# ATLAS – A Three-Layer Action Structure

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**Abstract.** ATLAS is a platform-independent combination of a general course/course material structure and a blend of techniques for analysis/synthesis of course content, writing/delivery of content and conversion of a collection of traditional content elements to e-learning material. It has proved its worth in the construction of 12 courses.

**Keywords:** e-learning · Learning Objects · Content Structure · One-Man Team · Templates · Design Patterns · Productivity Enhancement

## 1 The Structure – and What It is

What is here called ATLAS is a conceptual structure, useful for top-down analysis of existing teaching material of a substantial volume – typically an entire 5 ECTS points course or a 2½ ECTS points course part – as well as for the top-down analysis of a still-to-be-created course in the early phase of its implementation, be it as e-learning or in a conventional format. In fact, one function of ATLAS is to reduce the time and effort required to convert from the latter to the former, provided that the requirements of the structure have been observed throughout the development phase. As such, ATLAS is an intermediate between a template and a *design pattern*. Note, therefore, that ATLAS is ***not*** a software tool or structure but a mental aid.

A first, rather simplistic, visualization of ATLAS would be something like Fig. 1 with the three layers – 1) search or overview, 2) presentation, and 3) operation – shown as collections of teaching material (rounded boxes). The action paths, which in practice are either passive references or active hyperlinks, are shown as dashed lines and arrows, respectively. If this were all, the story could end here, and no one would be any wiser; but with each layer and the relations between them come observations, dos and don'ts, and decisions regarding their realizations which together define or at least strongly influence the quality of the teaching material. Their description will – gradually, one shouldn't expect revelations – make it clear why ATLAS is useful.


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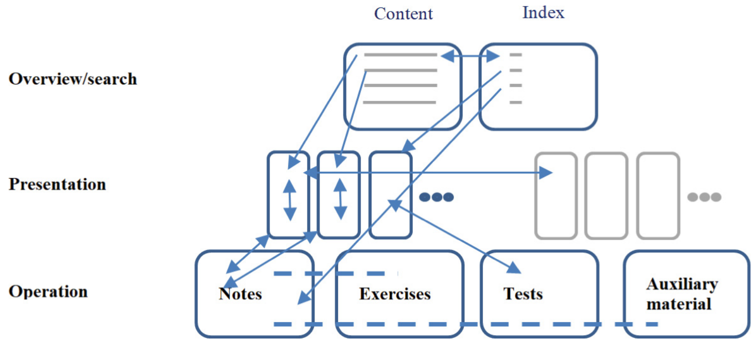


**Fig. 1.** Three layers, the components and the "action paths", primarily indicating connections available for navigation. See main text for explanations

## 2 Quick Overview of Some Recent Literature on Educational ICT

It is a relatively safe bet that e-learning is here to stay. It is, however, an equally safe bet that individual instances of e-learning have a limited durability. The same holds for tools of the trade: Authoring systems come and go, LMSs come and go, standards come and go, even phenomena as widely defined and as widespread as MOOCs tend to change to the point where what you thought you knew is suddenly obsolete or at the least inadequate and incomplete, relative to the everchanging picture.

A full review of the literature is out of the question here – and the present author not the right person to provide it, anyhow. Yet, these rather pessimistic claims can to some extent be justified: Various entries in Wikipedia (e.g., [23, 24]) tell the meandering story of the excellent Flash® software *versus* the fate of the SCORM standard. (There was also the Danish alternative to SCORM, called RUMLO, which seems to have been stillborn, although you can in fact download the report from [12]). As for the "death and resurrection" of MOOCs, see [30]. LMSs proliferate, but the demise of FOKUS, which the present author managed for a part of its lifetime [14] is probably typical of many such systems.

A few words about the more recent literature may help to clarify the author's need for the simplest possible solution to a very real problem:

The various elements of e-learning are discussed by Spector in [32], ch. 3 of [26]. Together with the list of skills required of an e-learning development team presented in [5] and briefly discussed in Sect. 3, Spector's observations help underlining the complexity of the subject. We shall return to this, and for now only keep in mind his remark:

> …the task of designing, developing, and deploying effective instruction has become ever more challenging…

The nature and scope of the challenges can be gleaned from the opening lines of [33]:

> Smart education requires design, development, implementation and active use of innovative systems, technologies, teaching and learning strategies and approaches

> that are based on various data sources in academia, modern mathematical methods in data statistics and data analytics, and state-of-the-art data-driven approaches and technologies.

The two books [34] and [35] edited by Uskov and his co-workers provide an up-to-date survey of the degree to which this requirement has been met.

An excellent summary of the historical development of e-learning is given by Heidkamp and Kergel in [21], ch. 4 of [27]. They emphasise three stages, marked respectively by 1) The introduction of the LMS (Learning Management System); 2) The shift from teaching to learning and the introduction of various forms of the PLE (Personal Learning Environment) together with multi-media, various versions of virtual or augmented reality, etc.; and 3) The amalgamation of these and other developments into a full-fledged digitalization of teaching and learning in higher education. They are quite clear about one aspect of this third phase:

> Most of the innovative E-Learning 2.0 concepts are realized via external fundings and possess thus only the temporary character of a project.

The reader may also want to consult ch. 1 of Dabbagh [7], which tells a related story but with focus on pedagogy, rather than technology. A special element of ICT in Teaching and Learning is 'gamification'. A typical statement occurs in the conclusion of Daling et al. [8], ch. 10 of [11], see also Fan et al. [9], ch. 10 of [4]:

> Most of the time, teaching materials are not motivating for the students to acquire. Therefore, taking a look at the computer game industry is a good choice as it manages to keep people on their chairs for hours and days (Prensky 2003).

The reference is not to Prensky's book but to his short paper [31], where we find:

> Sadly, our "digital immigrant" teachers know so little about the digital world of their charges…
>
> …there is a place where motivation itself is the expertise, and is, in fact the sine qua non – the $30 billion worldwide computer and video games industry…

The present author, old enough to have written Fortran programs on punched cards, is no 'immigrant'. The second statement explains why academic teaching cannot compete with the game industry: We do not have that kind of money. Still, gamification is worth considering. So is the use of VR (Virtual Reality) and AR (Augmented Reality), although some of the same difficulties arise. Kljun et al. ([29], ch. 1 of [11]) express this as follows:

> Despite the substantial body of work and positive reported outcomes of AR (Augmented Reality) usage for education, researchers claim that compared to other digital technologies such as multimedia and web services for teaching and learning, research in AR is still at an early stage, with the majority of studies being short-term, one-time experiments with high variability in the effect size.

Likewise, Wolf in [38] (ch. 2 of the same volume) concludes:

> AR technology is becoming more and more widespread and should therefore also be incorporated into the curriculum [of] contemporary learning activities. The actual integration of current AR-based tools into educational contexts, however, requires high technical and organizational efforts and skills both on the part of the students and the lecturers.

Returning to Kljun et al. (op. Cit.)

> …among 1000 K-12 educators in the USA only 2% used VR in their classrooms and a 2018 survey of 115 educators revealed that the adoption of VR and AR technologies is hindered by the lack of resources to buy appropriate hardware and software and the lack of training…

Other ICT elements – which are more affordable, but still require skills and a fair amount of time – are multimedia [6]. Still, Dabbagh et al. [7] quote van Eck [36] who underlines the need for a careful analysis of the strengths and weaknesses of the media, as well as its alignment with instructional strategies, methods, and learning outcomes.

In the follow-up [37], van Eck feels the need to stress that.

> The truth is that DGBL is simply not appropriate for all outcomes, all learners, all the time. There remains a place—even a need—for lectures and workbooks.

(DGBL is Digital Game-Based Learning). The list could continue, but the above must suffice. The message is clear: Advanced ICT requires special skills, a significant investment of time and labour – and money. The solitary academic author must say, with Chuck Norris in *The Expendables* 2:

> “I work alone”.

especially when given three weeks to design and then begin teaching, while writing material for, a new course or an update of an older one (“…because you are the most experienced…”). The quest was therefore for a tool that would:

- Allow (fairly) rapid development of teaching material in a format very close to that of the conventional book-lecture-exercises setup
- Engender (if not demand) a project-management-like systematization of the work in progress
- Divide the functions of the material into groups (that eventually became layers and components) with clearly separated purposes
- Allow simultaneous work on elements from essentially all groups/layers; *and*
- Allow this work to take place alternately with the actual teaching, delivery being just-in-time
- Allow (but not demand) the systematic use of templates at all levels. In particular:
- Allow the use of whichever selection of authoring tools considered most suitable for each type of element
- Allow an eventual conversion of the collection of elements into a genuine e-learning course

The result, ATLAS, meets these demands. The only requirements placed on the authoring tools is that they allow hyperlinking and that multimedia etc. does not disturb or overrule the divisions into layers and components.

The following is a discussion of some of the details of the above points. A handful of courses will be described briefly, ending with what would have been the ultimate proof of concept, had not time and circumstances prevented the author from adding the mesh of hyperlinks. *Sic transit Gloria Mundi…*

## 3 The Demands of e-learning

In the fine little pamphlet *E-learning 101* [5], Janet Clarey lists the members of a typical e-learning design team:

1. Instructional designer
2. Subject matter expert
3. Graphics artist/Designer
4. Writer/Editor
5. Course developer/Designer
6. Project manager

and briefly discusses the skills and experience each of these must possess. (Clarey, writing in the early 2000s, assumes that delivery will be by World Wide Web and therefore stresses mastery of HTML, probably not so important in 2022). Clarey also offers estimates of how many hours of work it takes to produce 1 h of teaching material in various e-learning formats, the lowest ratio being 32:1.

The solitary academic teacher-author cannot hope to match the list of requirements or to obtain permission to spend 32 h or more to create 1 h worth of teaching material. A total of 12 courses have been created using ever more refined versions of ATLAS, some of them including parts of existing material in a first iteration or otherwise deviating slightly from the ideal course of action, thus adding the demand for a certain flexibility. Without the final addition of hyperlinks, the estimated ratio has been around 8:1, and it is doubtful that this can be significantly improved.

### 3.1 The Author's Background

The choices made in the realization of ATLAS are consequences of the author's zig-zag path through the development of ICT-supported teaching. I hold an M.Sc. Eng. And a Ph.D. in mathematics, and thus feel comfortable teaching mathematics and not-too-distant subjects such as elementary physics or statistics. Also, I hold a diploma (roughly equivalent to a B.Sc.) in Project Management and the Danish *Pædagogikum* required for teaching upper secondary classes, which I did for 3½ years. I founded and for 13 years taught a course in Graphical Communication at my *Alma Mater*, the Technical University of Denmark, (DTU) and I have written more than 5000 pages of instructional material at levels from the 10$^{th}$ grade to M.Sc. Courses.

My earliest work (around 1990) with ICT in teaching consisted in the creation of a course in computer graphics programming (complete with basic interaction) using

IBM 3270 terminals [22] connected to a mainframe computer. These were replaced with Silicon Graphics workstations; but the course was discontinued.

DTU acquired an LMS and I got involved with development focusing on *learning objects*, nowadays called *content objects*, see [13, 24]. Some of the templates, as well as the ‘project-management-like systematization’ answering the demands on the list can be found in this work. Furthermore, certain pedagogical ideas that grew out of this development [13] have survived and been used *with* ATLAS but have perhaps been less influential in its design.

My contributions to VR, made in the days of the re-discovery of 3-D, are described in [16, 17]. Personally, I have used them in the production of exhibitions only, as circumstances stood in the way of their intended application in teaching. I left DTU in 2003 to take up the responsibility for the operation and development of an LMS, FOKUS [14]. There was a sufficient budget for this, but not for the development of two e-learning courses planned for it. I did, however, create a low-budget mathematics course (see below) that could be downloaded from FOKUS. This experience has had a definite influence on the design of ATLAS.

Next, I joined an IT company and implemented a wiki-based CSCW (Computer Supported Collaborative Work) system for company-internal use, see [19]. This was modelled on the generic LMS described in [1] but was mainly used for file exchange and maintenance of work progress ckecklists. Together with the company’s information engineer, I also created an ever-growing library of instructional videos showing senior staff explaining work processes. Owing to limitations on server capacity and bandwidth these could not be streamed from the wiki, but this was a definite wish for the near future. During this period, I also experimented with modes of delivery of instruction [17] and sketched and extension of PLEs that I called *Personal Bildung Environments*, see [20], the German word “Bildung” having no direct equivalent in English. (It denotes the combined effect of factual learning and personality development).

Back in the world of teaching, first in a full-time job in a *gymnasium* (secondary school), I continued my work on small stand-alone e-learning units, one of them in fact a genuine miniature game, complete with lanes and narratives. This became quite popular with the pupils, but my conclusion was that it required too much work to bear repetition. But I returned to DTU in 2014 and began distilling ATLAS from the experience thus gathered.

## 4 Storyboarding with ATLAS?

One last aspect of designing a university course, with or without ATLAS, deserves to be addressed separately:

The *storyboard*, apparently developed by Disney as an entry tool to be applied in the early phases of creating a cartoon movie [3, 25], has become widely popular with creators of other media presentations, including – it seems – developers of e-learning.

The conventional storyboard is “horizontal” and usually not only one-dimensional but with the topology of a line. Most textbooks discussing university-level disciplines have asides and optional extras, essentially maintaining the one-dimensionality but moving beyond the line topology.

ATLAS being first and foremost top-down has an upside-down tree-like (or brushwood-like) primary structure with internal, possibly circular, paths in each element and *in principle* horizontal storylines across the presentation and operational levels. Especially at the presentation level, actual hyperlinking *between* elements is not recommended as this tends to create what may be called "knots", confusing and hard to untie. As for interactive links at the operational level between the (equivalents of) notes and exercises, the author is still undecided, see below.

At any rate: Instead of a story board you may wish to create a *graph*, the nodes representing a presentation or operation, the arcs a hyperlink move. If you happen to have, and feel comfortable with, a good *folding editor*, outlining the pure tree or brushwood structure can be done in minutes and is strongly recommended.

## 5 Working with and Within ATLAS

The following is probably obvious by now: To work within ATLAS you need at least *one* authoring tool – and you will most likely prefer to use different ones for each type of component. These authoring tools need to have the ability to store in a digital format and to create both the anchor and target end of a hyperlink.

As a rule, you will begin by creating – or at least outlining – layer 1, **the overview**. It is recommended that you analyse the material in its entirety, until this outline states titles or other identifiers of all *Unit Content Objects* about to be created. A "unit content object" can be thought of as a nugget of information small enough to be grasped as a whole and large enough to stand alone. The author has analysed around a dozen courses in this way and found that for a 5 ECTS point university course the resulting number is around 100, for a one-year upper secondary mathematics course slightly higher, say, 130–150 such "objects". One can then *compose* the course from these objects and therefore from the outset create a template suitable for (almost) all of them and then start writing in a fill-in-the-blanks fashion, yet still have the necessary freedom to create variety and a living, breathing "narrative". See [15] for some considerations of this particular way of creating teaching material. The first version of the overview will most likely be a table containing the identifiers, such as a title and possibly a picture or an icon, of all 100+ objects, see the example below. This can be thought of as the **content** description. The dual part of the overview, the interactive version of the index, cannot realistically be added before everything else is finished. Also, it is less suitable for graphical embellishments.

It is worth emphasizing: Writing and re-writing the content table and thereby going through and refining the analyses of the objects-to-be and their relations is a very important part of the work with ATLAS. In the author's experience, the few but necessary changes made to this part in the early stage mitigates much agonizing later.

As for **the presentation layer**, the present author has had to make a virtue of a necessity: I suffer from MS and have for the last 10 or so years been unable to walk around and stand writing on a blackboard. I have therefore had to commit everything I would otherwise have drawn or written to PowerPoints, lecturing seated, laser pointer in hand. I can only say: My PowerPoints are ***not*** – as in ***not at all*** – bulleted lists, but highly structured texts with illustrations and links to notes and exercises, see below.

The user arrives at a PowerPoint presentation by clicking on its title in the overview. The PowerPoints are condensed versions of the Notes elements, i.e., each gathers three content objects on nine slides, adding an introductory "splash" and a brief final example. They are thus structured texts, they have internal navigation, and are from the outset prepared for the final addition of hyperlinks. They are also prepared for a cloning: A shadow version with "speak" – short, spoken explanations of a third of each slide at a time plus a summary of the slide is added, once everything else is ready. Per PowerPoint this adds another with four times as many slides + recordings of explanations and is by far the most time-consuming part of working with and within ATLAS. Luckily, this addition is not strictly necessary for the successful, more conventional, use of the material prepared for the three layers.

A healthy, agile teacher-author will most likely choose an entirely different way of implementing the presentation layer. The choice of format is immaterial, as long as the content object structure and availability of hyperlinks is maintained. Also, the use of templates is still strongly recommended, as it has proved time saving. In fact, the "three short paragraphs on each of three slides" was inspired by the task of rewriting the entire IPMA list of project management skills [10] into 150 of 21-line summaries structured as the *one-minute speeches* of Khan-Panni [28].

Again: An important aspect of ATLAS is that the presentation layer should strike a balance between being on the one hand a bridge between the overview and the operational layer, on the other the theatrical stage where the teacher-author displays his/her virtuosity.

The **operational layer** is in many ways the most conventional. Nonetheless, work on it should not commence until the analysis described above is finished (apart from the minor changes inspired or necessitated by subsequent work) but *can* take place before, during or after the creation of the presentation layer, as long as the hyperlink structure is not ruined (which it can in fact be before as much as one hyperlink is actually added). The author prefers to keep the "notes" part and the "exercises" part separated, at first only linked by a clear numbering, but this may vary according to the subject matter, the tools used, and the delivery platform. Thus, many Problem Solving Environments are really programming tools and should be kept apart from the notes part, while many modern CAS-tools are genuine word processors with algebraic computation facilities and can thus completely amalgamate notes and exercises.

The author prefers to expose the learner to three distinct views of each nugget of learning: In a presentation, in a far more elaborate note section, and in an exercise. This increases the amount of work necessary to build the course material, yes, but it also gives the students three different views on each subject – provided, of course, that the teacher-author can vary his/her exposition. We shall consider that a given. (Some students may declare themselves confused – you just can't win…). Further variation can be added in the lecture and/or the above-mentioned "speak",

So: ATLAS encourages multiple accounts of each of the content units; and with a suitable design of the templates, the learner may be brought to an understanding of what to expect from each type of exposition and perhaps finds his/her favourite or a preferred order in which to approach these variants.

## 6 Examples (and an *Iota* of the History of ATLAS)

To round off the description of ATLAS let us briefly look at some examples, the earliest from work that helped forming and refining the ideas described above.

The period 1988–2003 was, in retrospect, one of experimentation. The work on *content objects* is described in Sect. 3.1 above. More important, though, was the experience of the productivity enhancement gained from the use of well-designed *templates*.

The mathematics course mentioned in Sect. 3.1 course covers Danish *Gymnasium* level C ($10^{th}$ grade); and work on the design (Fig. 2) clearly influenced what was to follow:

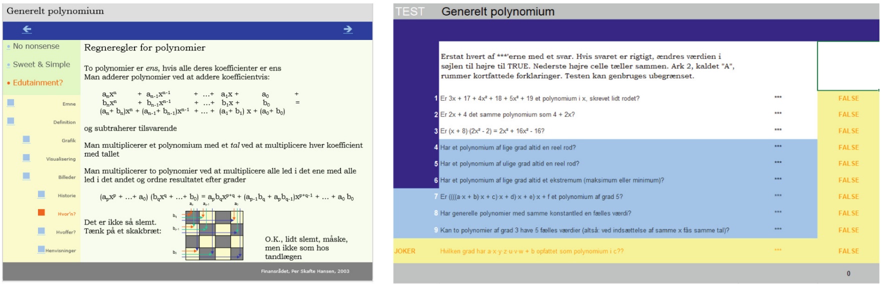


**Fig. 2.** Left: A page from the (e-learning) presentation of aspects of a mathematical subject. Right: An interactive test, allowing the student to judge his or her understanding of the subject

The course consisted of 26 presentations, each with a 10-question test. The presentations (example shown to the left) were delivered as PowerPoints with internal navigation – the column to the left and the two arrows underneath the title bar – and displayed a mixture of text, formulas, and illustrations. The tests (example shown to the right) were delivered as MS® Excel® spreadsheet and rarely went beyond the functionality of multiple choices. The examples clearly display most of the elements described as crucial for the ATLAS presentation and operational level, respectively, even though the test is rudimentary, compared to what was to follow. Also, the 26 units were identified by the process described in Sect. 5 above. The delivery format, a packet of pairwise connected PowerPoints and Excel sheet, was chosen, as it made production fast and cheap. Hyperlinks connecting the two were not added, although doing so would have been straightforward.

Incidentally, when asked to produce a course intended as a support of what might be called HRD, addressing the same group of learners, the author began by designing the interface and outlining various operational pages, this time solely in Excel (Fig. 3):

The graphics is now more daring, and a wider range of Excel's functionality is evoked. As the (internal) customer received the estimate from a company that was approached and given the same specifications, the entire project floundered as the price was considered too stiff. —

With the CSCW and the course described in Sect. 3.1, certain concepts now integrated into the ATLAS presentation layer took shape. Also, the Unit Content Object analysis technique was refined, as was the use of graphics in presentations (Fig. 4):

To the left is the overview as seen on the intranet, to the right an example taken from a large-scale experiment with images as the dominant element in presentations. (The latter is documented in [18]. The technique works only with a live presentation or a PowerPoint with embedded "speak").


**Fig. 3.** Left: The "splash" page of an intended e-learning course presentation allowing the student to enter personal preferences etc. Right: An experimental page, this one revealing the wondrous world of reverse polish notation.

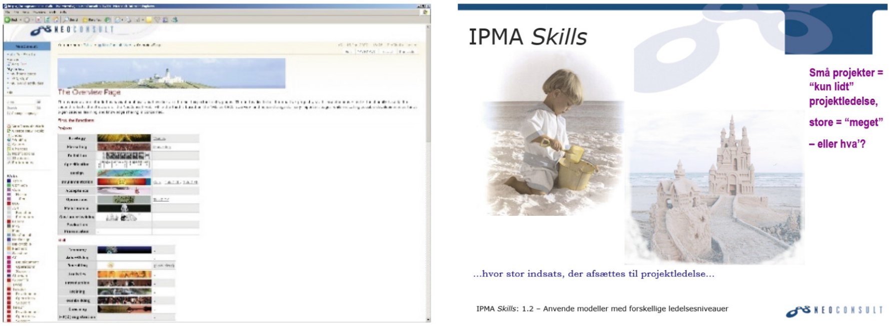


**Fig. 4.** Left: An overview-and-search page from a wiki-based CSCW constructed to resemble an LMS. Right: A presentation using primarily graphics and thus relying on live "speak"

The last step before the definition of ATLAS (and the choice of the acronym) was the miniature stand-alone e-learning components developed for the *Gymnasium* (Fig. 5):

The top image shows an example of a mathematics exercise set implemented as e-learning, clearly a (vastly) extended version of the earlier test type (Fig. 2 right). The bottom image stems from a game-type exercise in physics, which became surprisingly popular with the pupils. Both templates can be used directly as part of ATLAS instantiations for DTU, see below.

The author returned to a full-time position at DTU 2014. As it was explicitly stated in DTU's strategy that e-learning should have high priority, the author decided to distil from previous experience a single concept with the properties mentioned above:

1) A solitary teacher-author can use it as a scaffold
2) Work on the material can begin as if e-learning is only a later option
3) Every item produced is useful in conventional teaching as soon as it is ready
4) Conversion from conventional to e-learning mode requires little extra work

The story will be a bit convoluted (and in places personal); but as we are nearing the end, I hope my reader will bear with me. Visually, the subsequent development was something like this:


**Fig. 5.** Top: An interactive e-learning test of the learner's grasp of an aspect of mathematics. Bottom: A page of a gamified e-learning presentation-and-test of as aspect of physics. The Presentation is given as short paragraphs (white letters) ending in a question. The 'player' can only proceed to the next paragraph when the answer is correct.

Figure 6, starting from top left: This is what the first presentations looked like. Notes and exercises were written by another author and only available in print, so I concentrated on internal navigation – the hardly visible column of buttons on the left – a reasonable division of the area into headline, navigation column, main text, extra explanation and/or figure and footnote. The point is: These are (almost) always there, the learner quickly learns to expect them, and the author quickly learns to write them.

Supplementary notes and quick exercises in digital form were added, reachable via the links; but this didn't go down well with the rather distant course managers.

The next courses inspired the top right picture in the first and the two pictures in the second row. The top right picture has the same structure as the top left; but the students felt there was too much text to take in while listening to the lecturer. This prompted the version in row 2 left, where each slide is duplicated and partially greyed out, so that the


**Fig. 6.** The gradual development in layout and complexity of presentations created in accordance with the prescripts of ATLAS. See main text for descriptions.

text is only gradually revealed. Next, I added "speak", which is activated, slide by slide, by a click on the loudspeaker icon in the bottom right corner. Altogether, the students now found the presentation useful, the "speak" version for home study. – The course was then closed down. —

Work continued, though: I have spent 7½ years developing material for altogether 15 courses of varying sizes as measured by the number of ECTS points a student will achieve by passing. For 12 of these I relied on ATLAS, which stood the test, hence my wish to share the idea.

(Fig. 6): From row 3 left and onwards, ATLAS had found its final form: Each slide has a column of "buttons" to the left which allows navigation not only inside this specific PowerPoint but also to the relevant notes, exercises, tests, the "speak" version (or back to the pure text version, if you presently *are* in the speak version), the overview layer – or, if you need closure, to the elephant picture that marks the end of the session. (An old habit that has become a brand of sorts. There is a new picture with each PowerPoint). Also note that the use of a template has developed to the point where there are *exactly* 10 slides in each PowerPoint.

Please note, that only two reduced-size course material sets ever received the full set of e-learning embellishment, as the 12 courses were developed while being taught and proved too short-lived to reach the final state. Thus, the light green slide in the third row to the right belongs to a numerical analysis course which I hoped would finally carry the full implementation of ATLAS, links, "speak" and all. Unfortunately, a car rammed my disability scooter (with my humble self-inside it). The scooter did not survive its injuries and I spent 3½ weeks in hospital, followed by a rather long convalescence. When I returned to work, the numerical analysis course had been discontinued and I was asked to concentrate on:

## 7 The Magnum Opus

The final effort involving ATLAS – and the proof that it truly enhances productivity – was a tree-part, 15 ECTS points introductory course in mathematics and statistics. The material was created in the span of 2 years (May 2020–May 2022) and in its final form comprises notes and exercises, in digital form but also as 6 printed volumes (roughly 1600 pages), together with around 120 PowerPoints for presentation. There is supplementary material such as home assignments in mathematics, data files and mini-project assignments in statistics, etc., too. While writing, I also taught the course *and* supervised a class of 30 B. Sc. Students attending a 20 ECTS introductory mathematics course.

This could not have been accomplished without the framework provided by ATLAS. The fact that it was so is probably the best proof that ATLAS does indeed provide the necessary scaffolding for goal-directed authoring.

Perhaps it should be added that the material described needed no amendments when the course had to be taught online, owing to COVID-19. The third part of the course is taught in 3 weeks, 8 h a day, and left is all with a slight amount of "Zoom fatigue", though. See [2] for a discussion of this novel malady.

**Author's final note**: I no longer write programs (other than the occasional MatLab one-pager to try out a twist on a numerical algorithm); but I feel convinced that a code whiz among my readers can create an ATLAS shell – and would very much like to hear about the result.

## 8 Conclusion

ATLAS, a three-layer action structure, is best thought of as a concept, an intermediate between a template and a *design pattern.* It derives from the conventional textbook-lecture-exercises triple but introduces a different division in overview and reference, presentation, and operation(s), respectively.

ATLAS demands – or at least strongly encourages – the use of templates for each type of components in each layer as well a technique for analysis and synthesis based on unit content objects, best thought of as elements just small enough to be grasped as wholes and large enough to be stand-alone building blocks.

ATLAS, thus enhanced with architectural and compositional models and modes of work – and a modicum of authoring tools – supports the solitary academic teacher and teaching material author by substantially reducing the compass of each decision to be made during the design phase ***and***, most importantly, to allow the immediate use (in conventional teaching mode) of any element of material the moment it is finished. ATLAS likewise eases the replacement of an element, be it with an update or an entirely rewritten version. In fact, ATLAS has proved quite resilient to interchanges of entire threads of material spanning all three layers.

Lastly, ATLAS was created with a view to the passage from essentially traditional chapter-like elements to full-fledged e-learning. If use is made throughout of templates resembling those described in this paper, preferably in combination with a preliminary top-down analysis into unit content objects, all that is necessary for the final step is the connection of all elements with hyperlinks, where relevant.

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