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Open-book tests assessed

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Introduction

*“The open book examinations have not, hitherto, been generally accepted as a feasible method of examining in the public examinations, but there are no clear reasons, given that such examinations are carefully designed, and their advantages and disadvantages fully understood, why they could not be introduced on a wider basis”.*¹

This statement, made in the 1980s, is still valid 30 years later: to date, a closed-book test/exam is the most commonly used and accepted test format. In this thesis some of the advantages and disadvantages of open-book tests are analysed, since we feel that this type of assessment is particularly appropriate to today’s society and educational environment. At present, (medical) education has to deal with two important trends: a body of knowledge that is growing and changing faster than ever, and the increasing need to concentrate education on competences – the integration of knowledge, skills and attitudes. Open-book tests might be the format that best suits these developments.

Knowledge growth

At the AMEE conference in August 2007, Paul Glasziou indicated that an individual would need to study for about 30 years to gain knowledge of all of the known diseases of that time.² This means that it is impossible for medical students, who generally follow a six-year curriculum, to master all of the knowledge in the field by heart. Moreover, by the time they may have done so, this knowledge would have further expanded or changed in content. This is the situation that medical curricula, medical students and all medical professionals have to face: a huge body of knowledge that is constantly changing and growing.^{2,3} These circumstances also apply to other academic and professional fields.^{4,5} Spetz indicated that knowledge in the fields of history and the social sciences is doubling every ten years,⁶ and Meijer found that managers are also confronted with more information than they are able to process.⁷ The same problem occurs in the fields of engineering⁸ and economics.⁹

The increasing flood of information is something all academic fields and, therefore, all curricula have to manage. Rather than the way students recall many

factual details, the way they handle this extending body of knowledge is becoming increasingly important.^{5,10} However, there is still knowledge that must be known by heart. Smith suggested that teachers should make a list of those facts that would be known accurately by 90 out of 100 practicing physicians off the top of their heads. Only knowledge of these facts should be assessed using a closed-book test and such tests taken relatively infrequently.¹⁰ In the Bachelor's programme of the Groningen medical curriculum we have implemented a similar approach. The total body of knowledge has been divided into core and backup knowledge. Core knowledge is that which must be known by heart and backup knowledge is the total amount of knowledge students must be able to manage. Students have to find the right information at the right moment and apply this information properly.

Generic learning outcomes

In addition to the fact that universities have to manage a growing and changing amount of knowledge, organizations and employers increasingly look for employees who have a variety of skills and attributes, alongside discipline-specific knowledge and skills.¹¹ Therefore, learning outcomes are more often formulated as competences – integrating knowledge, skills and attitudes. In particular, so-called generic learning outcomes are discussed – comprising knowledge, skills and attitudes of university graduates beyond disciplinary content – which are applicable to a range of contexts.¹²

During the last decade much attention has been paid to generic learning outcomes,^{11,12} and as a result of the Bologna Declaration, European educational systems are in the process of reform. This process also raises the discussion about the comparability of curricula in terms of structures, programmes and teaching. To facilitate reform and assist faculties in this process, the Tuning project was started, its main goal being to 'understand curricula and to make them comparable'.¹³ The project has developed an approach which intends to design or redesign, develop, implement, evaluate and enhance programmes. One of the subject areas is generic competences or 'transferable skills'. The Tuning project distinguished three types of generic competences: *instrumental*, *interpersonal* and *systemic competences* and

defined 30 competences. Table 1 shows the three types of competences and provides examples of each.

Table 1. Generic competences as distinguished by the Tuning project

Type of generic competence	Examples
Instrumental	Capacity for analysis and synthesis; Capacity for organization and planning; Information management skills; Problem-solving; Decision-making
Interpersonal	Critical and self-critical abilities; Interpersonal skills; Ability to work in an interdisciplinary team; Teamwork; Ethical commitment
Systemic	Capacity to learn; Capacity to generate new ideas; Will to succeed; Concern for quality; Leadership

It is known that for successful learning it is important that the learning objectives, programme and assessment are consistent and congruent.¹⁴ It is also known that in particular assessment drives students' learning behaviours and, consequently, study success.¹⁵⁻¹⁷ If the assessment does not represent the learning objectives, these learning objectives will not be met since students focus most on what is required to pass the assessment.

The frequently used closed-book tests are suitable to assess the knowledge students must know by heart: core knowledge. Students must be able to recall this knowledge without consulting reference sources. However, open-book tests seem more suitable to assess students' ability to manage backup knowledge. Through the use of open-book tests it is possible to assess students' ability to find the right information at the right moment and apply this information properly. The focus is not on knowledge recall, but on using the knowledge to solve problems. This competence seems to fit the *instrumental* generic learning outcomes better than the ability assessed by closed-book tests. In addition, by using open-book tests alongside closed-book tests it might be possible to assess and include a broader body of knowledge than when only using closed-book tests.

Open-book tests

Generally, open-book tests allow students to use reference sources under test conditions. They are carried out in several ways.¹⁸⁻²⁰ Overall, open-book tests can differ on five variables: type of items, taxonomy of thought, reference sources permitted, timed or with no time limit, and in-class or take-home.

First, as in closed-book tests, the *types of items* used in open-book tests vary from selected-response to open-ended questions. For open-book tests the latter format is most commonly used, but with numbers of students above 300 this could become unfeasible. Moreover, objectivity might be a problem. Both multiple-choice and open-ended questions can be used to assess different outcome levels.¹⁵

The second variable is *taxonomy of thought*. Items which require the reproduction of facts are not suitable for open-book tests because answers can simply be copied from the texts permitted as reference sources. Items that assess comprehension and application are more suitable.^{20,21} These items can also be part of closed-book tests but if memorization is not the primary goal, open-book tests may be more suitable.¹⁰ Bouman and Riechelman compared essay questions from closed and open-book tests using two classifications: content (from factual to conceptual) and performance (knowing, using and applying).^{22,23} Two assessors scored the questions from four closed-book tests and four open-book tests. Two of the open-book tests received the highest rating for the assessment of conceptual knowledge. Bouman and Riechelman concluded that open-book tests provide the opportunity to stimulate deeper understanding and assess this.

Third, open-book tests may permit the use of *different kinds of resources*. In some cases, students are free to choose which reference sources they take with them. Baillie and Toohey described an examination during which students were allowed to use any material they want and in addition to discuss the questions with each other.²⁴ The underlying idea was that they could speak freely with their peers as they would with colleagues in professional practice. During other open-book tests, students may only refer to their own notes, which could improve note-taking and active listening during lectures.²⁵ Sometimes the number of books allowed as reference sources during the tests is limited to ensure all students use

the same resources to answer the questions and do not take excessive resources to the test room.

Fourth, open-book tests can be used *with or without a time limit*. Sometimes an examination without time limit is used to reduce unrealistic time constraints, but it appears that in such cases students spend a considerable amount of time on the test.^{1,25,26} Without a time limit some students remained in the test room for up to eight hours, much longer than necessary.²⁴ Boniface observed volunteer students during an open-book test and examined their use of time.²⁶ The total time was divided into time spent on writing, consulting notes, consulting texts and other behaviour. He concluded that the time spent on consulting notes and texts was negatively related to the test score. This result was confirmed by other studies.^{27,28} Francis found that some students consulted their books too often and relied on them too heavily during the test.¹ Tussing therefore recommended that a time limit be ascertained that identifies students who have not prepared properly.¹⁸ However, the optimal time to answer open-book questions has not yet been determined.

Finally, which reference sources students are allowed to consult and whether the test time is limited or not also depends on where the examination takes place. An open-book test can be *in-class or take-home*. The disadvantages of take-home tests include the problem of authorship and that they can encourage cheating. However, after comparing the answers of paired students, Weber et al. concluded that cheating does not appear to be a greater problem for take-home tests than it is for those held in class.²⁹

Advantages and disadvantages

Several studies have revealed that students have a preference for open-book tests.^{24,30-36} The students indicated that open-book tests offered an opportunity to apply the knowledge they had gained during the course in a creative manner, and that they were more able to demonstrate a true understanding of the material.^{25,33,34,37} In addition, open-book tests seem to represent the professional setting better than closed-book tests, because students have full access to their

references to find answers to the questions and solutions for the given problems, just as they would in practice.^{6,15,22-24,37,38} An individual student may be highly interested in a certain field of study and, consequently, be able to answer questions in this domain easily, whereas the same student may need some backup knowledge to answer questions about topics that are beyond his/her field of expertise (which reflects real life). Students also indicated that they experience less stress before and during an open-book test.^{18,25,30-34,37,38} Open-book tests reduce the need for cramming and the memorization of factual material.^{39,30,37} Finally, the use of open-book tests can reduce the problem of disagreement between teachers about the level of detail of questions students should be able to answer.

Smith, Feller and Cain all argued in favour of open-book tests because they expected them to encourage higher-order thinking and deeper learning approaches.^{10,38,39} A deep learning approach seems more likely because students are able to study by reading and thinking rather than reading and memorizing. However, there is scarce empirical data to support these expectations: only one study has closely examined the level of preparation by students for closed and open-book tests.⁴⁰ The researchers asked students of a programme in the field of education to score a questionnaire twice, once about open-book tests and once about closed-book tests. According to the results, students who prepared for an open-book test tended to apply higher-order thinking and study the course material in-depth. When they prepared for a closed-book test they applied surface learning and memorized information. However, the participants in this study were undergraduates whose assessment programmes did not regularly use open-book tests. Moreover, the students were to become educationalists and therefore were specifically interested in education and learning. Consequently, these results might be difficult to generalize to a medical setting, especially in conditions where open-book tests are a regular part of the assessment programme.

The literature also reveals that there are some disadvantages to open-book assessment. Despite all of the expectations that open-book tests would encourage a deep learning approach, evidence suggests that students spend less time preparing for open-book than for closed-book tests,^{19,26,27,33} and that they seem to

underestimate the need for preparation.^{27,37} Furthermore, it appears that teachers prefer not to use open-book tests. A study by Ben-Chaim and Zoller showed that teachers preferred the assessment format with which they were familiar – closed-book tests – rather than the format that better reflected learning objectives and was preferred by the students – open-book tests.³⁴ Open-book tests are considered to be easier than closed-book tests.^{22,23,27} Such phrases as: ‘Students only need to look in their books and no longer need to internalize concepts...’ or ‘We do not want students who can only look up facts...’, are often heard.

This summary of the literature shows that open-book tests have been the subject of research and some advantages and disadvantages have already been determined. As research revealed, students prefer open-book tests to closed-book tests, experience less examination stress during open-book tests and use less time to prepare for open-book tests, but require more time to complete the test. However, the optimal open-book test time and the relationship between open-book tests, learning behaviour and test results have not yet been examined. In addition to the empirical findings, most studies of open-book tests express certain expectations, for example that open-book tests stimulate deep learning and are easier than closed-book tests. There is little published research showing that open-book tests do, in fact, stimulate the use of a deeper learning strategy, and we have not found studies focusing on the relationship between deep learning and open-book test results. Moreover, the influence of open-book tests on retention and long-term success has also not yet been examined. Besides, in the few studies on open-book tests we found, the participating students were usually exposed to a single open-book test and had little or no experience with this kind of test.

Outline of the thesis

In our opinion, open-book tests can be a very useful assessment format to handle the growing amount and constantly changing content of knowledge. Additionally, these tests seem to be appropriate to learning goals formulated in terms of competences. More information about these tests and their influence on and

relationship with other variables, such as student behaviour, is required if we are to improve and optimize the use of open-book tests in medical programmes. Therefore, this thesis focuses on the use of open-book tests in an undergraduate programme in medicine. This thesis is based on separately published articles and therefore some repetition is inevitable.

In **Chapter 2** the use of open-book tests alongside closed-book tests is discussed, addressing the question: Why should open-book tests be implemented? Furthermore, the results of our study of open and closed-book tests are analysed. We investigated 1) whether the often-heard expectation that open-book tests are easier than closed-book tests is true, 2) whether there are differences in the reliability of open and closed-book tests, and 3) the relationship between open and closed-book test scores. Do students who performed best on closed-book tests suddenly perform worse on open-book tests?

Chapter 3 focuses on the influence of open-book tests on learning behaviour. As mentioned above, there are high expectations of a positive influence of open-book tests on the level of deep learning. These expectations inspired us to investigate whether students do, in fact, use a deeper learning approach when preparing for an open-book test than when preparing for a closed-book test.

Chapter 4 elaborates on the relationship between deep learning and open-book tests. We examined whether a deep learning approach or the students' personal preference to process information in general – need for cognition – influenced test results. LISREL was used to examine the relationships between deep learning, preparation time, the need for cognition, and open and closed-book test scores.

Several previous studies revealed that students underestimate the time and effort needed to prepare for open-book tests. This finding inspired us to investigate this possible disadvantage of open-book tests described in **Chapter 5**. We examined whether students who prepared thoroughly for an open-book test needed less test time than students who did not. Furthermore, the influence of preparation for an open and a closed-book test were examined in a quasi-experimental study. We investigated how students performed on questions they

expected to be assessed on in an open-book test but which were actually part of a closed-book test and vice versa.

Chapter 6 deals with the retention of backup knowledge in the long term. Students' long-term performance was assessed using progress tests. On the basis of progress test results, we examined the influence of the problem-based learning approach and open-book tests on long-term performance. The short and long-term performance of students participating in three different curricula was compared. These curricula differed in instructional approach (problem-based or traditional) and assessment format (only closed-book tests or a combination of closed and open-book tests).

Chapter 7 provides a general discussion of the findings of this thesis, considering the questions why we should and why we should not (solely) use open-book tests in all (medical) curricula. Our findings are synthesized and recommendations for future research are provided.

English and Dutch summaries are also provided at the end of the thesis.

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