A MIXED ONLINE/OFFLINE RESEARCH LAB AS A TOOL FOR FOSTERING CREATION OF SCIENTIFIC KNOWLEDGE ON THE FACULTY: FROM COLLABORATIVE LEARNING TO REPRODUCIBLE RESEARCH

Alexandra Akhmetchina, Alexander Didenko, Alexander Ilyinsky
Financial University under the Government of Russian Federation

Abstract

We briefly sketch the system of mixed offline/online collaboration between students and faculty research staff. The main goal of the system is to foster creation of new scientific knowledge by students and faculty research. While student research may be done by collaborating in workgroups, results are defended separately by each student as master dissertation. All the process is seamlessly recorded in electronic form and could be subject to meta-analysis of research process or used to accelerate getting novice in research to know his field. By combining online and offline communication between master students of both years and researchers, we encourage sharing ideas and ensure, that knowledge, created by master while working on his research would stay in Lab either in hard (texts and models) or soft (informal face-to-face communication) form. Other outputs of the system include working papers and publications by students and faculty staff.
Workflow of the system looks as follows. Two major mediums are used in system as basis for offline/online collaboration. First, Lab’s knowledge base, which sums all the information (texts, datasets, models, workspaces, audio/video protocols of meetings, thesis defences, etc.) produced both by faculty staff and students. Second which is used as medium for offline collaboration of students is class “Scientific research in finance”. Credit units, assigned for participation in class, serve as major “hard” motivation for participation in research.

Workflow of Lab is built around developing research tickets. When research problem is defined, it’s cataloged and stored in online repository in Mediawiki in the form of research tickets. Each ticket contains compact description of main research problem and its background, possible research outcome, possible research questions, research approach/methodology (or link to other research ticket indicating the need to create research approach/methodology), dataset (or indication of the need to create one), preliminary list of literature, links to relevant researches and reviews, pros and contras for participant which will be engaged in research. Tickets could be split (forked), merged, assigned to students and mentors, be archived, inherit other tickets. Only one ticket is allowed per student. If during research it turns out that due to the volume of research it’s not feasible to be finished by one student, it could be split or forked and later assigned to other students. First generation of tickets was breed by intercepting major scientific interests of faculty staff with Thompson-Reuters research fronts. The list of tickets is updated yearly after reviewing current Thompson-Reuters research fronts, or when any faculty staff reveals new research problem during research done by student. Also, at the end of research student must provide ideas for at least two new tickets, which then are approved by his mentor. Mentors could oversee several dozens of tickets, but at the same time be responsible for only up to 5 student researches simultaneously.

Demand of freshmans for specific type of research problems could vary from year to year depending on their background. To define major characteristics of research problems demand master freshmans are
surveyed and then interviewed by research staff in order to clarify their professional background, educational needs and potential research interests. To do that, member of faculty research staff examines cv’s and survey profiles of students and appoint interviews according to their interests. Students could also apply to interview with research staff members after reviewing their online profiles in Mediawiki. During interviews students could get initial information about tickets, supervised by researchers.

The cycle of work on master dissertation is divided into several parts, and student gets credits in Research problems in finance class after finishing next part. First two lectures are dedicated to description of the workflow and tickets of faculty. All tickets and researchers profiles are available online for studying by students.

After round of interviews and surveys major researchers (faculty staff) arrange yearly meeting. The goal is to decide what tickets will form supply side for coming year. Supply tickets taken by students will join pipeline, i.e. the subset of tickets, currently developed by students of first and second year. When deciding on supply priority is given to tickets according to its urgency, demand by students and perspective to leverage student’s collaboration in workgroups. For example, if during interview it’s revealed that student A is capable and well-motivated to develop tickets X1 and Y2, and student B – Z1 and Y1, Y1 and Y2 are based on shared dataset to be collected, then Y1 and Y2 are chosen to join pipeline this year.

Pipeline then is made available to students (which decide to enroll to tickets), and to other teachers of faculty, even those not involved in supervising research. Teachers are encouraged to slightly transform their curriculums to fit current pipeline. Tickets became student’s preliminary topics of master dissertations. Several classes (like econometrics) have partly agile curriculum, allowing teacher to tailor some lessons according to current pipeline. Individual assignments specified in class curriculum are chosen by teacher on the basis of tickets, developed by particular student. R-project/RStudio is used as major statistical tool. This is cross-platform open software, equipped with functionality of reproducible research (through Sweave technology) and collaboration (through integration with Git repository). All projects
done by students in “agile” classes are shared in Lab’s Mediawiki and are ready for further reuse and reproduction.

Scientific research seminar is built as a series of specialized sessions, where students in workgroups, comprised of major researchers and master students of first and second year, are receiving tailored classes according to their major topic of research, or delivering their own reports, and then participating in mock debates, imitating processes of dissertation theses defense or peer-reviewing of journal article. All materials (reviews, comments, audio/video materials from debates) are then shared in Lab’s Mediawiki. Participation in mixed 1st-2nd year groups encourages students to share their ideas and experience. Another way to simplify introduction of novice researcher to some problem is article reviews database. During research project each student reviews 2-3 articles from scientific journals on his topic, and sometimes – replicates in R quantitative model, used in articles. All reviews are submitted to Mediawiki.

Mediawiki is organized by workgroups. Initially, workgroups were created by manually analyzing Thompson-Reuters research trends and uniting several trends into more coarse structures. Research trend could thus be a part of several workgroups, and this defines links between interests of workgroups. Student could also be a member of several workgroups, depending on his research topic. Each workgroup page contains calendar of events and the list of current edits to Mediawiki, which might be of interest for workgroup members. For example, if student from Globalization workgroup submits paper review, where cointegration of equity indices from major international financial centers were studied, and supplies it with keywords “cointegration” and “equity indices”, students from Risk Management workgroup immediately see this new edit and could read the review, paper itself and replicate quantitative part, if interested. That happens, because supervisors of Risk Management group indicated mentioned keywords as relevant for their workgroup.

Interaction between mentor and student is organized as follows. After choosing his research ticket, student writes research proposal, submits it to Mediawiki, gets feedback from mentor, and after several rounds gets his proposal approved. All proposal review process is
stored in Mediawiki and could be used further for reflections on methodology of research as a whole. Second step is thorough review and analysis of several articles. Without approved proposal and paper reviews student won’t be credited for first part of scientific research seminar. As a rule, both reviews and proposals further become part of master dissertation text. Student could also use paper reviews of previous years to develop knowledge on his topic of research faster and more efficiently. All paper reviews are done in the same pre-defined structure. After setting initial hypothesis and tasks of research, student assigns deadlines to tasks, which are then approved by mentor. After each round of offline consultations master writes short memo, detailing what was talked, what feedback he got from mentor, what are new tasks with respective deadlines. All memos are submitted to Mediawiki and serve several goals: first, when student writes memo himself, he takes responsibility for result; second, mentor could receive feedback – what student understood and what he didn’t from what was talked during consultation; third, using all memos history it’s easy in future to understand total trend in research and extract some feedback concerning the logic and general methodology of research. Sometimes during research new problem is revealed, which could stop this current research from being finished in time. In this case new ticket or even tickets are created, and research proposal is reformulated to make total research project feasible in terms defined by master’s curriculum. New tickets could be also added by any time by major researchers (faculty staff) or even by students, after approval by major researchers. Also, after finishing his research and documenting all models and R code, written in support of it, student should add to database at least two new tickets, indicating further directions of research in his field. All new tickets together with older ones will form initial supply of research problems in the beginning of next year, from which some tickets will be chosen by faculty staff to join Lab’s pipeline after interviewing and surveying master freshmans.