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Ten Simple Rules for Organizing and Running a Successful Intensive Two-Week Course

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Introduction

Intensive summer schools often provide strong students with career-changing impact, teaching them the art of the trade, letting them understand the logical underbelly of a field, and connecting them with an elite circle of peers and field leaders. Indeed, many professors attribute considerable aspects of their growth as a scientist to such schools. Such summer schools are an essential service to the community. A well-run summer school combines many of the aspects that jointly define students overall success. Eight years of organizing the annual two-week Computational Sensory-Motor Neuroscience (CoSMo, http://www.compneurosci.com/CoSMo) summer school has allowed us to experiment with different approaches and evaluate teaching outcomes, and we have seen rather clear patterns. Many new schools are started each year, only some move on to ongoing success, and the vast majority take a while until they reach very good ratings (our ratings are still increasing but approaching 10/10). Focusing on the student experience, we present a set of 10 simple rules to help you organize better summer schools that are more useful to students.

Rule 1: Know the Students and the Change You Want to Effect for Them

We organize summer schools despite the considerable cost in terms of money and effort associated with them. We do this because we want to

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improve the field. Understanding the students and the change we want to effect is essential to being effective. For example, CoSMo mostly serves the objective of improving the way the field handles data and computation. Everything else derives from this objective. Teaching objectives should thus be defined by answering the following questions: What is missing in the field? What are the educational bottlenecks in the field? Where would we like the field to move? We should think of summer schools not as a generic way of teaching students but a specific way of effecting the change the field needs. Organizing a summer school is a way of leading the change you want to see.

Knowing the students also implies not overloading them. The learning experience is far better when students learn material that they can realistically acquire than if an overly ambitious program instead teaches the students a little bit of many things without giving them important new skills. A summer school is no replacement for an education in science. It is a boost and a little bit of a push into the right direction.

Rule 2: Select Educators, Not Necessarily the Best Researchers

Crucial to the success of a teaching objective is the recruitment of pedagogically outstanding lecturers. Those individuals do not have to be the biggest names in the field; rather, they should be good teachers and should have the required hands-on practical knowledge to tutor participants. This said, students are attracted by faculty stars, so consider a healthy balance between fame and pedagogy. It is often useful to recruit additional teaching assistants if necessary to provide a high teacher-to-student ratio where each student can receive individualized attention. Often there are also experts among the participants, and one can take advantage of impromptu peer mentoring approaches. Fewer educators are better than many so that a coherent teaching framework can be applied over one to two days for each lecturer team. If multiple lecturers coteach a topic, true coteaching can be tremendously beneficial (but requires serious initial organization). We found that reducing the number of lecturers was almost universally associated with improved perceived quality of education ratings.

Rule 3: The Importance of Developing a Coherent Curriculum That Works with Varying Participants' Background Levels

Summer school participants usually come with a broad variety of educational backgrounds and can be at different career stages. It is thus important to design the summer school teaching content in a way that provides enough introductory material in order to equalize knowledge before more specialized or in-depth topics are covered. Our experience shows that about half the content of the summer school should be structured to convey the basics of a research field. These basics should ideally be taught by a small

team of instructors (e.g., the way the three organizers of CoSMo do this) to ensure maximum coherence and coordination of content. Indeed, the content should be selected with at least two criteria in mind: it should level the ground for the following guest lecturers, who typically cover more specialized, in-depth content, and it should provide a coherent but critical perspective of current approaches in the field, including philosophical considerations.

A perennial problem when teaching the basics is how to provide the more advanced students with good learning opportunities while helping weaker students advance. We found that keeping tutorials multilevel can be good at solving this issue. First, the advanced students can be assigned to help the less advanced ones at certain times. Second, it is often possible to provide an extra-hard problem in the same tutorial content. When we teach, we often have the hard problems at the bottom of the slide and the main ones in the middle.

Rule 4: More Tutorials, Fewer Lectures

The aspect that sets a summer school apart from university-based teaching, lectures at conferences, and reading material is that due to the targeted topic and small number of students at a summer school, we can teach skills instead of material. Of course, some lecturing is important to introduce certain concepts and background. In a tutorial, students can learn how to solve problems in a way that will almost immediately allow them to replicate those skills back in their own lab. We found that in computational neuroscience, assigning more than half of the time to tutorials considerably improves what students learn.

We also found that switching to a microlecture-tutorial format considerably improved outcomes. We teach a concept for a few minutes, and then for about the next 10 minutes, students immediately use what they just learned to solve a concrete problem that they could encounter in their own lab. This immediate link between knowledge and its application makes it both easier to attend the lecture because it will become relevant knowledge in 5 minutes. It is also easier for students not to get lost. The application makes it easy for them to see what they have not understood. Learning outcomes are optimized through active learning. Problem-based learning tutorials are best because they require critical thinking and the development of logical solutions. They implicitly force participants to ask the right questions, identify assumptions, and make hypotheses explicit. This can be a slow process, but it ensures a profound and practical understanding. Also, whenever possible, choose a single data set or problem for participants to work on from different angles in order to reduce introduction time. Thus, often when it comes to selecting course content, less is more.

The venue should also be adapted to the teaching objectives. Interactive classrooms with round tables, lots of whiteboard space, breakout

rooms, and audio-video equipment in many cases greatly increases teaching efficiency. It is truly helpful if the more advanced students can help those who are less advanced understand the material. An open design (e.g., with round tables) makes it easy for students to interact with many peers.

We also found that switching activities is important to keep up participants' energy and attention span. Frequent switching between lectures and tutorials, switching between lecturers, switching groups for tutorial work, taking breaks, and interjecting special activities (e.g., sports, a special lecture, an open discussion, telling an anecdote) all help to increase the teaching outcomes.

Rule 5: Hard Group Work

Tutorials allow students to work on only small problems. A small group project (three to five group members are ideal) that spans the entire duration of the summer school allows a more in-depth treatment of a selected topic. It also fosters more creativity, additional individualized teaching opportunities, and opportunities for participants to more deeply network with other students with whom they have the most in common. For most summer schools that we know of, combining these two timescales of learning is perceived as productive.

Importantly, for group projects to be truly productive, it is essential that they are guided and tutored in the right way. Students need considerable guidance at multiple points along the way. First, it greatly helps if the group generation process is guided. Students should build groups that cover complementary skills while having common interests. Group parity should also be targeted because it leads to better group dynamics. Second, it is essential that group projects are tutored, but in a way that lets the participants steer them. The students can often learn a lot from learning why a given project is not a good group project. Third, it needs a final set of maximally public presentations so that the students have the sense that they are working toward an important goal. To maximize this effect, we convinced those at one of our field's main annual conferences to automatically accept the best paper presented at our summer school in a year. Moreover, CoSMo summer projects regularly end up being published as scientific papers in established journals.

The pace for the entire summer school, and in particular the group projects, is set in the first two days or so. Long work hours (e.g., 9:00 a.m. to 11:00 p.m.) create group cohesion (through "suffering" together) and promote a community spirit that is fertile for learning, ideas, and collaboration. This atmosphere can be enhanced by providing an immersive learning environment where lecturers and tutors are available at all times. Make sure enough time is available for group projects.

Rule 6: Have All Material Available Online

Teaching materials, including lectures, tutorials, solutions, and additional resources, should be publicly shared, for example, on a wiki site (e.g., http://compneurosci.com/wiki/index.php/CoSMo) or www.OSF.io. This crucial component has many benefits. It is, of course, useful for students to always have access to all materials. It is also useful for instructors to see what previous materials have been covered. More important, open access of materials is immensely useful for the community and in high demand. It is one way to extend the impact of a summer school far beyond the limited group of those attending. Other professors will use tutorial and lecture materials for their own classes. Researchers have a means to learn new approaches on their own, which can tremendously accelerate a field's research endeavor, especially when example code from tutorials is advanced enough that it can be directly applied to research questions. Finally, a public written trace is also useful for summer school lecturers to keep a good institutional memory. It is critical to remember over the years what has been taught, what has worked, and what needs to be improved (see also rule 10).

In fact, many of the materials developed for CoSMo ended up being used more broadly across the field. For example, a tutorial aimed at teaching multivoxel pattern analysis ended up being a crucial resource for teaching in the entire field (http://www.cosmomvpa.org/). In many ways, the online materials are a continuation of the summer school itself.

Rule 7: Networking

A summer school is a unique networking event that can build lifelong professional relationships. It is thus important to promote networking and have enough unstructured time available, even if that means prolonged lunch and dinner breaks. This can be done in many ways: through creating mailing lists, blogs, and forums; using social media; and organizing group events, (for example, an outing after the first week of the school, such as sightseeing or sports activities). Networking should not be limited to participants but should include all lecturers.

Our alumni organize get-togethers at the big national conferences. They share news of personal progress on the Facebook page for the course session they attended. They hire one another once they become professors. And they often end up collaborating with one another later in their careers. Keeping the network in place after a summer school is crucial to the success of the participants.

Rule 8: One-on-Ones

We found a simple yet critical way to increase the effectiveness of the summer school. A problem for probably most of our students is access to

research supervisors in their home universities. The students may have a supervisor, but that person may not have much time to give to his or her students. In addition, they have a conflict of interest as mentors. Therefore, having one-on-one access at the summer school to their field's leaders is incredibly valuable to these students.

We thus ask all students which of the professors they most would like to meet individually. Our guest lecturers coteach, each staying for two days but teaching only for one. The remaining time can then be used for a large number of one-on-one slots. Being able to sign up for one of these meetings, which last for 15 to 30 minutes, is one of the highlights for CoSMo attendees. Indeed, some have told us that this was the highlight of the school. The goal of these one-on-one meetings is to allow participants to establish a personal relationship with established researchers in their field. It allows participants to ask questions in a private setting while having the full attention of the experts. Conversation topics can range from career advice to feedback on research projects, work-life balance, or recruitment interviews. Other schools achieve the same aims simply by having faculty around for a long time and allocating a lot of time for unstructured networking.

Rule 9: Make It Fun!

Organizing and running a summer school is a lot of work, and the schools themselves are tiring for lecturers, attendees, and the organizers. In order to avoid burnout, maintaining a fun and supportive environment is crucial. Organizers and lecturers need to bring and share positive energy. Positive energy is contagious, and participants draw from the lecturers' energy. Make sure to maintain this positive energy. The emotional side of a summer school is essential. Happy lecturers come again, happy students spread the word and successfully network, and happy organizers will be more willing to go through all that work again next year.

Positive energy can be cultivated in a number of ways and should be spread from the beginning. One way is to spend time with your co-organizers and lecturers without students, even if that means less available networking time. It is essential to be there for one another as the teaching team but also essential to see the students as partners in learning. And, quite possibly, we should celebrate a summer school well run. By coteaching and co-organizeing with people we like, the fun will spill over to the participants. It also helps to plan for some fun bonding activities (e.g., sports, games) and make sure there is time for relaxation (e.g., cultural activities, day off, pub night), and not to overwhelm you or the participants.

Rule 10: Feedback

Successful summer schools learn from their mistakes and improve over the years, So ask for feedback from participants. Students often understand

what would have helped them. After the school, thier feedback can be followed up with questions asked through Google Forms. The feedback forms should be a mix of rating scales to get participants' overall impressions on what was good and what was not and free-form text for them to provide their feedback about the individual school activities. For example, you can ask separately about lecture versus tutorial content for each teaching component or each lecturer. What was the difficulty level? Did participants feel they really learned something? What improvements could be made?

Once feedback has been collected, analyze the ratings and suggestions. Often you need to read between the lines to identify the underlying causes of negative feedback or even to understand constructive suggestions. Always try to improve the summer school. Even after running CoSMo for eight years, we still see room for improvement. A research community is not static, and thinking as well as techniques evolve. Feedback also allows us to identify unmet expectations and make adjustments based on the direction the field is heading in.

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