Chapitre 3

La communication orale sur des thèmes en mathématiques : écoute et expression orale

Outre la compétence en mathématiques requise, la communication orale sur des thèmes en mathématiques (séminaire, colloque, exposé, présentation, ...) est un sujet qui s'acquiert et se consolide avec de l'expérience. Néanmoins, ce chapitre s'intéresse aux conseils et astuces dont l'étudiant « néophyte » a besoin pour bien communiquer oralement sur des thèmes en mathématiques (et qui peuvent être aussi utiles pour des chercheurs habitués, mais en quête de perfectionnement).

3.1 Généralités

La communication orale sur des thèmes en mathématiques englobe deux volets : *l'outil visuel* et *la présentation orale*.

- **Outil visuel :** C'est un sujet classique qui dépend des moyens en notre disposition. Avant l'ère du numérique, les exposés se faisaient par des diapositives (une diapositive, appelée diapo par apocope, est un morceau de film inversible montrant une seule photographie et inséré dans un cadre en plastique ou en carton pour être projetée ou regardé par transparence). Maintenant, on utilise des outils tels que Beamer (LaTeX), Microsoft PowerPoint, et bien d'autres outils, les uns payants et les autres gratuits. Ces outils ont le mérite d'apporter beaucoup d'éfficacité et sont devenus indispensables à la présentation, mais ce sujet sort des objectifs de ce cours et ne sera donc pas traité davantage.
- **Présentation orale :** La présentation orale en anglais par l'orateur, et en l'occurrence le mathématicien, qui nous intéresse dans ce cours. Bien que la langue change, et sa

maîtrise aussi, le principe reste le même, et ce que ce soit dans un séminaire, une présentation vidéo, une soutenance ou toute autre présentation.

 A seminar or any other presentation is a piece of communication. You are talking to smart people, so if they don't understand, that's your fault ! You have to take into account the following points :

1. Who is the (expected) audience ?
2. What do they already know about the topic ?
3. What are you trying to convey (1 idea) ?

You are telling a story : introduction, coherent arc, end with a punchline.

Le but de ce chapitre est donc de donner des conseils sur la communication, l'écoute et l'expression orale lors d'une présentation ou d'une rencontre sur des thèmes en mathématiques.

 Mais, la meilleure manière d'apprendre à donner un exposé (et ce en n'importe quelle langue) est la pratique. Don't hesitate to do it frequently !

Ce cours a été tiré de plusieurs documents, mais le lecteur peut consulter [5, 9] s'il souhaite d'autres avis ou pour enrichir ces compétences.

3.2 Expression orale sur des thèmes en mathématiques

Il ne s'agit pas ici de donner un cours sur l'expression orale en anglais, mais de donner des conseils sur « le comment » de l'expression orale sur des thèmes en mathématiques. Bien que la maîtrise de l'anglais est une chose primordiale, il n'en reste pas moins important les techniques à savoir et à adopter pour réussir toute intervention orale.

Voici quelques conseils généraux, souvent à prendre en compte en amont, et qui sont utiles pour réussir une présentation orale sur des thèmes en mathématiques.

- **Be sure to pick a topic that has sufficient mathematical depth.** The material you are presenting should be engaging from a mathematical point of view, not just because of its practical applications or its historical significance.
- **Do not give a survey talk or select a topic that is overly broad.** For example, rather than talking about "mathematics and art" in general, you should focus on a specific topic within that area. Remember that you will be presenting a talk during a limited time, not an entire course. It is better to say a lot about a little than a little about a lot.
- **You need to prove something.** While it is fine - and often necessary - to cite results you do not have time to prove, your talk must include at least one complete proof of a substantial result. For this reason, it is generally wise to avoid speaking about a "result" (e.g. Fermat's Theorem) that cannot feasibly be proved in a short time.

- **Present new results.** Usually new results are presented in seminars and colloquiums. However, to the best of your ability, try to avoid topics that have been used frequently in the past.
- **Meet frequently with people advising your talk.** You should take this opportunity while you are preparing your talk. While the quality of the talk is ultimately your responsibility, experienced people can offer valuable insights and suggestions - if given the opportunity to do so.
- **Think carefully about what to include in your talk and what to exclude.** You have a limited time to give your talk, which is usually not enough time to communicate everything you have in mind. When choosing specific items to include, think about what information would be most meaningful to your audience.
- **Use appropriate visual aids.** While it is possible to give a long talk using only a blackboard, it is generally advisable to prepare slides. Make sure not to overwhelm the audience with too many details. Think carefully about what you plan to say and what you need to write down. Avoid silly pictures or visual effects, as they tend to distract from the substance of your talk. But feel free to include suitable pictures and figures - as they help understanding.
- **Practice your talk beforehand.** Many people find it helpful to perform a "dry run" or "dress rehearsal" in front of a live audience. In any event, you should go through your talk at least once out loud - even if it is to an empty room.
- **If possible, prepare a short optional section.** Despite careful preparation, it is sometimes difficult to judge how long it will take to deliver a talk. Having some material that you can either include or exclude gives you a bit more flexibility if you need to lengthen or shorten your talk.

Voici maintenant quelques détails spécifiques pour la présentation orale.

- Give proof details (otherwise hard to get a 'taste' of the topic) - but only showing key lines can be a good way to go
- Don't show full generality : simplest interesting case is ideal. Mention more complicated cases for the experts : "In this talk, I will work in L^2, but everything works for L^p $(1 \leq p \leq +\infty)$ if you...", "I will work in $\mathbb{C}$, but this works for any eld...".
- Vary level of rigour/precision : some definitions and theorems in full details, some as heuristics.
- Examples and pictures are always useful.
- Notation : consistent, clear, minimal.
- Cite yourself with initials only, e.g. [P. P. & L. R., 2021].
- Slows you down - makes it easier to follow.
- Prepare detailed and clear notes. Do everything from memory, or with minimal checking of notes (slows you down, stops you skipping ahead).

- Beamer allows you to generate slides in LaTeX(but some use Keynote or Powerpoint). Pick a template that you like : not crowded, but some repeated information can be useful (e.g. name, title).
- Don't overcrowd information : nobody reads walls of text.
- Avoid cross-references : nobody remembers what "Lemma 2" or "equation (3)" was.
- Including citations is good : Formatting like this [Jones & Smith, 1998] or [Jones & Smith, Invent. Math., 1998] is better than [1], since audience can write down immediately.
- take 1-2 minutes per slide including "padding" slides (title, outline, etc.).
- Use figures, but keep it minimal : drop unnecessary lines, use short labels, few figures per slide.
- Size matters (figure size, line width ≥ 2, font size), avoid non readable colors, vary linestyle and/or markers.
- Obvious stuff : legend (not blocking important things), axis labels & values sensible, helpful captions.
- Explain what you are plotting, which line is which, give us time to understand (and hints are good : "higher curves are better").
- Tables are almost never a good idea, but use bold/colours/etc. to direct attention.
- Talk to the back of the room (unless using a microphone).
- Look at the whole audience while speaking (especially for board talks).
- Don't rush, vary pitch - make us want to listen to you.
- Don't read every word on a slide (or every term of an equation) : "Talk around each point", "Slide text shouldn't be full sentences".
- Observe others : what do you like/dislike ?
- Questions nd answers (Q&A) session :
  - Actually answer the question ! Don't lie, e.g."I'm not sure, but... is fine".
  - Ask good questions : ≤ 2 sentences, last sentence ends with a question mark.
- Always mention co-authors, acknowledge funding bodies, thank organisers (if relevant).
- Practice and double-check your notes/slides (mistakes, hard to read, ??, embedded videos, etc.) beforehand.
- Check the room beforehand : layout, equipment :
  - Projector works.
  - Using laptop or from USB (is there a desktop ?).
  - have all required cables.
  - Chalk/markers/erasers available ? Which markers work ? What colour(s) will you use ?

- Always start with an empty board, even if using slides.
- Stick to time.
- Arrive early, (meet the chair if necessary), don't leave immediately afterwards (if possible).
- Ask yourself :
  - What one thing do I want my audience to remember ?
  - Would I enjoy listening to my talk ?
  - What talks/lectures have I enjoyed/disliked & why ?

3.3 Apprendre à écouter et à comprendre l'anglais parlé sur des thèmes en mathématiques

Cette section, qui semble être redondante avec ce que nous avons déjà vu sur l'apprentissage de l'anglais sur des thèmes en mathématiques, est importante puisque elle cible et approfondie les conseils sur l'apprentissage de l'écoute et de la compréhension de langue dans le domaine précis des mathématiques. Généralement les deux points suivants sont toujours valables lors de l'apprentissage d'une langue.

- L'apprentissage des langues est un travail qui se fait sur la durée (le plus tôt possible).
- Le travail se fait de manière régulière (même (et surtout) pendant les (grandes) vacances).

Outre la terminologie en mathématiques qui doit être maîtrisée, voici quelques conseils pour développer et travailler sa compréhension orale en anglais.

- Regarder des vidéos en version originale (VO).
- Ecouter et regarder des vidéos sur Internet.
- Lire des livres ou magazines étrangers.
- Avoir un(e) correspondant(e).
- Faire un séjour linguistique dans un pays anglophone.

Aujourd'hui, il existe des moyens sur Internet qui permettent de progresser de manière active sur tous les thèmes qui nous intéressent. Voici quelques astuces, à utiliser (sans modération !)

- Ecouter et regarder des vidéos sur des thèmes en mathématiques sur YouTube. Voici quelques liens « Voici le vocabulaires des maths en anglais - partie 1 », « Voici le vocabulaires des maths en anglais - partie 2 » ou encore « Découvre le vocabulaire des maths - cours d'anglais ».

- Faire une lecture audio d'un fichier pdf en utilisant la fonction « lecture audio » qui se trouve dans le logiciel Acrobat Reader ou tout autre logiciel de lecture de fichiers pdf. Cela peut s'appliquer aussi à d'autres fichiers tels que les fichiers Word ou PowerPoint et également aux sites Web.

3.4 Parler et poser des questions lors des rencontres en mathématiques

Avant d'assister à une rencontre (colloque, séminaire,...) en mathématiques, on peut se poser la question : Why should I attend conferences ? La réponse à cette question peut être résumée dans les points suivants.

- **Connections :** Conferences are the main way for mathematicians to meet each other and make connections among their works.
- **Research topics :** At conferences, you will hear about what kinds of problems other people are working on and may find some new topics which interest you. You may even find someone to collaborate with and/or a concrete research project to work on !
- **Chances to give talks/posters :** If you give talks, more people will know who you are and what you study ! If you are presenting (talk or poster) and if someone likes your talk, they might approach you and ask about your work. These conversations can lead to enlightening exchanges of ideas, invited seminar talks, new collaborations, new friends, etc.
- **Learn about something totally new :** At any conference, there will be talks on topics you have (virtually) no prior knowledge about (at some very large conferences, there are hundreds of talks on an incredibly broad array of topics). It can be enlightening to attend talks on topics which seem completely unrelated to your own work. It is good to be (at least vaguely) aware of other parts of the mathematical community !
- **Make friends :** As you attend more conferences, you will inevitably run into the same people repeatedly. You can make friends with people all over the world !
- **Explore somewhere new :** Many conferences take place in interesting cities. Even "boring" cities all have enough interesting activities for the duration of a conference ! Mathematics (especially grad school) doesn't pay well enough to travel all over the world, but going to conferences usually means most or all of your expenses will be reimbursed. You can always find a few hours here and there to explore the area and try some exciting foods.

 Furthermore, note that mathematics is a speciality which can be very isolating at times ! Conferences are a great way to connect with others who share your interests.

- **Attend the talks :** You don't have to attend every talk, but you should make your best efforts to attend most of them, and to actively listen (take notes, ask questions, or whatever works for you). Take a look at the abstracts and speakers and choose talks that sound interesting and useful ! However, it is fine to miss some talks, for example, because you are having a great conversation with a potential collaborator.
- **Ask questions :** Before, during, and after the talks, it is great to ask questions. Most mathematicians are happy to answer questions, even naive ones. This doesn't at all have to be immediately after the talks during the Q & A ; in fact, it may be better to ask afterwards so you can have a longer conversation and more personalized answer. This is also a great way to start making a new connection !
- **Meet new people :** This may be both the hardest and most important part. Don't just spend time with people from your own university ! You are at the conference in large part to make new connections.
- **Talk to people :** Beyond the common opinion that meeting new people can be fun or interesting, talking to people can have significant positive impacts on your career.

Bien entendu, les questions se posent de manière naturelle durant, à la fin ou bien après la présentation.

Voici un dialogue, tiré de [11], entre un enseignant et son étudiant qui peut aider à formuler des questions en anglais.

A problem : *A dress was on sale for 50% off its original price of $40. Later, the store took another 25% off that price. How much does the dress cost now after all the discounts ?*

Teacher : What are you working on ?

Student : I'm trying to find the answer to this problem. It's kind of hard. I keep reading it.

Teacher : So as you read this problem, what are you thinking ?

Student : I'm really thinking about the words in the problem. They can help me know what to do. I'm trying to remember what my teacher last year told me. She said there were certain words that tell you what to do to find the answer. I found a word that I think she talked about — "all" — and underlined it. I think that means I have to add things up to find the answer.

Teacher : Why do you think that means you should add to find the answer ?

Student : Because there are certain words that tell you what to do. I think "in all" means add. But I'm not really sure how to add this up.

Teacher : As a mathematician, you know how important it is to first read and understand the problem you are trying to solve. You are working on the first step in problem solving ! Let me share something with you that I have learned. When I am faced with solving a problem, I have to do more than just look for certain words. I have to really try to see in my mind what is happening, so I can figure out a way to solve it.

Just because this problem has the word "all" in it, it doesn't necessarily mean that we add to solve it. Let me tell you what I do sometimes when I read a problem. I try to think about and "see" in my mind what is happening. So when I read that there is a sale, I know that I can buy something for less than what it used to cost. The store takes something off the price — it costs less to buy it when it is on sale. Then, I think about what mathematical operation I should use to show that something is taken off or away from the price. What do you think ?

Student : I think you subtract. Don't you ?

Teacher : That's right. When we read carefully and really tried to think about what happened in the problem instead of looking for certain words, we were able to figure out what to do to solve the problem. Do you remember how to find a percent ?

Student : Yes. I just couldn't figure out what to do with it.

Teacher : Can you tell me in your own words what we did to figure that out ?

Student : Well, for one thing, I didn't just look for those words like from last year.

Teacher : Well, what did we do ?

Student : I put it in my head. I mean, when I read it, I made sort of a movie to see what was happening. Then, when I thought I knew what was happening, I knew I had to subtract. That dress wasn't going to cost so much.

Teacher : Now you are thinking just like a mathematician ! Whenever you are trying to solve a word problem, do just what we did with this one. Try to see what is happening — just like making a movie in your head.

Enfin, voici maintenant un autre dialogue sur *l'inverse d'une fonction* entre un enseignant et son étudiant, voir [7] pour le dialogue complet. Ce dialogue a pour but de montrer l'intérêt et l'efficacité du dialogue pour présenter des techniques et pour comprendre et développer des idées en mathématiques.

Teacher : We have learned many things about functions and have learned of many types of functions, such as linear functions, quadratic functions, and trigonometric functions. Today I would like to discuss another type of function with you. This kind of function is called an inverse function.

Student : What does an inverse function look like ?

Teacher : Do you mean, "What is the nature of its graph" ?

Student : Well, no, but can you give me an example of one ?

Teacher : Certainly. For each real number x let $f(x) = \frac{1}{2}(x+3)$.

Student : That sure looks like an ordinary linear function with slope $\frac{1}{2}$ and intercept $\frac{3}{2}$.

Teacher : You are correct. An inverse function must meet the requirements for functions in general.

Student : Like being a set of ordered pairs of numbers in which no two different pairs have the same first members ? : I thought you would never get that idea straightened out. But, of course, we now realize that we can consider functions from several

points of view. In addition to your "set of ordered pairs" concept I would also like to have you recall the idea that a function can be thought of as a "mapping." Mathematics teachers like to discuss the relative merits of these various points of view, or definitions of the term function. *The American Mathematical Monthly* published several notes on this subject not long ago. A report on this might be an interesting special project for you. But we should get back to inverse functions.

Student : O.K. I have a question or two. Are all inverse functions linear, or are all linear functions inverse functions ?

Teacher : The answer is no, since the answer to each part of your disjunction is no.

Student : Well, how can I tell if I have an inverse function ?

Teacher : There is a way, but we can have a better discussion if we talk of something else first.

Student : What is that ?

Teacher : I think it is better to think about in verse functions in pairs.

Student : Not another set of ordered pairs ! Aren't you going to run out of ways to use pairs of things in mathematics pretty soon ?

Teacher : Probably not. Pairs of things are very basic to mathematical thinking. You might like to read a section in Halmos's *Naive Set Theory*. There he will show you how to make ordered pairs out of unordered pairs.

Student : That sounds like getting something for nothing.

Teacher : By now you shouldn't be surprised when your intuition fails you. Remember when we first "counted" the even natural numbers. Now about those pairs of functions. Let us begin with a function f, thinking of f as a set of ordered pairs $\{(x,y)\}$. Now make a new set of ordered pairs $\{(y,x)\}$ by reversing every pair in f. If this latter set is a function we call it the *inverse* of f and denote it by f^{-1}. Now, how do we judge whether or not $\{(y,x)\}$ is a function ?

Student : Easy. You check to see whether (y_1,x_1) and (y_2,x_2) have the same first elements when they are different.

Teacher : When what are different ? Oh, never mind. But try to describe your "check" in another way.

Student : O.K. We check to see if $y_1 = y_2$ when the pairs are different.

Teacher : That means you consider the implication, "If $y_1 \neq y_2$, then $x_1 = x_2$."

Student : I guess so.

Teacher : What do you decide on the basis of your "check" ?

Student : I'm kinda mixed up here. I guess you don't want the "check" to happen.

Teacher : This is correct. Let us say it another way. A given function $f = \{(x,y)\}$ has an inverse provided the implication, "If $x_1 \neq x_2$ then $y_1 \neq y_2$" is always true.

Student : Cool.

Teacher : Please go to the board and illustrate this with the graph of some function.

3.5 Activités d'atelier

Atelier 3.1

1. Pair up with someone from your classroom (or elsewhere).
2. Explain your topic to him (some minutes) - questions are encouraged !
3. He (She) will then explain your topic to another pair (some minutes).
4. Repeat.
5. Look at what did/didn't work ?

Atelier 3.2

1. Pair up with someone from your classroom.
2. Choose a topic or a theorem from your course.
3. Discuss with him (her) the topic or the proof of the theorem.

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