The Internet - a problematic source of knowledge for first-tier studies architecture students

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ABSTRACT: The first year of study for students of architecture, who have never been in contact with technical drawings or general construction, is particularly difficult. The graphical, two-dimensional representation of three-dimensional space and construction elements is like an alphabet, which must be learned at an accelerated pace in order to fully participate in other activities. Taking shortcuts - in the form of searching for solutions on the Internet that can be easily incorporated into a project - has become a common practice. However, the lack of elementary knowledge, and thus the ability to recognise correct solutions results in mindlessly copying found fragments into a drawing. This consolidates popular drawing errors and design flaws. The Internet can be a great source of knowledge for both beginning and practising architects. However, it is necessary to know how to select appropriate sources of knowledge. This article describes the factors that can make a source of knowledge support a student's education, instead of contributing to slowing it down and increasing the number of errors in projects.

INTRODUCTION: *OMNE INITIUM DIFFICILE EST* (EVERY BEGINNING IS DIFFICULT)

In this article, the author's experience is presented concerning the problems caused by the use of Internet resources by first-year students attending the General Building Construction classes in the Faculty of Architecture at Cracow University of Technology, Kraków, Poland. These problems concern both the preparation for projects and the study for tests and examinations.

The first year of architecture studies can be particularly difficult due to the large number of subjects with which students have had no contact in earlier stages of their education. These include the subjects, Structural Mechanics, Basics of Architectural Design and Descriptive Geometry or Building Construction. At the Faculty of Architecture all these subjects start being taught as a part of the first-tier studies curriculum (undergraduate).

The teaching of Building Construction has been designed to start from the basics (symbols, projection principles, types and thickness of lines) moving on to the graphical representation of a fragment of a typical residential building. The student is then familiarised with contemporary technologies and solutions featured in the characteristic elements of a building - foundations, walls with window/door openings, precast floor slabs, stairs, roof trusses, flat roof types, windows and doors. The project to summarise this stage consists of a complete architectural technical design of a single family house.

The two-year educational process ends with an interior design project of a space inside a public building. This two-year period can be compared to learning the alphabet in elementary school where students first learn the graphical representation of individual sounds. They then put them into words, then into sentences and later into shorter or longer essays. At the end of the process they are able to write a story or a novella, and presenting their thoughts in the form of graphical characters should not be a problem.

BARBA NON FACIT PHILOSOPHUM (A BEARD DOES NOT CONSTITUTE A PHILOSOPHER)

The Internet is now considered to be the most common source of information, especially for students. Its main advantage is instant access to resources and the seemingly easy manner of searching for desirable content. However,

> *…beside credible, honest and up-to-date information, there sometimes appear those that are incorrect or misleading for the reader* [1].

The presence of incorrect or misleading information is a result of the simplicity of the publishing processes that are without obligatory reviews or editing. There are databases and services that can be guaranteed to contain reliable content, as well as those that contain information that is intentionally wrong or biased [2].

An obligatory element of the process of acquiring information from the Internet should be its detailed verification. But, it is difficult to require students, who have just started their education regarding matters of construction, to be able to tell apart correct and incorrect information. Academic teachers often refer to sites that would appear to be trustworthy, such as manufacturers' Web sites for specific materials and construction products. The information they provide about the products they offer is in most cases faultless and accurate. The problem arises when content must go beyond the scope of a company's business profile. This situation appears most often in construction drawings, where there is a need to present other - even fragmentary - elements of a building, going beyond the offered product, e.g. the elements by which a material or component is supported or which it insulates.

There are numerous examples of drawings illustrating, for example, flat roof systems with a complete, layered layout recommended by the manufacturer [3][4]. The company will have made every effort to accurately show how to use its product, in a way guaranteeing long-term, failure-free operation. Other elements of the building, such as the outer wall or cornice along the eaves are shown in a highly simplified manner (and, very often, there is little information). They are drawn, for example, as having no thermal insulation.

For experienced designers, these deficiencies are not important, because they are aware of what the subject of the drawing actually is, the purpose for using it and the knowledge to be adapted (not transferred) for the technical drawing. This type of documentation constitutes extremely valuable auxiliary material that makes work on projects quicker and easier, but must be used properly.

On the other hand, for beginner students such a drawing is regarded as a complete detailed drawing developed by a specialist, so they assume it is correct. It may cover the scope required by the teacher and, without being aware of any shortcomings or simplifications, the entire drawing is copied and pasted into a project. The increasing availability of drawing libraries in .dwg and .dxf formats constitutes additional encouragement for this kind of behaviour. This leads to a situation in which pasting a detail into a project does not even require reading the content of the drawing or redrawing it. As a result, highly important stages of design education are overlooked.

DISTRINGIT LIBRORUM MULTITUDO (THE ABUNDANCE OF BOOKS IS A DISTRACTION)

The Internet has opened up access to vast sources of scientific materials, such as technical literature and publications. In addition, the Internet has simplified and streamlined the availability of finished course projects from previous years. But, access to these many sources can be a problem.

For less inquisitive students at an early stage of education, the first materials corresponding to a design task most often will be sufficient to complete their work. However, if students are unable to recognise reliable sources from unreliable ones, they will not search further. Basing work on unreliable sources will reinforce erroneous solutions, even while students are convinced of their correctness.

Searching for reliable sources of knowledge is difficult and time consuming. Due to the large number of classes during the first year that often feature new subjects and new issues to be learned, the time to find these reliable, credible sources is limited. The simplest and most effective means of preventing such problems is to have a researcher indicate appropriate, reliable sources during the course.

FIDE, *SED CUI* VIDE (*TRUST*, BUT BE CAREFUL WHOM YOU *TRUST)*

Another problem with using the sources of knowledge available on the Internet is whether they are up to date. Students make use of projects and work prepared by students from previous years, such as project sheets and lists of answers to examination questions. These works are posted on Web fora, Facebook groups, and group e-mails year after year with little or no changes or editing.

Building technologies age; newer technologies enter use; old ones are phased out. Construction and operating standards and, above all, technical requirements in terms of the energy efficiency standard, are changing.

Projects developed in 2016 may no longer meet the requirements set for 2017, for example due to the change of thermal transmittance values (U-value) calculated for a particular partition (e.g. wall, floor). As well, peer-reviewed books and publications discussing these issues become outdated. The use of work from previous years is not bad *per se*. General design principles such as construction or building physics remain the same. The role of the teacher is to focus the students' attention on content that may become outdated. The use of modern solutions, technologies and current standards should be required.

PARVUS ERROR IN PRINCIPIO MAGNUS FIT IN FINE (A SMALL ERROR IN THE PRINCIPLES IS LARGE IN THE CONCLUSIONS)

The copying of solutions and inserting construction details like stamps into a project is a common practice. It is always aimed at obtaining a good grade with a minimum of effort. The lack of any attempt to understand the content included

in first projects results in a snowballing effect - small acts of negligence during the initial phase of education deepen when moving on to the next stage, making it impossible to read new content and understand more advanced source materials. There is less and less time to catch up and it becomes impossible at some point. Referring to the comparison from the introduction about learning the alphabet - it is not possible to learn how to assemble words into sentences without the ability to assemble letters into words. The only rational solution is then to go back to the initial stage and learn everything from the beginning in the right order.

REPETITIO EST MATER STUDIORUM (REPETITION IS THE MOTHER OF LEARNING)

Modern design practices would no longer be viable without computers equipped with specialist software. They aid architects in the preparation of design documentation, which needs to be very precise and detailed due to the immense amount of advanced technologies, which is used from various branches of engineering. The level of complication, and thus the size of design documentation, increases every year. However, the initial conceptual stage, the one with which every design process starts, does not require any advanced tools. On the contrary, the easier and simpler a tool is to use the better it allows one to present ones thoughts in a graphical manner. Quick conceptual sketches make it possible to record these ideas. They are ambiguous in that they do not define a solution, but this does not matter at this stage [5].

A large number of ideas can be transferred onto paper in a very short amount of time allowing a later selection of the best ones...

> *…During the process of experimentation, the first sketch is often a blurry and imprecise representation of the overall concept of a building. On the other hand, despite the brevity of the symbols being used, the image is saturated with content. The elementary nature of the first sketches that has been observed is completely natural, just as the concretisation of visual images is performed gradually along with the development of an idea - from a small* hieroglyph *to detailed drawings* [6].

Successive sketches make it possible to define more and more elements. They also allow the abandonment of initial assumptions to pursue a completely different idea. Goel defines two types of a sketch transformation. The first is *vertical transformation*, which is the development of the initial idea, detailing it through to complete design documentation. The second is *lateral transformation*, which is an alteration of the initial idea. It enables a search for alternative solutions to a design task [7]. This broadens the spectrum of answers to a given problem with details developed during successive stages.

Starting the design process using a computer greatly limits the capabilities of a designer. It limits the conceptual design phase, constraining the spectrum of applied means to only those forms and symbols supported by these advanced tools. The explicitness and unambiguity of a line, point or plane removes the capacity for a mixed interpretation of the drawing. This discourages the introduction of changes, the pursuit of ideal proportions or indicating relations between elements. Omitting initial design phases does not allow the selection of the most optimal and appropriate solution. This is especially true of persons who are beginning their design education.

A digital drawing is created on a screen with no specific scale. While zooming in on a given fragment, attention is drawn away from the essence of the object that is being designed. It leads to focusing on problems that are unimportant at this design stage. Persons who have never come into contact with hand-drawn technical drawings cannot orientate themselves to the appropriate level of detail. For instance, when drawing to a scale of 1:50 too much attention is being focused on drawing the layout of individual masonry units or bricks, while forgetting about the functional or structural layout.

Due to limitations of precision caused by the scale used by drawing tools, hand-drawn documentation is best for persons who are just beginning their architectural education. Different scales make it possible to focus on various problems that occur during the design process. A clear barrier is formed between the successive stages, one that cannot be surmounted due to the precision of the drawing. In the case of a digital drawing, the entire process blends into a single stage. Thus, the amount of knowledge that needs to be learned is very large. Difficulties in learning and the systematisation of such a broad sphere of knowledge arise.

In the Faculty of Architecture at Cracow University of Technology, first-year students are required to draw by hand all projects for the General Building Construction subject. Initial drawings are made in pencil on tracing paper. They are later drawn in ink, using Rapidographs. Such requirements are often met with misapprehension or a lack of acceptance by students. This aversion is largely the result of the necessity to redraw the same elements many times over, which is considered a waste of time.

In a digital drawing, an element that has been drawn once (a brick, a masonry unit, a set of stairs, a balcony) can be easily copied multiple times. Fragments can be easily pasted from other projects without the need to understand them. Drawing the same element by hand forces the draughtsman to analyse the content that is being presented, requiring at least a partial understanding of it, which allows the draughtsman to better remember what is being drawn.

ERRANDO DISCIMUS (BY MAKING MISTAKES WE LEARN)

Using a computer to draw can lead to taking the aforementioned shortcuts. Having numerous libraries with finished and easily copied drawings of building fragments enables apparently complete and professional drawings to be produced with little effort, but also with little understanding. Drawings prepared by specialists are being brought to classes in the form of print-outs that are mindlessly redrawn. The result is no understanding of the content of the drawing, a lack of any analysis and often an improper merging of individual fragments. Such an approach may be encountered by teachers at an early stage of a project, but then, they can point out the accumulating mistakes. If such a project is not reviewed and is submitted towards the end of a semester, there is no possibility of correcting it.

A different problem when using finished drawings arises when all fragments are merged appropriately. This can mean that a student understands what is presented on the drawings and is capable of utilising the information found on-line skilfully enough to *assemble* a project out of them. However, designing on the basis of finished fragments of drawings resembles assembling buildings from typical premade elements. This will greatly limit the creativity and development of a student. Furthermore, such a design process makes it possible to avoid errors that, particularly during the starting phase of education, are an important element of learning. When detected and discussed during classes by a teacher, errors point to gaps in a student's knowledge.

> *The errors that are made - provided that they are identified as errors early - also provide us with feedback regarding the ineffectiveness of our actions and thus lead us to concentrate our attention on our own behaviour and the context and conditions of operation. They somewhat force us to shift our cognitive apparatus to a more analytical way of processing information, on expanding the scope of information that is considered. This aids in the search for new, additional pieces of information, the formulating of new questions, searching for alternative forms of action. At times - when repeated attempts at achieving a goal do not yield the desired results despite modifying the methods of action - leading us to reassess and reformulate the previous goal, including the abandonment of pursuing it. When making mistakes we learn to identify and locate the boundaries of our own knowledge and ignorance* [8].

An attempt at single-handedly preparing design documentation from the start, even if unsuccessful, leads to a result in the form of knowledge and acquired skills. However, the errors should be identified at an appropriate stage, so that they are not repeated.

CONCLUSIONS: *PER ASPERA AD ASTRA* (THROUGH HARDSHIPS TO THE STARS)

The Internet undoubtedly has greatly influenced learning methods at colleges and universities. On the one hand, it has opened up access to sources that otherwise would be very hard or even impossible to reach. The ease of posting information and quick searching allows students and researchers to familiarise themselves with the latest achievements in a given field.

On the other hand, unverified sources remain problematic. Anyone can post information on the Internet, even without appropriately verifying it. Thus, there can be no certainty as to whether it is true or appropriate.

An excessive number of sources do not make it easier to obtain information, especially for persons who are at the starting stage of their education. Due to a limited amount of time, there is no possibility of analysing all sources in terms of their credibility or comparing the information that they contain.

Despite enormous libraries and easy access to them, the role of academic teachers in education, and especially individual reviews of students' projects still remain significant. However, they are subjected to a transformation. During classes, due to the limited amount of time and the immense scope of currently available technologies, there is no possibility of discussing all the possible solutions to a given problem. It appears that the main focus should be directed at teaching how to use available sources. A creative approach should be encouraged, convincing students to inspire themselves with solutions from available sources, but instead of copying them - to creatively adapt them. (Even if they have been posted on the Internet by manufacturers intending them to be copied.)

A significant number of students treat the Internet not as a source of knowledge, but as a source of finished projects or their fragments. The mindless copying of solutions and the pasting of details into a project is common practice. The aim of this behaviour is to achieve a good grade with the least possible amount of effort. Studies have shown that academic teachers are aware of this [9].

The Latin phrases that are the titles of chapters prove that similar problems have been present in education from the beginning. Along with the development of civilisation, the methods employed by education change, and so does the scope of knowledge that needs to be mastered. However, the necessity of putting in an immense amount of effort and work in order to achieve educational goals has remained the same. In this particular case, it is the understanding and the mastering of problems in General Building Construction.

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