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Use of Reading Logs in the Flipped Classroom

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Abstract

For a successful implementation of the inverted classroom format, it is important that students come to the classroom sessions well prepared. This includes, above all, a reflective engagement with the course content and materials. To support this process, we have tested the use of Reading Logs, sometimes referred to as Learning Assessment Journals, in several courses. The Reading Logs are designed to guide students to reflective engagement with the new content by asking leading questions. This, combined with ideas of Just-In-Time Teaching, has led to much more effective use of face-to-face time. An evaluation in two courses of the physics teaching degree program also showed that the students were significantly more motivated and satisfied despite the (supposed) additional work.

Für eine erfolgreiche Anwendung des Inverted Classroom Formats ist es wichtig, dass die Studierenden gut vorbereitet zu den Präsenzterminen erscheinen. Hierzu zählt vor allem eine reflektierte Beschäftigung mit den vorzubereitenden Inhalten und Materialien. Zur Unterstützung dieses Prozesses haben wir in verschiedenen Lehrveranstaltungen den Einsatz von Reading Logs (Logbücher), manchmal auch als Learning Assessment Journals bezeichnet, getestet. Die Logbücher sollen die Studierenden durch Leitfragen zu einem reflektierten Umgang mit den neuen Inhalten anleiteten. Dies hat, in Kombination mit Ideen des Just-In-Time Teaching, zu einer deutlich effektiveren Nutzung der Präsenzzeiten geführt. Eine Evaluation in zwei Veranstaltungen des Physik-Lehramtsstudienganges hat darüber hinaus ergeben, dass die Studierenden trotz der (vermeintlich) zusätzlichen Arbeit deutlich motivierter und zufriedener waren.

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1. Introduction

In response to the teaching challenges posed by the Corona pandemic, many teachers have made their first experiences with the "flipped classroom" format and have come to appreciate its advantages. In contrast to the classic lecture, in the flipped classroom the students are responsible for learning new content outside of class time. For this purpose, course materials (e.g. lecture notes or videos) are made available in advance. The in-person class time is then used to clarify comprehension problems and to deepen the understanding through exercises, discussions, etc. The students are significantly responsible for their own learning.

The flipped classroom has numerous advantages over the traditional lecture format. It shifts the focus away from the teacher to the learners. The learners are flexible in their timing and can determine individually the learning pace. However, the format can also harbor dangers that should be countered with appropriate measures. In particular, it is important to ensure that students reflect on the content to be learned. This initial reflection on content is a basic prerequisite for a sensible use of the classroom times.

In this paper we want to introduce the concept of the Reading Log [1,2], sometimes also called Learning Assessment Journal, which we have tested and evaluated in numerous courses of the physics teaching program at the University of Cologne [3]. In the process, a possible influence on learning motivation was also investigated in more detail.

2. Flipped Classroom

In the traditional form of teaching, there are usually two phases that alternate regularly. In the first phase, the content is taught or developed; in the second phase, the content is deepened through exercises, discussions or further research. The content is usually taught by the teacher or the lecturer in the form of prepared teaching formats in person. In the university context, this means that the content of a lecture is conveyed by the lecturer. Subsequently, the content is deepened independently by means of provided exercises or learning quizzes. The second phase is therefore an individual learning phase in which the students are independently responsible for their consolidation of learning, regardless of place and time (cf. [4], p. 4).

In the Flipped Classroom model, however, the activities are reversed. The 1st phase is used for individual concept transfer and concept development, in which the students acquire the new material individually through their own work ([5], p. 46). The content and media with which the students deal depends on the teacher. The teacher must prepare the materials accordingly and make them available. In addition, the role of the teacher changes. He or she is no longer merely a person who imparts knowledge, but a contact person, advisor and learning helper (cf. [5], p. 46). It should be noted, however, that there should not be a reduction in in-person classtime. Therefore, the self-learning and presence phases must be well coordinated [5]. The in-person classtime can then be used - under the guidance of the teacher - for discussions, reflections and problem-based learning [6]. However, the model is not a completely new method, but has been used in its basic features for a long time. By using modern media, however, it is possible to apply and use this approach in a completely new way (cf. [7], p. 19). A main goal of the inverted classroom model is to increase the effectiveness of the in-person class [7]. Fig. 1 summarizes the essential idea of the inverted classroom concept in a compact way.

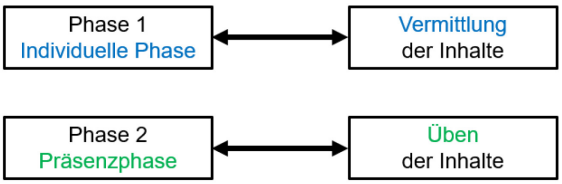


Fig. 1: Structure of the Inverted Classroom format (after [4])

There are some essential requirements for the successful implementation of the in-person classroom phase. These should of course be prepared as well as possible in the individual phase. To this end, a reflective engagement

with the new content is essential. It should become clear to the students in the individual phase to discover which open questions and problems still exist and at which points there is still a need for clarification. In addition, the barriers to address problems in the presence part should be as low as possible.

An obvious idea for checking acquired understanding is quiz questions, e.g. in an online quiz. While this allows for immediate feedback, especially in a multiple-choice format, it usually tests factual knowledge rather than understanding or interconnectedness of knowledge. Alternatives, such as homework that is then handed in and graded, contradict the basic idea of the Flipped Classroom format.

Typical problems that can occur in the individual phase relate, for example, to accomodating and classifying the new information, which is imperative for a deeper understanding. In addition, questions that arise cannot be answered immediately. One possible solution to this is discussion forums, which can be set up in many online learning environments. However, many years of experience have unfortunately shown that practically no use is made of this option. It can be assumed that the lack of anonymity in these forums plays an important role here and social pressure from students reading along is avoided, which can arise even with anonymized contributions.

3. Reading Logs

To increase the motivation and quality of preparation, we have used reading logs in various courses. These contain concrete work instructions for the students in the form of guiding questions that are to be answered briefly. The reading log is intended to guide students to a structured engagement with the material to be prepared and to encourage them to reflect on what they have learned. They also offer the possibility of direct individual contact with the lecturers without having to expose themselves to the risk of social pressure.

The reading logs had to be edited and handed in weekly for the respective content to be prepared. This was done by uploading a pdf file in the learning platform Ilias (Integrated Learning, Information and Work Cooperation System) [8]. For this purpose, students were provided with a template in pdf and doc format to allow for the most flexible form of editing. Most students used the pdf format for submission, in which the answers were inserted using the comment function. Handwritten completion of a printed template and submission of a scanned version was also possible in order to keep the technical effort for the students as low as possible.

The timing of a tasking cycle typically looks like this:

- Students will be informed about 10 days before the corresponding attendance date which part of the course reader or textbook has to be prepared.
- You will then typically have 7 days to complete the associated reading log and upload it to the Ilias electronic learning platform.
- The uploaded logbooks are then reviewed and commented on by the lecturers. The feedback is also made available to the students via Ilias in good time before the in-person class session.

The weekly submission of the reading logs is mandatory in order to motivate the students to deal with the course contents on a regular basis. An extension of the deadline is possible in justified cases.

The reading logs give the lecturer the opportunity to identify problems and to take this into account in the design of the in-person phase (see section 5). Feedback BEFORE the in-person phase has been shown in the evaluation to be an important factor for acceptance and motivation (see section 6). However, it is not limited to criticism and answering questions, but also includes praise, e.g. for particularly successful summaries.

4. Structure of the Reading Log

The form of reading log used goes back to D. MacIsaac [2], which in turn builds on preliminary work in [1]. The reading log was adapted accordingly for use in teaching at German universities. Unlike the original template, which

was two-sided to fit on a sheet of paper, the reading log used consists of 4 pages. This change is due to the format with an online submission. The students should have enough space to upload their handwritten texts in a legible form. However, the content of the reading log is largely identical to the two-page template.

As already emphasized, the reading log should help the students to reflect on the contents to be worked on. It is therefore important to ensure that, for example, the course material provided is not only looked at once superficially, but that it is worked through as many times as possible - ideally from different perspectives. This is to be achieved by answering guiding questions.

The reading logs consist of three parts. The first part is for assignment purposes only. Here, the name of the student and the chapter of the lecture worked on are requested. The other two parts are titled *"Notes after first reading"* and *"After second reading"* (Fig. 2). As described earlier, they are intended to ensure that students work through the material multiple times.

.

Logbuch Festkörperphysik

Name: Datum:

Kapitel der Vorlesung:

Notizen nach dem ersten Lesen

Zeit, die zum ersten Lesen benötigt wurde: _____ **Minuten**

Inhalt

*Notieren Sie hier wichtige Themenkomplexe, Größen, Beispiele, Illustrationen etc., die Ihnen beim ersten Lesen aufgefallen sind!! **Fassen Sie sich kurz und formulieren Sie möglichst selbstständig!***

Modifizierte Version nach Dan MacIsaac (Buffalo) und D.K. Apple (Learning Assessment Journal)

Fig. 2: First page of the reading log for the course "Solid State Physics".

First, a part of the lecture notes/textbooks is to be read and the essential topic concepts are to be summarized briefly. The work instruction for this is "Write down *here important complexes of topics, quantities, examples, illustrations, etc., which struck you during the first reading!!! Be brief and formulate as independently as possible!*" This answer can be in the form of keywords, graphs or similar and should not be longer than half a page (Fig. 2). The restriction to "important" topics should encourage the students to structure the new content to a certain extent. The request for "independent" formulations should help to avoid simple cut-and-paste from the lecture notes/textbooks.

On the second page (Fig. 3), the essential new terms and their definitions are then recorded in a glossary. The work instruction is "*Write down important new terms, quantities, etc. and their definitions here!*" The glossary can thus be used later as a kind of reference book.

To promote reflection, students are then to formulate a maximum of three open-ended questions ("Note here questions and problems that arose after the first reading! These questions are to be kept in mind during the second reading and/or discussed in the course!"), which came up during the first reading and to which special attention is to be paid in the second reading.

Glossar

Notieren Sie hier wichtige neue Begriffe, Größen etc. und ihre Definitionen!

Begriff, Größe,...: **Definition, Beschreibung,...:**

Offene Fragen

Notieren Sie hier Fragen und Probleme, die nach dem ersten Lesen aufgekommen sind! Diese Fragen sollen beim zweiten Lesen im Auge behalten und/oder in der Veranstaltung diskutiert werden!

1.

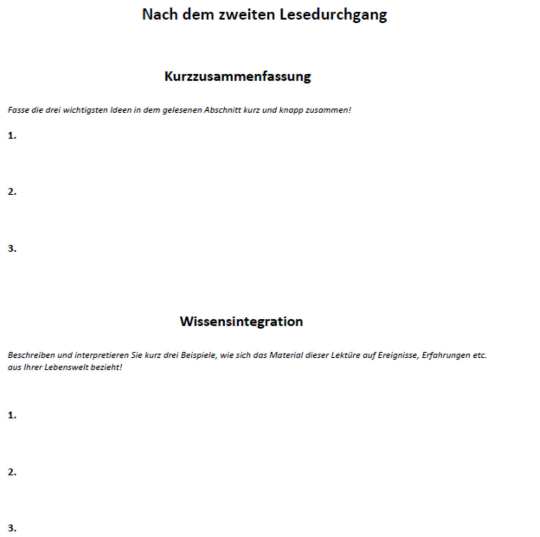
2.

3.

Fig. 3: *Second page of the reading log for the course "Solid State Physics".*

After the second reading, the most important new ideas, concepts, etc. are summarized in a few words (*"Summarize the three most important ideas in the section* you *have read!"*) (see Fig. 4). The restriction to a maximum of three aspects is intended to stimulate further reflection on the content. Another important point is knowledge integration, in which cross-connections are to be made to already known phenomena or examples from everyday life *("Briefly describe and interpret three examples of how the material in this reading relates to events, experiences, etc. from your real life!").* The new content here should be linked to familiar content, ideally from the students' real life.

By asking the question *"What new interpretations and insights of the essential physics concepts you listed at the beginning have emerged after rereading? Discuss this briefly!"* the learning process itself can be reflected upon (Fig. 5). This aspect is especially important for prospective teachers.



Nach dem zweiten Lesedurchgang

Kurzzusammenfassung

Fasse die drei wichtigsten Ideen in dem gelesenen Abschnitt kurz und knapp zusammen!

1.

2.

3.

Wissensintegration

Beschreiben und interpretieren Sie kurz drei Beispiele, wie sich das Material dieser Lektüre auf Ereignisse, Erfahrungen etc. aus Ihrer Lebenswelt bezieht!

1.

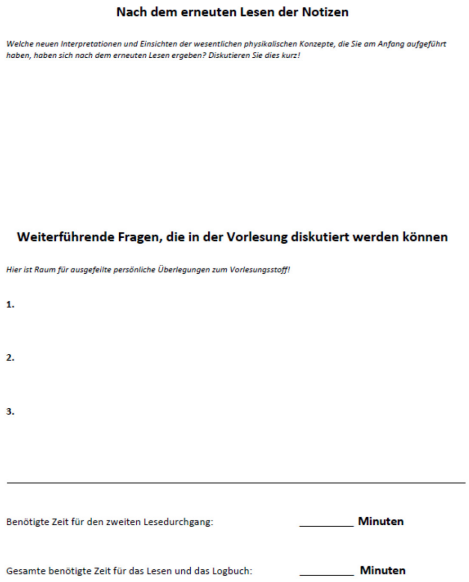
2.

3.

Fig. 4: Third page of the reading log for the course "Solid State Physics".

Finally, there is the possibility to ask further questions to be discussed during the in-person classtime. In addition, the completion time is recorded, for the second run and the total time including the creation of the reading log. The indication of the completion time is intended to help the students primarily in their reflection, e.g.to assess for themselves whether they have dealt sufficiently with the material. This is also communicated at the beginning of the course. In addition, the information provided by the teacher helps students to assess which topics are considered difficult and whether the amount of material was appropriate. This was also explained to the students at the beginning of the course when the reading log was presented.

Students receive individual feedback on the completed reading logs before the classroom session. By submitting them early, the lecturers have enough time to prepare the discussion of problems that have arisen during the in-person class time in the sense of just-in-time teaching (section 5).



Nach dem erneuten Lesen der Notizen

Welche neuen Interpretationen und Einsichten der wesentlichen physikalischen Konzepte, die Sie am Anfang aufgeführt haben, haben sich nach dem erneuten Lesen ergeben? Diskutieren Sie dies kurz!

Weiterführende Fragen, die in der Vorlesung diskutiert werden können

Hier ist Raum für ausgefeilte persönliche Überlegungen zum Vorlesungsstoff!

1.

2.

3.

Benötigte Zeit für den zweiten Lesedurchgang: _____ **Minuten**

Gesamte benötigte Zeit für das Lesen und das Logbuch: _____ **Minuten**

Fig. 5: Fourth page of the reading log for the course "Solid State Physics".

5. Just-in-Time Teaching

An invaluable advantage of Reading Logs is the possibility of Just-in-Time teaching [9]. This refers to the dynamic adaptation of the content in the face-to-face part to the needs of the students. The online quizzes and reading logs help to identify problems and deficits. From the summaries in the reading logs, it can be seen whether the students have recognized and understood the essential aspects of the new material. If this is not the case, it can be addressed in the in-person class.

The item *"Further questions"* from the reading log provide important clues to problems or points of interest. In contrast to open formats (such as lectures), comprehension questions are often asked here and a lack of prior knowledge is addressed. This can then be specifically addressed, which is particularly important with a relatively heterogeneous group of students (see section 6).

For the application of Just-in-Time-Teaching it is crucial that the students submit the reading logs early enough before the face-to-face session . Only in this way do the lecturers still have enough time to adjust the planning for the face-to-face sessions. As a rule, an interval of 2 days is sufficient if there is already a basic concept for the in-presence lecture preparation to which only adjustments would need to be made.

The just-in-time concept helps to keep the attention of the students high in the in-person classtime, because one can avoid the repetition of trivialities or over-complex contents. The face-to-face time can thus be used more effectively.

6. Evaluation

The concept was tested and evaluated in several courses within the framework of the teacher training program in physics. The results are very promising, both from the point of view of the lecturers and the students. Students came to the face-to-face sessions significantly better prepared. At the same time, they found the increased autonomy in developing the new content to be positive.

The evaluation of two physics lecture courses took place towards the end of the summer semester 2021 in the course of a master thesis [3]. In this thesis, the influence of the reading logs on the motivation of the students regarding the contents of the lecture course was investigated. One lecture course was on atomic physics and the other on relativity theory. The lecture course on atomic physics is a compulsory course for the bachelor students of the teaching profession secondary school (HRG) in the subject physics, whereas the lecture on relativity theory is attended by students with a major in physics (in the teaching profession secondary school, HRG or special education) as well as bachelor students who study another natural science and can choose this lecture as a supplementary module. For atomic physics, this results in a homogeneous population, while relativity has a rather heterogeneous population in terms of prior knowledge and interest in physics. This poses special problems for the teacher, since the different prior knowledge must first be diagnosed and then compensated. For this purpose, reading logs appeared to be an ideal tool.

In both courses, students were provided with lecture notes. These were originally created for a traditional course. They contain an elaborated presentation of the material analogous to a classic textbook. A special revision for use in the inverted classroom scenario did not take place (initially). Further materials were not needed or mentioned in the lecture notes (e.g. links to simulations). The lecture notes are about 100 pages long. With 13-15 class sessions per semester, each reading log has a typical amount of material of 6-8 pages per week to be analyzed.

For both courses, according to the module regulations, 30h contact time and 60h self-study are scheduled. Since there was no further homework besides the reading log, the students could spend about 4h per week on content preparation and the reading log. According to the students' statements on the actual time spent in the reading logs, this was almost always less than 4h.

The number of participants in the courses was about 20-25 students. The review of the reading logs was solely in the hands of the teacher, who thus had to review 40-50 reading logs per week. During the test phase, however, it seemed important for the teacher to keep a complete overview. The workload was high, especially at the beginning of the semester (about a full workday), but the workload was reduced significantly after both students and teacher gained more experience with the format. For example, student responses became much more concise and questions and naming of problems more precise. This resulted in significantly less time spent providing feedback.

For the evaluation, anonymous surveys were conducted in both lectures towards the end of

the semester, asking for an initial personal assessment of the usefulness of the Reading Logs. From these surveys, people were then randomly selected and requested for interviews[1]. In the lecture Atomic Physics only one person agreed to be interviewed, in the lecture Relativity nine, of which four persons were interviewed. The interviews were problem-oriented, guided interviews [3], which were conducted individually via video call and transcribed afterwards. The focus of the interview was on the students' personal thoughts and emotions, which allowed conclusions to be drawn about their motivation regarding the processing of the readeing logs and participation in the face-to-face sessions.

The subsequent theory-based analysis of the interviews was conducted using qualitative content analysis according to Mayring [10]. The categories necessary for analysis are taken from the Self-determination theory according to Deci & Ryan [11], according to which the type and degree of learning motivation can be positively influenced by a learning environment that fulfills the need for autonomy, experience of competence and social belonging.

The results of the analysis in [3] suggest that students experience themselves as more motivated and competent by working through the reading logs before the face-to-face session than in previously attended lectures. According to the students, autonomy in editing, timely feedback from the instructor, which is perceived as appreciation towards the students' work, and better understanding due to intensive engagement with the content played a major role. Participation during in-person sessions was higher, and at the same time the dropout rate was lower than in comparable lectures. Overall, it could be shown that the use of the Reading Logs had a positive influence on the motivation and learning growth of the students.

7. Outlook

Reading logs have proven to be very useful tools in the flipped classroom format. When implemented consistently, both students and instructors reap the benefits.

These consist first of all in better preparation for the in-person phase, which can therefore be used more effectively. The reflective interaction with the content to be prepared not only helps students to articulate their problems more clearly, but also to ask deeper questions that can serve as a basis for further discussions. On the other hand, lecturers can diagnose typical problems early on and plan the in-person phase accordingly. Here it helps that the reading logs offer a low-threshold opportunity for comprehension questions due to their relative anonymity, without building up social pressure from other students.

As shown in an evaluation, despite initial skepticism (" make work"), students have found reading logs to be a valuable tool. The high level of acceptance among students has contributed to the reading logs being worked on regularly and well. It has also been shown that the concept works not only in conjunction with a handed-out lecture notes, but just as well with pre-recorded lecture videos in a fully digital setting.

The problems that have arisen mainly concern the synchronization of the various steps in terms of time (creation of the reading logs, correction, and in-person sessions). Here it is important to avoid time pressure for the students and the lecturers and at the same time not to let the time between the processing of the lecture notes, creation and submission of the reading logs, its correction with feedback and the associated in-person session become too large. A weekly course often leaves only 2-3 days for each phase. Time pressure on the students sometimes leads to less reflective interaction, in which the reading logs were generally created by cut-and-paste of content from the lecture notes.

Another problem is the question of scaling. Our experience with the concept is mainly based on events with a maximum of 30 participants. For larger courses, it is important that the tutors, who are responsible for providing

[1] The lecturer of the course did not participate in the interviews.

feedback to the students, also inform the lecturer exactly about the problems that have occurred so that the in-person session can be planned accordingly. This is an additional step in the cycle that takes additional timeTherefore, the students should be given the opportunity to deal with the content flexibly in terms of time by announcing the respective tasks early on.

One problem that should not be underestimated is the lecture materials provided for the individual phase. These are often not optimized for self-study, since, for example, already existing lecture notes intended for traditional lectures are used. Here, care should be taken to ensure that the materials are adapted for use in an inverted classroom scenario.

Acknowledgement

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Literature

[1] D.K. Apple, S. Caroll, S. Beyerlein: The Learning Assessment Journal as a Tool for Structured Reflection in Process Education (1996) https://doi.org/10.1109/FIE.1996.569969

[2] D. MacIsaac, D. Abbott, K. Falconer, D. Henry: Promoting physics student reflection via Reading Logs and Learning Commentaries. http://physicsed.buffalostate.edu /pubs/AAPTmtgs/.

[3] D. Abrams: Evaluation of the Use of Reading Logs as a Method of Inverted Classroom, Master's Thesis, University of Cologne (2021).

[4] A.M. Schäfer: The Inverted Classroom Model. In J. Handke, A. Sperl, & German ICM Conference (Eds.), The inverted classroom model: Companion volume to the first German ICM conference (pp. 3-11). Oldenbourg (2012)

[5] K. Zickwolf, S. Kauffeld: Inverted Classroom. In S. Kauffeld & J. Othmer (Eds.), Handbook of innovative teaching (pp. 45-51). Springer (2019)

[6] K. Morisse: Inverted classroom in higher education teaching - opportunities, barriers and success factors. In J. Handke, A. Sperl, & German ICM Conference (Eds.), The inverted classroom model: Companion volume to the first German ICM conference (pp. 17-28). Oldenbourg (2012).

[7] A. Sams: The "Flipped" Classroom. In J. Handke & A. Sperl (Eds.), & J. Handke (Trans.), The inverted classroom model: Companion volume to the first German ICM conference (pp. 13-23). Oldenbourg (2012)

[8] https://www.ilias.de

[9] R. Kellner, S. Stanzel: Reading before instead of reading aloud. Physics Journal 21(7), 35 (2022)

[10] P. Mayring,: Qualitative content analysis: basics and techniques (12th, revised ed.). Beltz. (2015)

[11] E.L. Deci, R.M. Ryan: The self-determination theory of motivation and its relevance to pedagogy. S. 223-238 (1993)