest that there may be elements in the FM curriculum that might support surface approach learners in their learning. The qualitative results reveal that providing structure plays an important role for learning. All learning approaches favoured a reduction of the EL through a structured curriculum design. Deep-learning students highlighted the positive effects of curriculum activities that foster GL through schema-based learning for example during simulation-seminars.

Structural elements in family medicine education

In self-directed learning, students choose their learning goals individually, develop learning strategies and choose their learning material [1]. This technique has benefits, especially for lifelong learning. However, it might not be largely appli-

cable in any university-context, due to the preset learning structure finalizing in formal assessment. Within a curriculum, learning objectives, learning activities and assessments need to be constructively aligned within any subject, but also on a macro-curricular level. We assume that curricular structure and the external rhythm might be especially important for deep learners, who may spend more time on details. At the same time, the provision of structure and external rhythm appears to also appeal to surface approach learners, with a lack of focus, as it enforces a more steady learning progress in these learners. All student-types in the interviews favored a clear structural outline and logic constructive alignment of the curriculum. This might be due to the common, overarching goal of succeeding in the exam after the preset study period predefined by the semester. For that reason, the results of this study do not allow to show a connection between structural elements of the curriculum and a student's individual performance. Other publications have shown that providing structure can offer help to be more successful in learning [15].

Based on other qualitative results, future FM education should consider to consciously foster students' learning progress [16]. This paper shows that constructive alignment and the provision of curricular structure may be important when wanting to reduce the mental effort required by students to follow a newly designed curriculum. Aspects like actively measuring task fidelity, task complexity and usage of instructional support may be used to help evaluate the workload necessary for individual learning activities [16]. Key points that this paper suggests to consider in future FM curriculum design are flexibility in learning and external rhythmization. It also suggests a meaningful allocation of topics and a clear constructive alignment of relevant topics based on exam relevance and clinical life. For some of our participants, schema-based learning occurs naturally during a clinical traineeship (Interview 2, transcript, pos. 56). We suggest, an undergraduate

FM curriculum needs to actively incorporate activities that encourage schema-based learning. From literature it is already known that even for deep-learners schema-based [concept] learning is more likely to take place, if it is part of the curricular structure [8].

Limitations

CLT as a key concept in instructional design may be seen critically from a methodological point of view, since the fundamental assumptions may not be applied nor tested independently in practice. Studies show that using CLT as a framework for instructional design is effective in improving student's performance [17]. Learning approaches were assessed by a shortened, translated version of the ASSIST questionnaire. Cronbach's α were lower than in other publications, where the full ASSIST questionnaire was used [8]. Feasible questionnaire reading times were favoured in order to optimize study participation and collect at least minimum information about learning approaches from a larger cohort. In this study, some students were not clearly allocated to one single study approach. These participants were not invited for qualitative interviews. For simplicity, learning approaches were seen as static in this study. However, students may change their learning approach due to especially motivating, or less inspiring learning activities. Future studies may want to reevaluate their learning approach allocation over time.

A major part of the FM exam originated from the state-exam pool with comparable item-difficulty levels to the state exam. Therefore, it was assumed that differences in performance were not due to varying difficulty levels or different types of questions. Based on our qualitative findings, curricular, structural elements may be a possible explanation for an overall better performance especially of the surface learner cohort.

Conclusions

This study provides some evidence that providing curricular structure and fostering schema-based learning

may be beneficial for all learning types. For all learners, the key element of a curriculum is a well-designed course structure, based on constructive alignment with a focus on exam content and clinical relevance. During times of increased online learning or during blended-learning curricula, the need to provide structural elements, may be especially important for future FM curriculum designers.

Ethics approval

Ethics approval was obtained by Saarland medical association ethics committee on 25.09.2020 (Bu234/20) prior to the initiation of the study.

Disclosure of interest

The authors declare that they received financial and structural support by AMBOSS®, the Medical Faculty of Saarland University and the Kassenärztliche Vereinigung Saarland. The department of family medicine Homburg has cooperation agreements with AMBOSS® and the IMPP as external parties. No external party had any influence on study design, data collection, analysis, or publication procedures.

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