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1 **Designing an interactive environment to share**
2 **education materials and resources. Application to**
3 **the Geomatics Hub at Institut Polytechnique**
4 **UniLaSalle Beauvais**

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9 **Abstract**

10 Teaching is a process requiring a logical and progressive frame, which is formalized in
11 the pedagogic curriculum. Selecting, arranging and framing the content is necessary to
12 enhance the learning experience (Deng, 2011). The making of a curriculum implies the
13 creation of materials that can be numerous. These pedagogic resources can be of different
14 kinds: course materials, exercise instructions or help tools. Using technology to provide
15 an easier access to these resources to the students through an online platform is a great
16 way to perpetuate these materials and ease the work of teachers (Nachmias et al., 2008).
17 Furthermore, the development of such online media permits a valorization of the
18 pedagogic resources and its innovations (Mahajan, 2010). It is a step towards an open
19 science approach of teaching geomatics which goes further than actual textbooks (Bell
20 et al., 2018). This paper focuses on the online platform designed by the Institut
21 Polytechnique UniLaSalle Beauvais for the Geographic Information System (GIS)
22 courses: The Geomatics hub, which is mostly free to access for the general public.
23 54 answers were collected from a survey to collect the experience of students on this online
24 tool. 87% declared that this platform allows a better access to the pedagogic resources
25 while 89% indicated that its organization is clear and logical. The Geomatics hub is also
26 a way to display the results of projects lead by either teachers or students. The use of an
27 innovative solution with a digital open-access has a reach that is not limited to the
28 students. The display of the education tools produced by UniLaSalle Beauvais for GIS
29 can be noticed by companies, potential partners or former students.

30
31 **Keywords:** Innovation diffusion; open science; e-Learning; Educational innovation

32 **1. Introduction: teaching geomatics at UniLaSalle – Campus of Beauvais**

33
34 Geomatics is an umbrella term for all disciplines related to collecting, analyzing and
35 storing geographic data. It gathers Geographic Information Systems (GIS), Remote
36 Sensing, and Photogrammetry. The sensors and platforms are extremely varied, from
37 ground-based GNSS to imaging satellites, or airborne LiDAR systems. The full Data Life
38 Cycle is included, from the acquisition to the processing and communication of the results
39 (Levitin and Redman, 1993). At UniLaSalle, the topics studied are mostly centered
40 around Earth Observation, and more precisely Agriculture and Geology.
41

42 UniLaSalle Beauvais is an engineering school, teaching to about 3000 students in 5 years.
43 Geomatics is an important part of the curriculum, with on average XX % of the time spent
44 learning GIS, Remote Sensing and Photogrammetry, with an emphasis on the former
45 (REN, 2022). Since the students have different career ambitions in Earth and Life
46 sciences, being able to offer a wide range of real-life examples, especially for lab sessions,
47 is estimated crucial as a way to keep them interested and therefore more engaged. One
48 goal is to bring the students to work autonomously on Labs that they choose from a
49 library. Taking ownership of their learning experience by choosing exercises could
50 increase the efficiency of the course (Kolb and Kolb, 2005).

51

52 Additionally, as teachers we are aware that some knowledge learned during in college
53 years, if not used, will be forgotten. We wanted to provide Alumni with a tool that will
54 allow them to access hands-on knowledge and tutorials even years after graduating, if the
55 need arises for them to use the geomatics tools in their careers.

56

57 Teaching requires to produce a non-negligible quantity of materials. While some teachers
58 choose to make those available through their professional or personal webpage, some of
59 these materials are lost. Making all materials available for the teachers of an organization
60 could provide more time for others to improve their own curriculum, without having to
61 reproduce materials that already exist. It is also in line with the Open Access movement
62 claims, which is that everyone would gain from making materials public, by avoiding
63 duplicate work (Hylén, 2021).

64

65 Creating interactive online course materials was selected as the way to evolve teaching
66 Geomatics at UniLaSalle. The Geomatics Hub was invented as a platform to gather all
67 those materials and bring them beyond the classroom, in the light of the new paradigm of
68 Education 4.0 which emphasizes experimentation as a way to learn, especially by taking
69 advantage of emerging technologies (Almeida and Simoes, 2019).

70 **2. Development of the Geomatics Hub**

71

72 *2.1. The Geomatics Hub: a repository for course material*

73

74 The Geomatics hub was developed in 2019. It is freely accessible online at [https://hub-
75 geomatique-unilasalle-fr.hub.arcgis.com/](https://hub-geomatique-unilasalle-fr.hub.arcgis.com/). About four teachers are involved and make
76 their materials available in the platform. The main strategy is to provide students, as future
77 Technician and Engineers, real-world examples and problem-based exercises to work on.
78 The design is meant to be very interactive, with the implementation of naturally
79 interactive tools, such a Genially, a platform to create dedicated interactive content.

80

81 The original idea was to give more autonomy to students by making them work on a
82 workflow-based approach, where they were provided data, some context, a general
83 workflow and access to a user manual created by the teacher. This allowed the teacher to
84 focus on students with more difficulties. Those labs were then hosted and gathered under
85 one Hub. Student can work in complete autonomy, by choosing in a library of labs with
86 varying levels of difficulty, and also check their skills autonomously using lists of
87 technical skills. GIS was originally the main discipline taught in Geomatics but creating
88 an online Hub was to opportunity to gather together all the disciplines in Geomatics.

89

90 The three main disciplines are easily available: GIS, Remote Sensing, and
91 Photogrammetry. For GIS, the main parts are: the lecture slides, about different topics
92 related to GIS, the exercises as Lab Sessions, and an online help on three software:
93 ArcGIS Pro, ArcGIS Online and qGIS. Online skills trees also guide students to different
94 parts of the user manual depending on the skill they want to practice. For the
95 Photogrammetry part, lecture slides are available as well as an online help on the software
96 Agisoft Metashape (proprietary). There is a similar structure for Remote Sensing: lecture
97 slides, labs and online help on ENVI (proprietary). In terms of web hosting, the user
98 manuals are written and hosted on Scenarii, the lecture slides are in Genially, the Labs
99 are on ESRI's servers in the form of Story Maps.

100

101 *2.2. The Hub as a pedagogic tool*

102

103 The use of StoryMaps allows to set levels for the Lab sessions. For the GIS part, all labs
104 sessions are taught as Problem-based-Learning, where a situation is described to the
105 student, who then has to follow steps of the processing tasks to complete the scenario.
106 While in the first labs, the workflow is often given to the student, it is progressively less
107 and less detailed, in order to let the student, improve and decide on their own of which
108 tools to use, with the end goal of writing and developing their own workflows. Added to
109 the list of labs, the students have access to an auto-evaluation of their skills, with a
110 division in small skills that they can improve by completing the corresponding lab.

111

112 In Photogrammetry, the students are provided with a generic workflow and a detailed
113 user manual, developed by the teaching team. The student then has to apply the processing
114 to given sets of data, that can be changed year after year depending on the current need,
115 for example when we want to student to work on new data.

116

117 The display tools chosen as a support (StoryMaps, ESRI hub, Scenari) are easy to edit if
118 the leading teacher is not in charge of the Hub anymore, as it has been the case in this
119 study.

120

121 As for now the platform is in French only. Finally, it is worth mentioning that geomatics
122 also includes data acquisition. That encompasses a wide range of platforms: ground-
123 based, drone, satellite, and of sensors. The data acquisition part is not covered by the
124 materials in the Geomatics Hub yet.

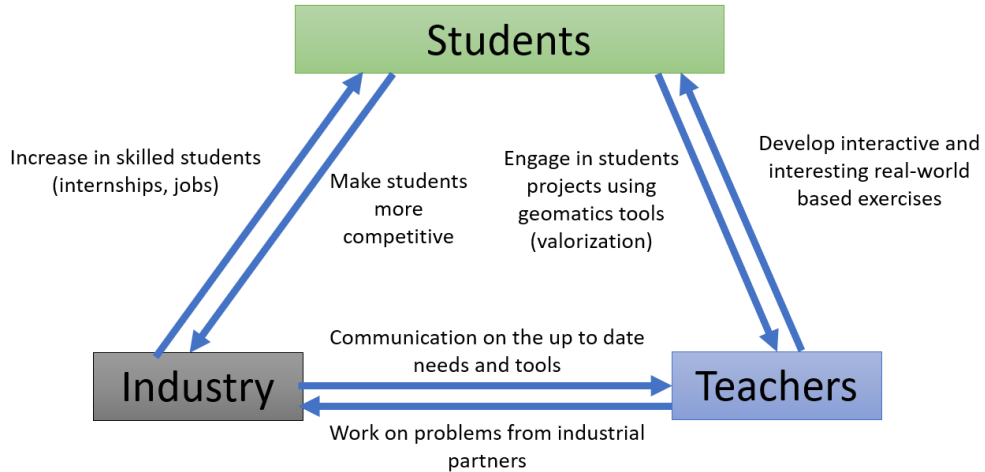
125

126 *2.3. The Geomatics hub as a showcase platform to enhance relations between companies 127 and education*

128

129 The Geomatics Hub is in close relation with the GéoLab, an innovation center at
130 UniLaSalle Beauvais that provide an access to students to work on innovative numeric
131 tools for 3D modelling and 3D printing. This includes high-quality PCs, software
132 licenses, technical support and more. The Hub is a way to present the current and past
133 student projects. Beyond being a platform for students, it is also the opportunity to build
134 bridges between the academic world and industry. By showcasing the researchers and
135 students work, companies are more willing to offer internships or job offers, or rent the
136 services of the GéoLab for one-time projects, such as fossils and minerals 3D modelling,
137 bio-mimicry research work. It is also a showcase of the education offered at UniLaSalle
138 and bring in new customers for one-time workshops and companies' workshops. By

139 interacting both with students and professionals, the benefits are coming back to students
 140 because the teachers are on the front line and can estimate the needs of the companies, by
 141 being in direct communication with them (see Figure 1).
 142



143

144 Figure 1 - Multi-parts benefits of an Open Educational Resources with an emphasis on the
 145 communication between all three actors of learning: students, teachers and the industry

146 3. Three years in: evaluating the use of the platform

147

148 The main objectives of the Geomatics Hub are (1) to be an efficient tool for current
 149 students at UniLaSalle Beauvais, (2) to be useful for former students (3) to be used as a
 150 showcasing website for external users, whether they are individuals or companies. Two
 151 metrics are here studied to quantify the success of the platform. Firstly, we will evaluate
 152 the impact on student through surveys. Secondly, a study of the hub engagement metrics
 153 will be used to quantify the impact of the website.
 154

155 3.1. Students survey

156

157 A study was conducted in September 2022, and 66 students answered of the 406 students
 158 surveyed. The students targeted were those who already studied GIS in their course, so
 159 the third, fourth and fifth year in the curriculum, and the students who had recently
 160 graduated. 48.5% of the students who replied are in their third year at UniLaSalle. The
 161 questions were divided into three sections: The Geomatics Hub in general, the chronology
 162 of the Lab Sessions, and the skills tree. The objective of the survey was to target those
 163 specific pedagogic tools in order to assess them individually.
 164

165 To the first question (“To which occasions are you using the Geomatics Hub?”), and
 166 besides a use during the class, 67% say they use the Hub when studying for the exam,
 167 17% say they use it to know more about geomatics in general, 56% say they use it for
 168 projects outside of the class, and 15% say they are using it when working for a company
 169 (either during an apprenticeship, internships, or in their new position for the recently
 170 graduated students). When asked which resources the students were looking at the most,
 171 the first place comes for the course materials (73%), then the chronology of Exercises in

172 ArcGIS (59%), the user manuals (55%), the library of exercises/examples (41%). About
173 the use of the Hub outside of the classroom, a third of the student said they were using it
174 regularly (33%), a third replied they were using it outside of the classroom but not
175 regularly (35%) and another third replied that they were not using it outside of the
176 classroom (31%). Three following questions are about the display and ease of use of the
177 platform. In a large majority, students find that the Hub is easy to use (90%), and would
178 recommend it to someone who is a total beginner in GIS (94%). However, those results
179 are to put in perspective with some written comments by students who say that the
180 interface is sometimes too busy and that there are too many steps to get to the course
181 content.

182
183 The second part of the survey deals with the chronology of the exercises. Almost all the
184 students say that the chronology is easy to understand and use (98%), and that it allows
185 them to understand better the course in terms of skills to learn, by putting all the exercises
186 in perspective (94%). The third part of the survey is about the skills list. While only half
187 of the students had seen the skills list before (53%), a large majority of them think that it
188 can be useful for them to learn GIS (85%), and that they would use it autonomously,
189 without being expressively told to during a lecture (75%).

190
191 This first experience in surveying the students provided insights on the use of the platform
192 but will also be used to improve the next surveys, especially in terms of focusing
193 questions and getting the students more engaged.

194 195 3.2. Website engagement overview

196
197 ArcGIS Hubs show a part of statistics on the website views. In the past year (Nov.2021
198 to Nov. 2022), over 15,000 visits were recorded, and on average in the past three months
199 the visits are about 1,400 visits / month. There is no information on summer views, which
200 could have been a good indication of views from students vs. Views from external users.
201 Those metrics are limited but give a good quantitative indicator on the website's relevance
202 and use.

203 4. Conclusion

204
205 After three years of use of the platform, we now feel confident in putting in perspective
206 the use of the Geomatics Hub. Overall, the feedback from students and teachers alike is
207 in the majority positive. The students can work autonomously, during labs the teacher is
208 in a support position. Students can follow their own pace and see the big picture of the
209 skills expected from them at any time of their education. During the lifetime of the
210 platform, teachers in Geomatics have partially changed. The existence of the platform
211 made those changes easier, and lessened the disruption on students. The school's
212 industrial partners also gave positive feedback. ESRI France, the French branch of the
213 leader in GIS and Remote Sensing software, broadcasted the Geomatics Hub in their
214 magazine "SIGMag" in December 2020.

215
216 The feedback is for the moment limited and there is no way for website visitors to leave
217 comments that could let the developer team that something is wrong with the content
218 (broken links, outdated data or new processing technologies, general remarks and

219 suggestions). Additionally, including Single Sign-On (SSO) to the website would give
220 more information on the profile of the users.

221

222 With the improvement in topics such as small objects photogrammetry, there is a need to
223 update the tutorials. New topics related to Spatial Data Science should be included, like
224 Machine Learning techniques, now broadly used in Spatial Data Science, including
225 Geomatics. A part on data mining and data downloading should also be added, as well as
226 reflecting on how to include the data acquisition part. A translation in English would also
227 be a plus. Following the survey with students, it seems important to modify the
228 architecture of the website to streamline the access to the different parts of the materials.
229 A focus should also be made on accessibility (option for contrast, image alternative text
230 for example). One main risk taken with the architecture of the hub is that it relies heavily
231 on external storage. The StoryMaps and main interface are hosted on ESRI's servers, the
232 data is hosted internally on the school's own platform, Claroline. The Software manuals
233 are hosted on Scenarii, and the slides are hosted on Genially and also archived on the
234 teacher's own computers. A way to bypass this would be to develop a server internal to
235 the school, like an ESRI ArcGIS Enterprise solution. In terms of pedagogy, more didactic
236 tools should be tested, such as glossaries, quizzes, serious games.

237

238 After three years of experimentation, the students and teachers alike are using the
239 Geomatics Hub for its intended purpose with success. The students appreciate the
240 diversity of materials, but it can also be a drawback by making the platform busy and hard
241 to navigate in. The teachers can rely on previously prepared materials, and also have a
242 freedom to edit anything they want. In the future, the objective is to add or complete the
243 contents, update the information on the software and document the process. Adding levels
244 of help for the GIS labs is proven to be efficient so it should be generalized to all three
245 disciplines. The open science approach is a philosophy the team still fully adhere to, and
246 therefore once the Geomatics Hub fully updated it will be more widely advertised at the
247 level of UniLaSalle Group at first (Beauvais – Amiens – Rouen – Rennes) and in the
248 Geomatics community in general.

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