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Telling tales together: creating good collaborations between journalism and computer science students

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Abstract

Technology keeps offering journalists new tools and techniques for exploring fresh ways of finding, researching and telling stories. This provides journalism educators and students with an ever-changing range of challenges and opportunities. One possible response is for journalism students to learn to collaborate with students from other subject areas, such as computer science, to

enhance their storytelling. This article critically discusses the potential of such collaborations by using the Knight Lab, at Northwestern University, Chicago, as a case study. The Knight Lab is a world-leading community of journalism educators and students, designers and developers, who work together on experimental projects aimed at finding new ways of doing journalism. The article's findings are based on an observation of a Knight Lab class, interviews with Knight Lab staff, and an online survey of its students. Among its findings are that such collaborations work best when embedded in courses as optional modules, scaled properly and employing a selective process. Journalism students benefit from some prior coding knowledge, while classes need the support of specialist staff to be effective. The evidence also suggests there are pedagogical and employability benefits for students from these collaborations as they mirror current best practice in many newsrooms.

Introduction

Journalists and journalism students now have access to more data than ever before. This means they have more potential stories to tell than ever before. But how as practitioners and educators can we help our students make best use of these resources? One approach would be to train budding journalists in a vast and comprehensive range of new skills - to ensure they are experts in data, coding and programming as well as the traditional skills of interviewing, writing and finding stories.

Another approach would be to help them learn how to work with students from complementary subject areas – students who could help journalists find stories within data, make sense of that data, and tell those stories in compelling ways. It is this second approach which will be the focus of this article.

The article seeks to address the following core questions:

What are best conditions for creating successful collaborations between journalism and computing science students?

What can journalism educators, and their institutions, do to promote these conditions?

What value do such collaborations have for journalism students?

These questions will be explored via a case study of the Knight Lab – a world leading organisation in collaborations between journalism and computing students. The Knight Lab is based at the Medill School of Journalism, Northwestern University, Chicago. The School is regularly listed at or near the top of lists of the

best journalism schools in the US, its course fees are around $50,000, and it accepts approximately 13% of applications it receives. The Lab itself is billed as a 'community of designers, developers, students, and educators working on experiments designed to push journalism into new spaces' (Knightlab.edu). Physically, the Lab takes up a small wing of the journalism building, comprising two workshop rooms, a meeting area and staff offices. Founded in 2011, the Lab was originally funded by a grant from the Knight Foundation. It is perhaps best known for the range of open-source media tools it has produced for reporting, data gathering and storytelling. These include TimelineJS, which is now available in more than 60 languages and has been used by more than 300,000 people worldwide.

The formal, curriculum based part of the operation is the Knight Lab Studio, which is a 10-week class running quarterly across each year. The class is credit-bearing for journalism and computer science students, but also open to students from other disciplines, and brings together small multi-disciplinary teams of students and staff to work on small-scale media related projects. Students attend a two-hour workshop in the Lab, twice a week, and are expected to do a further six hours of work each week in their own time. These workshops consist entirely of group work and there are no formal lectures in the module. Students wishing to take the class must apply to take part in specific projects, which are proposed and designed by staff in the Knight Lab and wider journalism team. Groups of four or five students are then selected to work on each project. In the most recent round of selections, more than 80 students applied for around 20 places. Students taking the Knight Lab class are assessed on a critical evaluation of their experiences in the Lab, rather than on the outcomes of the projects themselves. Examples of recent projects include a tool to help journalists make sense of US Census data, experimenting with best use of sidebars and glossaries in storytelling, an audience study of when and how to deliver news on mobile, and a tool to help citizen journalists best record and report on public meetings.

The inspiration and funding for the empirical foundations of this article come from the authors' participation in Creative Fuse North East. This three-year, AHRC funded research project has involved partnership between five north east universities (Sunderland, Durham, Newcastle, Northumbria and Teesside), working with the region's creative, digital and tech industries. One of the aims of Fuse has been to explore potential new collaborations across these sectors. Academic staff at the University of Sunderland have been involved in a number of activities bringing together specialists from the worlds of journalism and computing – these include a mini-conference, an investigative journalism project researching online abuse of female politicians, and the running of a short-course in journalism skills.

Creative Fuse provided funding for the authors to visit the Knight Lab in early 2018, to observe the Lab in action, meet staff and students, and collect some of the data on which this article is based. The visit, and the resulting findings discussed below, will also inform curriculum development bringing together staff and students from journalism and computer science subject areas.

The following section of the article provides a critical discussion of some relevant previous literature about collaborations between journalism and computing, the subsequent section outlines the methods used to gather empirical material for the article, before the findings of this empirical work is presented and contextualised. The article finishes with a conclusion directly addressing the core research questions set out above.

Research Context

As Lewis and Usher (2014) have argued, two major factors have encouraged intersection and collaboration between the worlds of technology and journalism - an increase in data driven journalism requiring programming skills, and new forms of news presentation that rely on interactive web design. In terms of data, journalists and journalism students now have access to more data than ever before. This presents opportunities and challenges in terms of identifying, researching and visualising stories. This, in turn, requires a new set of skills and approaches to doing journalism. Without such progress, the danger is that journalism will waste the potential benefits that new access to data can bring. As Long argues: '…there can be floods of open data pouring into newsrooms every day, but without the ability to extract it, and the ability to place it in context, it is not going to be much advantage to newsrooms' (2014, p.33).

The above challenges have led, in part, to the development of computational journalism (Gynnild, 2014) – the concept of journalists using computers to tackle problems and produce content that would not otherwise or previously have been possible. One approach is for journalists themselves to learn the coding and programming skills required to perform this type of journalism. For a while, particularly in the US context,

there was a growing consensus that journalists would need to be all things to all people and embody a mix of journalistic and technical/computer skills - what has been termed the hybrid, programmer-journalist model of journalism (Parasie & Dagiral, 2012). In response, and following the lead of Columbia, New York, in 2011, a number of educational institutions now offer courses combining computing and journalism.

However, more recently, there is growing evidence to challenge this idea of the programmer-journalist model, and to suggest the idea of the 'newsroom unicorn' is a myth. For example, Howe et al (2017) conducted some international research based on 72 interviews with data journalists, web developers and design editors. They found the reality of how newsrooms operate to be based on collaboration rather than individual, hybrid specialism. The best, and most common, practice identified involved small, nimble teams combining journalists and computing specialists coming together to work on short-term projects to create editorial content or products. Hannaford reached similar findings in a case study of computational journalism in the newsrooms of the Financial Times and BBC, concluding:

A team approach is adopted whereby journalists, programmers and designers work closely together to produce multimedia, interactive news products… In this model, the journalist is responsible for sourcing the data and carrying out the initial analysis in order to find the news story to be pursued and then contextualising it. Indeed, the story remains central to the whole team's approach (2015, p.14).

Hannaford (2015) also found that most journalists working in teams on computational journalism projects did not identify themselves as coders, but did have skills in data analysis – and with Excel in particular. There is a need to be careful about relative and subjective definitions here, as the journalists interviewed were tech savvy and knew enough to communicate effectively with coders. They may not have felt their skillset merited the term 'coder', but this was in comparison with the experienced developers they were working alongside. As Hannaford observes however, the journalists did 'have enough knowledge of some programming languages to enable them to carry out, for example, important data-gathering tasks such as web scraping' (2015, p.16)

These findings have important implications for journalism educators and decisions about the curriculum they should be teaching their journalism students. At the heart of these decisions are questions about whether journalism students should be taught how to code and, if so, to what level? The emerging consensus seems to be that most journalism students would benefit from some teaching in how to code. However, students do not need to become proficient coders and programmers themselves, rather they need to reach a level that allows them to communicate effectively with coders and understand what is possible with code. As Anderson et al have argued: 'Journalists should learn to code… every journalist needs to understand at a basic literacy level what code is, what it can do, and how to communicate with those who are more proficient' (2012). Journalists and journalism students need to be able to understand coding and programming skills in order to communicate and think about problems, and their potential solutions, in a useful way. Long has suggested this is very similar to some traditional relationships journalists have had with others in newsrooms, such as page designers – 'I didn't have their talents, but we could talk about the aim of the page, and how to achieve it stylistically' (2014, p.30).

Communication and understanding across subject specialisms are important because, as Lewis and Usher (2014) have identified, a deficiency in these has previously provided barriers to successful collaboration between journalists and computer specialists. In their study of the Hacks/Hackers network they observed problems relating to 'technical jargon that developers knew and journalists did not; others were about differences in thinking – such as journalists' concern with short-term, one-off stories compared to developers' interest in long-term, ongoing software development' (2014, p.389). A jarring of working cultures, exacerbated by limits in effective communication, can therefore hinder projects.

All of this has implications for journalism educators and suggest that, particularly for those interested in teaching data related journalism, there is value in helping students learn to collaborate so they can succeed in the 'inextricably social nature of the workflow' (Howe et al 2017: 4). Previous studies have discussed how a culture of professional independence and autonomy can lead to resistance among some journalists to working with others from outside of their immediate network (Deuze 2008). By introducing journalism students early to the potential benefits of collaboration, and the skills and qualities necessary to make it work, we can help overcome some of this resistance. There is also evidence that working in interdisciplinary groups can help journalism students reduce anxiety and improve understanding. For example, Chowdury et al (2018) concluded that students 'found collaboration valuable in learning computational thinking by allowing them to ask about and explain problems, especially with students from different disciplines who perceive and explain a problem differently' (Chowdhury et al 2018).

Such collaborations could be conceived of as communities of practice. These are often self-selecting

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groups of practitioners who come together around an idea or issue with 'shared commitment and expertise, committed to interaction and learning' (Das and Clark, 2017, p.3). Communities of practice can form across spatial and institutional boundaries, or across boundaries within individual institutions. Schmitz-Weiss and Domingo (2010) have used this framework to examine collaborations across departments within newsrooms, such as between journalism and technology teams, and argue it provides a useful approach to understanding how innovation can occur through 'the learning and sharing of knowledge'. Those studying communities of practice seek to understand how skill-building and professional development occurs through a process of collaboration across traditional boundaries. Meltzer and Martik (2017) have argued this approach can be usefully applied to the study of journalists, and the same could be argued for the study of journalism students and education. As Hannaford observes: 'A useful model would be to 'bring together the social worlds of journalism and technology students within a university setting to foster greater understanding and collaboration' (2015, p. 19).

This leads to questions about what makes for successful communities of collaboration? What conditions make for good collaborations between journalism and computing students? And how can these conditions be developed or encouraged? These questions will be addressed in the following sections.

Method

This article takes a case study approach to its subject. While this must place some limitations on the extent to which its findings can be generalised, there are benefits to the detailed and focused nature of this approach. As Flyvberg has argued: 'The advantage of large samples is breadth, whereas the problem is one of depth. For the case study, the situation is the reverse. Both approaches are necessary for a sound development of social science' (2006, p. 241). The Knight Lab provides an interesting and useful case study as it is one of the world leaders in this subject area and has gone through a series of changes and 'improvements' since its inception (discussed above). Understanding these improvements, the reasons behind them, and how they are perceived by staff and students, is therefore of wider benefit and interest to other journalism educators. That said, the fact that the Knight Lab is such a well-resourced centre within one of the world's best regarded institutions, means it has a relatively privileged position in this field. Findings need to be thought of and considered in this light and issues, such as resources, will form part of the later discussion.

The methods used to gather data for this article have combined observation, interviews and an online questionnaire. The authors spent a day (January 2018) visiting the Knight Lab and watching a class in action. During and after the class, authors talked to students and staff about what they were doing and their perceptions of how the class worked. This included conversations with two key members of the Knight Lab staff:

Zach Wise is Associate Professor in the Medill School of Journalism at Northwestern University and one of the founders of the Knight Lab. He was formerly a Senior Multimedia Producer at the Las Vegas Sun, where he won a Pultizer Prize, and then part of the New York Times' Multimedia team – where he won an Emmy and received various other honours. He is creator of the Knight Lab's TimelineJS and StoryMapJS products.

Joe Germuska is Knight Lab's Chief Nerd and is in charge of the Lab's technology professional staff and student fellows. He previously worked for the Chicago Tribune as part of its News Apps team.

In addition, an online questionnaire was sent to students doing the Knight Lab class, asking them about their experiences of taking part in a collaboration between journalism and computing students, and what they felt had and had not worked. The questionnaire was completed by 10 students which included a mix of students from the journalism and computer science subject areas.

Findings and Discussion

In this section we will draw on our observation of the Knight Lab, and interviews with its staff and students, to identify key lessons about what makes for good collaborations between journalism and other students.

Creativity and exploration are core to the philosophy of the Knight Lab, and a key part of this is giving students the space to fail, and to learn from this. As Joe Germuska identified: 'The path to journalism innovation is diverse, nimble and creative teams focused on identifying real human needs and experimenting with

solutions to them. It's about moving quickly, trying things, failing, learning, and trying again' (Interview, 2018). Germuska also reflected on the fact that this philosophy can lead to problems with external partners who place more priority on 'successful' outcomes from projects, and that creativity and innovation within education is sometimes easier when free of such partnerships. In its early stages the Lab had more formal project partnerships with external organisations but has, more lately, reduced these to protect educational freedom and creativity.

This freedom, and the freedom to fail, is also reflected in the nature of the assessment in the Knight Lab Studio, in which students are not assessed on the outcome of the project, but on an individual critical reflection of their experience of the class. This is designed to encourage innovation, reflection and learning, rather than specific outcomes. In the UK, data journalism educator Paul Bradshaw has similarly reflected on the importance of designing assessments to promote experimentation and depth of learning. As part of his data journalism MA course he has an assessment in which students participate in such communities and are assessed on research, reflection, and creativity. He said: 'The design of the assessment is geared to ensure that students focus more on learning than execution, and are therefore prepared to take more risks in their work' (2011).

The evolution of the Knight Lab class over the last seven years has seen staff adopt a design centred approach to projects. This involves putting people at the heart of the process, considering what problems they have, and then coming up with solutions to help them solve or deal with these. Knight Lab staff believe such an approach helps students, and journalism students in particular, see the relevance and usefulness of their work.

We really see this as a design operation. You have only limited time and skills to work with technology, so you'd better be doing it for good reasons. So we start with design process to identify the right thing to do and design methods that allow you to do research and experimentally evolve into the right thing. The other thing we like about design as a frame is it is maybe a little more inviting for example journalism students. There is a lot of language about design thinking and design approaches that is really about a balanced approach. (Germuska interview, 2018)

These ideas resonate with the findings of Howe et al who found digital journalism collaborations within newsrooms often working best when they followed a design approach which can involve 'brainstorming, human-centred design, iteration, collaboration, rapid prototyping, user testing, and an open process that doesn't shut out personnel' (2017, p.4).

As well as having the right underpinning philosophy and educational approach to projects, the Knight Lab experience tells us it is also important to create the right structures around the class. As outlined above, the class works on the basis of students applying to take part in specific projects proposed by staff. The staff set out the foundations of what the project is about and aims to achieve. In the most recent round, more than 80 students applied for around 20 places. Staff believe this approach, adopted recently, has had a number of benefits.

One benefit is that it tends to produce teams of highly motivated and enthusiastic students who value their place on the module and try to make the most of it. It is interesting that, even at such a highly ranked and selective university as Northwestern, staff still complain about student attitude and apathy in some core classes:

One of the things is we kind of get to cherry pick, especially with employing students. I love to work with people who are learning and have never been enthused by the idea of teaching a class where people were obliged to be there. Every Journalism student goes though fundamentals that include basic web stuff, but it's one of the staff's least favourite things to teach because students are doing it because they have to. (Germuska interview, 2018)

That said, the Knight Lab has also found that embedding the class within degree programmes, by making it credit bearing, has helped improve student engagement:

Last year it was listed as a journalism credit and over the summer we were able to reconnect more directly with the computed science department, so now you can get a computed science credit for it which has helped us get better participation. (Germuska interview, 2018)

The right balance for a class of this kind appears to be to give it value in terms of programme credits, so participating students get something tangible in terms of their degree, but to make it an optional, selective module within that degree.

A second benefit of the selective process is that it allows staff to scale the process more efficiently. Projects have, from the start of the class, already have some definition to give students direction. In addition, students

will have given the project some thought as part of their application. Staff have found this works much better than a situation where students arrive to the class in week one with no idea of what their project will be – particularly in a relatively short class of 10 weeks.

At the conference table we lay out applications in a stack and say 'this seems good', but the real part of that is to make sure students are engaged in a specific project idea rather than learning about it the day the class starts. (Germuska interview, 2018).

Students also identified getting the correct scale to projects as being crucial to making the class work. One said: 'It is important to ensure students choose reasonable end goals as it is easy to over or under estimate the amount that can be done in a given timeframe' (Student, online survey, 2018). If projects are not finished by the end of the 10 week class then staff will sometimes role them over into the following term. Students are also permitted to take the class more than once and so can continue on an unfinished project or start work on a new one.

> *Projects don't all have a life beyond the class, but if they do have promise we are in a position to carry them on, whether because we can repeat it the very next quarter or because we know we can break it out of the class and carry it on with paid work either by professional staff or student employees. (Germuska interview, 2018)*

A third benefit of the selective approach to the class it that it helps staff create groups of diverse and complementary skills. It has been found in the Knight Lab that the ideal group size for such collaborations is four or five students, with the right balance of journalism and computing students:

> *Having a good ratio of technical to journalism students is key to success. Having a 1:3 or 1:2 ratio of journalism to technical students is likely ideal. (Journalism student, online survey, 2018)*

As the Knight Lab is essentially a computational journalism class, focused on producing storytelling tools, it is likely to require a higher proportion of computer science students than, for example, a data journalism class in which the outcome of a project might be a story, rather than a piece of software.

In terms of roles performed within project teams, journalism students often provide management of the group, keeping a focus on the people-centred problem at the heart of the project and how potential solutions will work for the audience – in the world beyond the Lab. Knowing your audience and keeping them in mind when producing content has always been a core skill for journalists and journalism students. For example, one student said:

> *The journalism students act as nontechnical project managers and provide background knowledge and some direction to the computer science students. The computer science students do the bulk if not all of the programming work to build prototypes/projects. (Computing student, online survey, 2018)*

Another commented:

> *I feel like journalism students add value by bringing a solid vision to the project and a good grasp of audience engagement. Students with computing skills have, in many respects, the harder job of making these ideas and informational interviews come to fruition (Journalism student, online survey, 2018)*

Another function of the journalism student(s) within the group often relates to how the results will be communicated – again drawing on traditional, core journalism skills:

The journalists should be working with the computing students to create widely-understandable tutorial and testimonial content/documentation for the projects. (Student, online survey, 2018)

These findings correspond with the observations from Hannaford (2015) and Lewis and Usher (2014) about roles usually played by journalists in computational collaborations in newsrooms. They found that it was the journalist's role to keep the work focused on the story, and to provide direction and grounding to the more technical work of their colleagues.

Another important factor in creating effective collaborations is that of resources. While the Knight Lab is clearly a very pleasant place to work, it is not filled with expensive looking or state of the art equipment. It is an average-sized, well-lit classroom, to which students bring along their laptops and sit and work together in groups. The blackboards on the classroom walls, filled with doodles and brainstormed ideas, give a sense of the work that goes in there, but they would be within the budget of almost any educational institution. Instead, the most obvious and powerful resource on show were the staff. For a class of around 20 students, there were two academic staff and two technical staff. As Germuska observed:

We are fortunate that Northwestern has a lot of resources… Direct staffing is two assigned Faculty because project classes just require a lot of oversight. They have obligations of evaluation. (Germuska interview, 2018)

This is important as Heravi (2018) and Treadwell et al (2018) recently identified a shortage in specially trained staff as a major challenge in this area of journalism education. Lewis and Usher (2014) have also previously identified institutional support as being crucial in establishing effective collaboration. While many institutions will not be able to match the resources of Northwestern, it needs to be recognised that classes of this kind require the support of enough staff with the requisite specialist skills if they are to be successful.

The Knight Lab have also used external grant money to pay student fellows to support teaching staff. These student fellows are students who have previously studied the Knight Lab class, and shown aptitude, who are paid to provide teaching support to project groups in class and help other students who just want to come to the Lab in their own time to work on material of interest to them.

We were really fortunate to have a grant from one foundation that is very loose in its expectations except that it needs to be spent on student experiences. And we interpreted that as we can pay students to do work for us, so we started hiring student fellows. (Germuska interview, 2018)

Another important consideration is the level of computing and coding skills required by journalism students to take part in collaborative projects. As discussed above, this has been a longstanding discussion within this field of journalism education and the findings here support an emerging consensus – that while journalism students do not need to be skilled coders themselves, they do need a minimum level of proficiency to effectively participate in computational journalism collaborations.

One reason for this is to do with communication within the group. As one student said:

Not every journalist involved needs to have coding skills to define the problem and provide feedback, but for teams that have more than one journalist, one journalism student should have ample coding experience to communicate solutions-oriented feedback from the journalism students that may struggle to communicate with engineers. (Journalism student, online survey, 2018)

This potential communication gap can also be helped by students being willing to avoid jargon and make allowances for the various levels of knowledge within a group:

Explain yourself clearly on both sides, avoid industry terms, meet the other person at their level, use basic explanations and analogies for technical terms or ideas, and be patient and understanding. (Computing student, online survey, 2018)

Cross-collaboration and being willing to answer even seemingly silly questions has been particularly important too. (Journalism student, online survey, 2018)

I have found that providing a lot of structure as to how to talk about a project on a micro (conflict resolution) and macro (outlining next steps) level is helpful at a beginners' level, as it provides clarity on what each person is responsible for on the team. (Computing student, online survey, 2018)

Another reason for journalism students to have some grasp of coding is to do with understanding the potential paths a project may take:

It is important for them (journalism students) to understand what is feasible with current technology in the given time frame. Experience with programming can help provide this knowledge. If they would like to help build the prototype/project more programming experience is definitely helpful. (Computing student, online survey, 2018)

Also, do as much research together as possible. Journalists are often observers, when they can see how small tweaks to the engineer's code directly manipulates product-solutions, they more quickly understand the potential and restrictions for the engineering solution. (Computing student, online survey, 2018)

Heravi, in an international review of data journalism courses and modules, found that students tend to have received a lack of education 'in the more technical areas of data journalism, such as data analysis, coding and data visualisation' (2018). This supports the findings of Treadwell et al (2018) who identified shortage of student competency in these skills as a major challenge in the teaching of data journalism. Students who are selected for the Knight Lab class are well aware of this shortage of technical and data skills among some of their peers, and how having such skills can give them an advantage in both their education and future careers:

I was a Journalism and Computer Science double major throughout my first year at Northwestern, and I saw a gigantic dearth of technical skill on publications and in classes. I was seen as very valuable on publications for this reason. (Journalism / computing student, online survey, 2018)

Not having a basic understanding of HTML, CSS or and how a CMS functions are pretty major hurdles to overcome as a journalist today. It also seems like a lot of the emerging jobs relate to data in one way or

another, so having some facility with that is super helpful too. (Journalism student, online survey, 2018)

I think it's extremely important for all students to have coding skills. It allows them to explore a different career path that they may not have considered before and even if a journalist chooses to stay in a traditional role, a coding background allows them to work better with product and graphics teams in the newsroom. (Computing student, online survey, 2018)

The message, in terms of collaborative working, is that it is important for at least one of the journalism students to have some coding knowledge and vocabulary. Journalism students can manage groups and maintain focus on audience at the heart of the story or problem; CS students can bring their coding and programming skills; but some knowledge of coding among journalism students is required to bridge the gap between the two.

The above discussion has looked at some of the conditions required for creating healthy collaborations between journalism, computing and other students. Staff and students at the Knight Lab are convinced there are huge benefits to creating such communities of practice within journalism education. Some of this benefit is pedagogical in value – learning how to learn within groups and learning from others with a different, complementary set of skills and mindsets:

I think the exposure to an alternative way of thinking is really valuable. For Journalism students, they get exposed to different ways to think about problems. It's really valuable for them to get some sense of what things can be quantified and computationalised. (Germuska interview, 2018)

Another benefit lies in the longer term employability advantage it provides students who go through a class such as the Knight Lab. Howe et al (2017) and Hannaford (2015) have identified how newsrooms are increasingly employing small, temporary, collaborative teams of journalists and programmers to work on computation, data driven projects. Journalism graduates who can demonstrate experience and talent at working in such collaborative groups therefore have great potential value to employers. As Joe Germuska said:

The philosophy is that the team as a whole can do more than the individual student. Newsrooms for a while seemed to be looking for news unicorns, the person who has all the skills and can do everything – but this is just not realistic. Instead the truth is that diverse teams, working well together, will find the way forward for journalism.' (Germuska interview, 2018)

One of the tasks for journalism educators therefore is to provide opportunity and support for journalism students to learn how to contribute and work effectively in such teams.

Conclusion

This article has explored the best-practice conditions for educational collaborations between journalism and computer science students and considered the role journalism educators and their institutions can play in encouraging such environments. Based on a study of the world-leading Knight Lab, it has identified the following recommendations:

Ethos and approach:

The importance of creating an ethos of creativity, experimentation and freedom to fail within classes.

The value of a design-centred approach which places the audience and human focused problems at the heart of projects.

Curriculum design:

Modules benefit from being embedded (ie credit-bearing) in both journalism and CS programmes.

But should be optional as this tends to result in higher levels of perceived value and motivation among students.

There is value in having an application and selection process as it tends to create more motivated and efficient project teams.

Pre-defined projects give focus to groups and help scale classes more effectively.

Groups of 4 or 5 students work best – containing one or two journalism students.

Journalism students should receive some prior instruction in coding – but this is only required to a level that will allow them to communicate with CS students and understand the potential scope and solutions of

the project.

Assessments that reward experimentation and reflection, rather than project outcomes, tend to have more value and help engender the 'freedom to fail' ethos.

Institutional support and resources:

Collaborations require resources and the support of enough specialist staff.

Creating paid roles for former students can be a useful way to support these staff.

The evidence gathered from this case study, and supported by the recent literature discussed above, suggests there is great value in fostering healthy collaborations between journalism and computing students. In doing so, educators are preparing students for how many newsrooms work on data and computational journalism projects, thereby increasing their employability and value. By working effectively on such projects, journalists are making the most of the data now available to them and that might otherwise go to waste. Furthermore there is pedagogic value in the process of collaboration itself, in gaining confidence, empathy and a wider appreciation of how to learn and work.

The Knight Lab was selected as a case study because of its excellence in this field and it has many lessons from which others can benefit. It is also a highly privileged institution in terms of resources and the quality of staff and students on which it can draw. More work now needs to be done to explore how the findings presented above can be applied in a variety of other educational contexts and institutions with different sets of priorities and challenges. At the heart of these variations though, one message holds true – that by teaching journalism students to tell stories with others, we can help them tell new, better and otherwise untold stories.

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