TEACHING DATA DRIVEN JOURNALISM: HOW TO INTEGRATE DATA SCIENCE INTO EXISTING CURRICULA SHOWN IN THE EXAMPLE OF A JOURNALISM PROGRAM AT THE BACHELOR'S DEGREE LEVEL

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ABSTRACT
Developing an integrative curriculum has become a globally discussed issue and challenging for all institutions of higher education. Curriculum development is a multi-step process which is undertaken after every specified period defined by an educational institution. Though it may vary from university to university, generally it is a four to five years period with ongoing updates and revisions. Data journalism is thriving worldwide, but what is missing from data journalism education? This question is addressed in this study by applying the Stanford University Berret-Phillips approach for modeling curricula in teaching data and computational journalism for a 6-semester journalism program at the Bachelor's Degree Level in am European University. After a qualitative state of the art analysis of the program, the journalism program's curriculum was enriched with the dimension 'data science', (1) by implementing data science as a core course and (2) by integrating data science into existing courses and concentrations. The results of the study revealed that offering a three-dimensional data science education with (1) integration of data science components in traditional journalism courses, (2) offering fundamental courses in data-driven journalism as well as (3) offering a specialization in data journalism for students interested in advanced skills, is essential for a journalism programs in Higher Education to equip students with data skills for a data journalist.

INTRODUCTION
Journalism education has tended to respond slowly to developments in digital journalism, such as data journalism, although journalism in the 21st century involves finding, collecting, analyzing and visualizing data for stories. Journalism educators worldwide tend to train their students in similar ways focusing on some universal needs, regardless of cultural, environmental or technological differences and scholars focus on developing global approaches for journalism education concepts. Data journalism is an umbrella term that summarizes a set of tools, techniques, and approaches to storytelling. It can include everything from traditional computer-assisted reporting to data visualization and news applications. Data journalism can help a journalist tell a complex story through engaging infographics. Data can be the source of data journalism, or it can be the tool with which the story is told, or it can be both. Data journalism contains the following steps: finding data, interrogating data, visualizing data, and mashing data. Data journalism is Journalism that uses technology to access, analyze and find stories in data and then tell the stories of the people the data represents. Data-driven journalism is an emerging discipline that brings together knowledge from several disciplines, such as news and journalism, information and data Sciences, data analytics, information design, and storytelling.

LITERATURE REVIEW
Curriculum models help designers to systematically and transparently map out the rationale for the use of particular teaching, learning and assessment approaches. One categorization of curriculum models is to distinguish between product models and process ones.According to Neary (2003), the product model emphasizes plans and intentions, while the process model emphasizes activities and effects. The product model can be traced to the work of the writings of Tyler (1949) who greatly influenced curriculum development. Product models focus on the instructor as an 'expert, with guiding students towards the achievement of an "end state", which is often defined by

external (assessment agencies). Learning outcomes are clearly defined and emphasis lies on assessment. Advantages of this model are that (1) learning outcomes can be defined precisely, (2) the model enables that content can be selected and structured, (3) learning levels are clearly defined. Disadvantages might be that (1) at higher levels behavioral objectives might be difficult to define, (2) creativity might be discouraged, the (3) attitude of 'teaching for the exam'.Process models focus on the instructor as 'facilitator', focusing on engaging students in the learning process and developing their capacities for learning by encouraging learners autonomy. The advantages of these models are an emphasis on (1) engagement and interaction and (2) learning skills. On the other hand, these models might not be easily applied in some areas and have a lack of emphasizing on appropriate content (O'Neill 2010, Neary 2002, Stenhouse 1975, Tyler 1949). Ornstein and Hunkins (2004) classified curriculum models into technical and non-technical approaches; which is similar to the product/process breakdown. The technical approach uses the curriculum development as a blueprint for structuring the learning environment; the non-technical approach, in contrast, focuses on the learner (similar to the process model previously introduced). Examples for technical curriculum models: 1. Tyler (1949) Four Basic Principles: Tyler's work equates with the product model and is the foundation of the current Learning Outcomes Curriculum. 2. Wiggins & McTighe (2010) Backward Design Model: it is a variation of Tyler's model and links with the idea of graduate attributes and competencies. Examples for non-technical curriculum models: Ornstein and Hunkins (2004) The Deliberative Model: This model addresses the gap between the complete freedom for students to choose what they would like to learn and the prescription of learning. A process is proposed where educators share their ideas with students, and together they develop an educational plan, with feedback loops and adjustment options. Ornstein and Hunkins (2004) Post-Positivism Models: these models focus on less intervention of the educators. In this approach 'students are not presented with ideas or information with which they will agree, but with encounters with content arranged as such that students will see that they have to seek more to find frameworks and generate fresh understandings' (Ornstein and Hunkins, 2004, p213). The aim of these models is to allow unexpected and creative learning as well. Toohey (2000) focused on how curriculum models view knowledge, assess learning, define goals and defines which resources are needed. She defined experiential models and social critical ones. Experiential models (1) believe in the importance of personal relevance and learning from experience, (2) the curriculum is organized around life situations, (3) adults learn to be able to solve problems, (4) these models focus on authentic assessments. Social critical models (1) seek to develop a critical consciousness in students so that they become aware ill of society and are motivated to alleviate them, (2) content is drawn from significant social problems of the day, (3) these models focus on collaborative group work and projects. Ornstein and Hunkins (2004) classified curriculum models in subject-centered designs and learner-centered ones. Subject-centered designs are centered on the conceptual structures of the discipline and inform the work of people in the discipline. These models merge several disciplines into an interdisciplinary subject are, focus on conceptual clusters and are theme based. Learner-centered designs emphasize on the process of learning, e.g. critical thinking, and less on content. Assessment should reflect the process. These designs are used where educators feel the students may be able to make more informed decisions, such as Masters programs, or in adult education. Table 1 shows how the different curriculum classification categories and how they are related.

Table 1: Categorization of curriculum models

Product/Process	Sub-categories		
Product models	Technical (Ornstein, Hunkins)	Four Basic Principles (Tyler)	Subject-centered designs (Ornstein & Hunkins)
		Backward design (Wiggins & McTighe)	
Process Models	Non-technical (Ornstein, Hunkins)	The Deliberation Model (Ornstein & Hunkins)	Learner-centered designs (Ornstein & Hunkins)

It is essential to understand global journalism education needs, to be able to predict and guide educators in how to structure education for future journalists. Journalism education worldwide is becoming increasingly professionalized, formalized, and standardized, and, as a result, increasingly homogeneous (Goodman and Steyn 2017, Gray et al. 2012, Bromley et al. 2001). The World Journalism Education Council actively promotes universal standards for journalism education, and adopted the Declaration of Principles, identifying 11 principles to serve as a standard for journalism education. These principles are summarized in Table 2.

Table 2: Principles of Journalism Education (World Journalism Education Council, Goodman and Steyn 2017)

Principle	Explanation
1	journalism education is a balance of conceptual, philosophical and skills-based content
2	Journalism is a field appropriate for university students from undergraduate to postgraduate levels
3	Journalism educators should be a blend of academics and practitioners
4	Journalism curriculum includes a variety of skills courses and the study of journalism ethics, history, media structures/institutions at the national and international level, critical analysis of media content and journalism as a profession. It includes coursework on the social, political and cultural role of media in society and sometimes includes coursework dealing with media management and economics. In some countries, journalism education includes allied fields like public relations, advertising, and broadcast production.
5	Journalism educators have an important outreach mission to promote media literacy among the public generally and within their academic institutions specifically
6	Journalism program graduates should be prepared to work as highly informed, strongly committed practitioners who have high ethical principles and are able to fulfill the public interest obligations that are central to their work
7	Most undergraduate and many masters programs in journalism have a strong vocational orientation
8	Journalism educators should maintain strong links to media industries
9	Journalism is a technologically intensive field. Practitioners will need to master a variety of computer-based tools. Where practical, journalism education provides an orientation to these tools
10	Journalism is a global endeavor; journalism students should learn that despite political and cultural differences, they share important values and professional goals with peers in other nation
11	Journalism educators have an obligation to collaborate with colleagues worldwide to provide assistance and support so that journalism education can gain strength as an academic discipline and play a more effective role in helping journalism to reach its full potential.

Curriculum development should be the central focus of the strategic planning activity of an institution. Khan and Law (2015) defined an integrative approach to curriculum development.

Step 1: Environmental Scanning: both internal and external environment should be studied in order to have a comprehensive knowledge and understanding of what is happening in and around the educational institutions

Step 2: Graduate competencies: specific competencies to be developed in students are identified and analyzed

Step 3: Curriculum development: the actual curriculum is designed and developed keeping in mind the knowledge of previous two stages

Step 4: Pedagogical strategies: specific pedagogical strategies, which are most relevant and effective in imparting the knowledge intended in the curriculum are identified and proposed.

Step 5: Implementation, Evaluation, Feedback: carry out regular evaluation of the learning outcomes, provide necessary and on time feedback to interested parties in education.

THE STUDY: INTEGRATING DATA SCIENCE INTO A JOURNALISM PROGRAM'S CURRICULUM

The **objectives** guiding this study were for: (1) applying the Stanford University Berret-Phillips approach for modeling curricula in teaching data and computational journalism for a journalism program at the Bachelor's Degree Level and (2) designing and implementing a 'data science' dimension to the program's curriculum. The

target group for the data-driven journalism analysis conducted in this study is students of a journalism and public relations program at the bachelor's level at a higher education institution in Europe. **Target program**: Mode of Study: 6 semester, full time, 180 ECTS; Academic Degree: Bachelor of Arts in Social Sciences. Table 3 shows research design, methodology and methods applied.

Table 3: Research design

Research approach	research design (purpose)	research methodology	Research methods
deductive	descriptive study	qualitative	Literature analysis, Document Analysis, Case Study

After a literature analysis on curriculum development methodologies and approaches, a document analysis was done on journalism programs in different European countries and the United States. The aim of this analysis was to filter out programs similar to the one considered in the case study analysis. These programs were analyzed in terms of if and how data science is currently included in these programs. On a whole 7 journalism programs (5 from the United States, 2 from the United Kingdom) were selected for a detailed analysis. Based on these, a case study was conducted in a European university, was in an existing journalism program at Bachelor's level was implemented a data science specialization and selected courses enriched with a data dimension.

LITERATURE ANALYSIS
The literature analysis conducted in this study is summarized in section 'literature review'.
Essential findings of this study are summarized below:
- ✓ Curriculum models can be product or process related, technical or non-technical
- ✓ Some models are educator focused, some learner-centered
- ✓ A curriculum development process should contain the following steps: environmental scanning, graduate competencies, curriculum development, pedagogical strategies, implementation, evaluation, and feedback.

DOCUMENT ANALYSIS
Journalism and Media programs at the Bachelor's Level, listed on bachelor's portal.eu * *Sub-disciplines, which are not listed below are media studies & mass studies and translation & interpreting,* are summarized in Table 4.

Table 4: Journalism and media programs

Programs listed by disciplines (total)*	Discipline: Journalism & Media: 984 (total) Sub-discipline journalism: 369 (total) Sub-discipline public relations: 137 (total) Sub-discipline media management: 82 (total) **total for countries listed below*
Programs listed by country	

(1) Austria	Discipline: Journalism & Media: 3
	   Sub-discipline: Journalism: 0
	   Sub-discipline: Public relations: 0
	   Sub-discipline: Media management: 1

(2) France	Discipline: Journalism & Media: 2
	   Sub-discipline: Journalism: 1
	   Sub-discipline: Public relations: 0
	   Sub-discipline: Media management: 0

(3) Germany	Discipline: Journalism & Media: 4
	   Sub-discipline: Journalism: 0
	   Sub-discipline: Public relations: 0
	   Sub-discipline: Media management: 4

(4) Netherlands	Discipline: Journalism & Media: 11
	   Sub-discipline: Journalism: 0
	   Sub-discipline: Public relations: 0
	   Sub-discipline: Media management: 5

(5) Spain	Discipline: Journalism & Media: 12 Sub-discipline: Journalism: 4 Sub-discipline: Public relations: 4 Sub-discipline: Media management: 1
(6) Sweden	Discipline: Journalism & Media: 1 Sub-discipline: Journalism: 0 Sub-discipline: Public relations: 0 Sub-discipline: Media management: 0
(7) Switzerland	Discipline: Journalism & Media: 4 Sub-discipline: Journalism: 0 Sub-discipline: Public relations: 1 Sub-discipline: Media management: 0
(8) Turkey	Discipline: Journalism & Media: 12 Sub-discipline: Journalism: 2 Sub-discipline: Public relations: 6 Sub-discipline: Media management: 0
(9) United Kingdom	Discipline: Journalism & Media: 411 Sub-discipline: Journalism: 135 Sub-discipline: Public relations: 27 Sub-discipline: Media management: 37
(10) United States	Discipline: Journalism & Media: 525 Sub-discipline: Journalism: 227 Sub-discipline: Public relations: 100 Sub-discipline: Media management: 32

Since the program considered in the case study focuses on the disciplines journalism and public relations only programs of these sub-disciplines are considered in the further analysis (Table 5). From these 137 programs, the course curricula were analyzed in terms of similarity to the journalism program considered in the case study; and 20 similar programs identified. From these 20 programs only 11 had a comparable structure to the case study one; out of these 11 programs, 7 had data science somehow considered in the course curriculum (Table 6).

Table 5: Journalism and media programs

Programs listed by sub-disciplines	Sub-discipline: Journalism France: 1 Spain: 4 Turkey: 2 United Kingdom: 135 United States: 227
Sub-discipline: Public Relations	Spain: 4 Switzerland: 1 Turkey: 6 United Kingdom: 27 United States: 100 *TOTAL: 137*
Programs listed by sub-discipline journalism (combined with public relations)*	Turkey: 1 United Kingdom: 5 United States: 14 *TOTAL 20* **taken from program title*

Table 6: Programs considered for the study

Programs considered for case study analysis	United Kingdom: 2 United States: 5 *TOTAL 7*
How was data science considered in these 7 programs?	
(1) COURSES	
United Kingdom	Investigative Strategies for Journalists Public relations research Public relations campaigns Data-driven marketing
United States	Data journalism Coding and data skills Coding for reporting Public relations research Strategic communication Data analysis and interpretation
(2) SPECIALIZATION	
United Kingdom	Digital media
United States	Data journalism Digital media

Findings from document analysis

Journalism programs are mainly offered in one category with media programs. The 'Journalism and Media' discipline might be divided into the following sub-dimensions: journalism, public relations, media management, as well as mass media and media science. From a total of 984 programs in 10 countries 369 belong to the category 'journalism', 137 to 'public relations' and 82 to media management. Countries with most programs in 'journalism' are the United Kingdom with 135 (out of 411) programs, and the United States with 227ones (out of 525). The following countries are offering journalism programs which are combined with public relations: Turkey (1), United Kingdom (5) and the United States (14). Out of these 20 programs, 11 had a comparable structure to the program addressed in the case study analysis. Again, out of these 11 programs, only 7 (from the UK and the US) had 'data science' as a discipline somehow considered in their curricula. 'Data science' was considered in journalism programs as (1) an integrated part of courses and/or (2) as independent specializations. Data science integration could be found in courses such as data-driven marketing, public relations investigative strategies for journalists (all of them in the UK); and data journalism, coding and data analysis and interpretation (in the US). Generally, it could be seen that in the United States data science tends to be an integrated part in courses and a computing & IT focus could be recognized. In UK 'data science' plays a minor role in journalism curricula. Specializations related to data science are digital media (The UK and the US) and data journalism (US).

CURRICULUM DEVELOPMENT

The digital revolution lets to changes in how information is structured, shared and used. Journalism has to focus on trend topics, such as on adaptation to social media or adoption of new visualization technologies. That is why the journalist has to be taught how to use data. Data journalism curricula respond to objective change in the amount of information stored digitally. *Berret and Phillips (*2016) did an analysis on about 100 journalism programs in the US on if and how data science and computation are integrated into current journalism programs and found out that many journalism programs offer few or no courses on data journalism, and there is a lack of skill in data journalism. They recommended that journalism schools should cooperate across the university to meet their need for instruction in data science and computation and should focus on alternative ways of teaching to fill the gap in their own faculty, such as individual tutorial packs or online courses. Berrez and Phillips (2016) defined the key areas of data journalism as (1) data reporting: obtaining, cleaning and analyzing data for use in telling journalistic stories, (2) data visualization: using code for digital publishing, (3) emerging journalistic technologies: new developments using data and technology, and (4) computational journalism: the use of algorithms, machine learning and other new methods to accomplish journalistic goals. They defined five different models for integrating data science and computation in journalism programs, summarized in Table 7.

Table 8 shows the curriculum of the journalism program to be enriched with a data science dimension.

Table 7: Curriculum models for journalism programs (Berret and Phillips, 2016)

Model	Title	Content
1	Integrating data as a core class	Title: Foundations of data journalism The course is an introduction to the collection, analysis, presentation, and critique of structured information by journalists
2	Integrating data and computation in existing courses and concentrations	- integration in introductory and required journalism classes - integration in advanced classes and electives
3	Concentration in data and computation	A data journalism concentration should begin with several core courses, required classes before moving into a track of electives offering data journalism analysis, visualization, and online research/backgrounding.
4	Advanced graduate degree I	Title: expertise-driven reporting on data & computation
5	Advanced graduate degree II	Emerging journalistic techniques and technologies

Table 8: Curriculum

Semester	Course	ECTS
1	Communications in Theory and Practice (L)	4
	Media Evolution (L)	4
	Fundamentals of Public Relations (L)	4
	Journalism Basics (L)	3
	Journalistic Writing (iL)	3
	News Writing (Se)	2
	Web Technology Fundamentals (iL)	2
	Communication on the Social Web (iL)	2
2	PR Concept (L)	4
	Journalism in Practice (Se)	6
	Research-Based Writing (Se)	2
	Introduction to Scientific Methods (L)	3
	Content Management (iL)	3
	Web Publishing (Se)	3
	Pictorial Editing (IL)	3
	Project Management (Se)	2
3	Applied Social Research (iL)	5
	Video Production (iL)	5
	Reportage Writing (Se)	4
	Media Theory and Analysis (L)	4
	Strategic PR (Se)	4
	Strategic Corporate Communication (L)	3
	Bachelor Paper 1 (BA)	8
4	International Media (Se)	2
	Scripting and Coding (iL)	4
	PR Lab (L)	2
	Online Magazine Journalism (Se)	5
	Content Strategy (Se)	6
	Project (Se)	8

5	Integrated Communication (iL)	6
	Media Trends (iL)	7
	Opinion Mining (iL)	4
	Mobile Reporting (Se)	4
	Corporate Publishing (Se)	6
	Work placement 1 (PR)	9
6	Seminar (Se)	2
	Bachelor Paper (BA)	10
	Work placement 2 (PR)	9
	Project (Se)	9
TOTAL		180

L ... lecture, Se... seminar, iL.. integrated lecture   BA... Bachelor work
PR.... internship

Based on the literature review in general, the study of Berret and Philipps (2016), the document analysis done within this study, and the state of the art analysis on the program, it was decided to (1) implement data science as a core course and (2) integrate data science into existing courses and concentrations, as illustrated in figure 1. In a first step, it was, together with the instructors from 1-year courses, analyzed for which courses it would be possible to add a data science dimension: course objectives, learning outcomes, course content and instruction methods were reviewed. Four lectures of the first two semesters, which are Journalism Basics (1. semester, lecture, 4 ECTS), Web Technology Fundamentals (1. semester, integrated lecture, 4 ECTS), Communication on the Social Web (1.semester, integrated lecture, 4 ECTS) and Introduction to Scientific Methods (2.semester, lecture, 4 ECTS), were enriched with a data science dimension. For at least 3 lessons data science was included in each course syllabus as a mandatory dimension. On a whole 12 lessons from 4 courses focus within the new curriculum on data science from different perspectives.

In the following step, a new two-dimensional course on 'data science' was implemented for the 3.semester, with (a) the lecture section focusing on data science from a social science perspective and (b) a training section offering students the opportunity to apply theoretical concepts in small tailored projects. The course 'Data Science' was designed in two part: Data Science 1 (lecture, 2 ECTS) and Data Science 2 (integrated course, 2 ECTS). To integrate these two courses and hold the 180 ECTS max rule, the ECTS for the following courses were reduced: Introduction to Scientific Methods (2. semester, ECTS reduced from 4 to 3), Video Production (3. semester, ECTS reduced from 6 to 5), Online Magazine Journalism (4.semester, ECTS reduced from 6 to 5) and Mobile Reporting (5.semester, ECTS reduced from 5 to 4). In the lecture, the instructor focuses on the following topics: statistical inference, exploratory data analysis, data science process, extracting meaning from data, data visualization and ethical issues. The training section focuses on deploying a structured lifecycle approach to data analytics problems, applying appropriate analytic techniques and tools to analyze big data and on how to tell a compelling story with the data to drive business action.
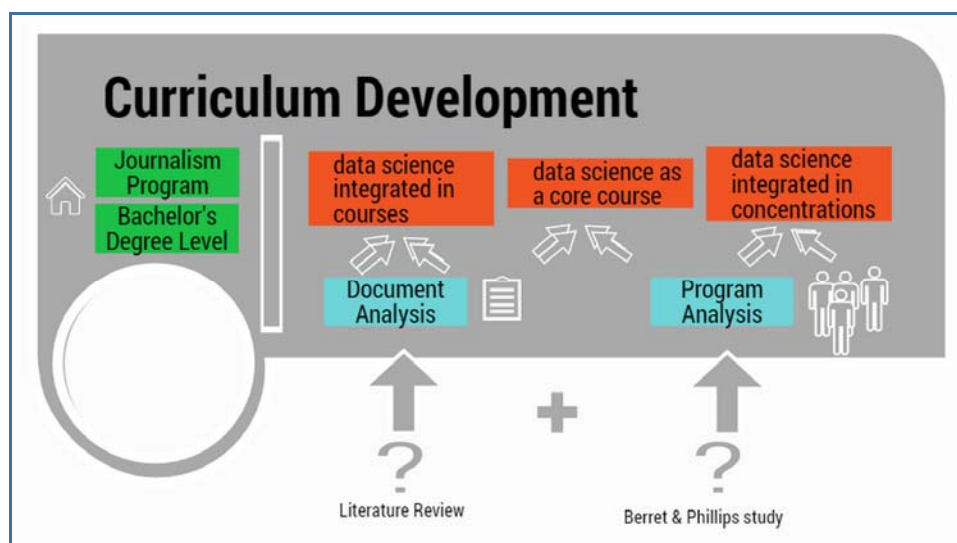

Figure 1: Curriculum development roadmap

Additionally, a specialization on 'digital journalism' was implemented. According to the newly developed curriculum, from the 4. to the 5. semester students are able to choose between an 'Online Communication' specialization and a 'Digital Journalism' one. The following courses of the previous curriculum were added to the Online Communication field: content strategy (6 ECTS), Integrated Communication (6 ECTS), corporate publishing (6 ECTS), media trends (7 ECTS), PR Lab (2 ETCS), in sum 27 ECTS. The second field, the newly defined Digital Journalism specialization contains the following courses: data journalism (4 ECTS), data-driven analysis methods (6 ECTS), online magazine journalism (5 ECTS), mobile reporting (4 ECTS) and a newsroom project (8 ECTS), in sum 27 ECTS as well. The structure of the revised curriculum is shown in Table 9, where the courses from the 1. to the 3. semester are unchanged, but the content of selected courses enriched with a data science dimension.

Table 9: Curriculum 'Digital Journalism'

Semester	Course	ECTS
1	Communications in Theory and Practice (L)	4
	Media Evolution (L)	4
	Fundamentals of Public Relations (L)	4
	Journalism Basics (L)	4
	Journalistic Writing (iL)	3
	News Writing (Se)	2
	Web Technology Fundamentals (iL)	4
	Communication on the Social Web (iL)	4
2	PR Concept (L)	4
	Journalism in Practice (Se)	6
	Research-Based Writing (Se)	2
	Introduction to Scientific Methods (L)	3
	Content Management (iL)	3
	Web Publishing (Se)	3
	Pictorial Editing (IL)	3
	Project Management (Se)	2
3	Applied Social Research (iL)	5
	Video Production (iL)	5
	Reportage Writing (Se)	4
	Media Theory and Analysis (L)	4
	Strategic PR (Se)	4
	Strategic Corporate Communication (L)	3
	Bachelor Paper 1 (BA)	10
4	International Media (Se)	4
	Scripting and Coding (iL)	4
	Project (Se)	9
5	Opinion Mining (iL)	5
	Work placement 1 (PR)	10
6	Seminar (Se)	3
	Bachelor Paper (BA)	10
	Work placement 2 (PR)	9
	Project (Se)	9
TOTAL (main courses)		150
Field Online Communication		
4	Content Strategy	6
4	Integrated Communication	6
5	Corporate Publishing	6
5	Media Trends	7
5	PR Lab	2
TOTAL (field)		27
Field Digital Journalism		
	Data Journalism	4
	Data-Driven Analysis Methods	6
	Online Magazine Journalism	5

	Mobile Reporting	4
	Newsroom Project	8
TOTAL (field)		27
TOTAL (ECTS)		180

CONCLUSIONS AND RECOMMENDATIONS

Curriculum development is risky as a strategy, costs money, is time consuming but a competitive factor for higher education institutions. For institutions, it might be simple to add some courses or changing a few topics in an existing curriculum, but curriculum development should be linked with an institution's vision and mission. It should be a democratic and participative process within an organization and should offer short run and long run benefits. For creating an integrative curriculum development, the following parameters should be considered: Lack of strategic planning, a culture of curriculum development, lack of leadership skills and limitation of resources. Challenges are (1) the rapid need for curriculum changes triggered through the institution's environment, (2) the culture of the institution, and (3) the differences in the learning styles of individuals. The results of the study revealed that offering a three-dimensional data science education with (1) integration of data science components in traditional journalism courses, (2) offering fundamental courses in data-driven journalism as well as (3) offering a specialization in data journalism for students interested in advanced skills, is essential for a journalism programs in Higher Education to equip students students with data skills for a data journalist.

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