Practical R&D Skills Asynchronous Tutorial Development and Course Implementation Processes

To facilitate the design of modular upskilling tutorials that can be reused efficiently as effective student training, onboarding and recruiting infrastructure for your team, or run in series as a university course with Graduate Assistant (GA) support, we have developed the following step-by-step guide based on best practices to achieve solid tutorial handouts, grading rubrics, and Canvas course assignments. Aligned with this guide is an example gold-standard tutorial: ***PRDS_Example-Tutorial-TOPCAT.pdf***

1. [**faculty lead**] Define the topic and related SLO(s)[1] to clearly frame the skills tutorial objective. Example SLOs:
   - learn basic data analytics operations on tabular data using Python and Matplotlib
   - understand and describe common galaxy measurement **parameters** used in extragalactic research
   - learn basic functionality and operation of an IR spectrograph
   - gain proficiency in collecting and analyzing spectroscopic data to characterize materials
   - learn research method _____ commonly employed in R&D topic _____

2. [**faculty lead**] Provide your GA content and guidance to assist you in drafting the main body of the tutorial handout. Effective training tutorials **include 3 critical components**:

Component	**Purpose**	
Introductory instruction	Introduce students to topic and SLO(s), define terms and concepts, explain example skills applications and R&D contexts, provide illustrative figures.	*1pp or more*
Learning Activities	(i.e., practice activities) Provide students structured opportunities to practice new skills and learn-by-doing (*not graded*).	*As many as needed*
Assessment Task(s)[2]	(i.e., graded tasks) Test students' level of competency in the practical application of tutorial concepts, data, and skills to realistic problem-solving scenarios common to your R&D specialization (*graded*).	*Align with SLO(s)*

   i. Provide your GA guidance on the tutorial handout formatting, editing, and reviewing process that will most productively facilitate your needs.
   ii. Define the specific student tutorial submission format that will be expected for grading (in courses).

3. [**GA**] Develop a tutorial grading rubric of a) competency grading standards and b) actionable feedback for achieving Excellent competency on each Assessment Task:
   i. complete a trial run through the full tutorial to produce a sample student submission and determine ECTs[3] for each critical component such that the sum of individual ECTs = overall tutorial ECT
   ii. collaborate with your faculty lead to define Excellent (100%) and Satisfactory (70%) standards for calibrating grading of each Assessment Task

[1] "Student learning outcomes (SLOs) describe the specific, measurable knowledge, values, or skills that students will be able to demonstrate upon completing the (tutorial) using precise language focused on the student, as opposed to the program." (*google*)

[2] "a tool, device or constructed situation that creates the opportunity for learners to demonstrate or display the nature and depth of their learning." (*google dictionary*)

[3] Estimated completion time (ECT) for a typical (novice) student to learn and achieve satisfactory or better overall tutorial competencies. This communicates necessary asynchronous student effort to upskill.

iii. collaborate with faculty lead to create brief, reusable comments that steer students toward achieving Excellent competencies during a second (final) option to improve their grade

4. [**GA**] Build and publish modular assignment on Canvas course page. Collaborate with faculty lead to develop instructional tutorial demonstrations delivered to students during a brief (50-min) group meeting.
   a. employ tutorial scheduling and coordination tool to determine submission due dates

5. [**GA**] Grade student submissions (initial & final), provide actionable feedback (initial only).
   a. use Canvas *Speedgrader* in conjunction with 3.ii and 3.iii
   b. provide score and feedback for <u>each</u> Assessment Task using the percent scale: Excellent (**E, 100%**), Very Good (**VG, 90%**), Good (**G, 80%**), Satisfactory (**S, 70%**), Needs Improvement (**NI, 50% or less**).

6. [**McIntosh**] Provide <u>student-centered</u> guidance to faculty lead and professional development of course GA toward achieving effective skills tutorials and assessment of student competencies:
   a. <u>Tutorial handouts</u>:
      i. development guidelines (*this document*)
      ii. boilerplate language and structure example (***PRDS_Example-Tutorial-TOPCAT.pdf***)
      iii. critical review of drafts for alignment of SLO(s) and critical components
   b. <u>Tutorial grading rubrics and assessment practices</u>:
      i. critical review of rubrics for alignment of Assessment Task standards with SLO(s)
      ii. professional development of GA in competency-based assessment practices
   c. <u>Canvas course support and instructional practices</u>:
      i. course Syllabus and overall Grading Rubric templates
      ii. self-consistent (with 6.c.i) canvas tutorial Assignment and Module templates
      iii. professional development of GA in Teacher and TA role functions and grading tools
      iv. professional development of GA in effective instructional feedback practices

7. [**faculty lead**] Recommendations and tips for saving time during the tutorial handout design stage (steps 1 & 2):
   a. Try using ChatGPT to provide ideas for critical tutorial components. Example prompts:
      - provide example student learning outcomes for an undergraduate training course in data analytics with Python
      - provide 1 page of introductory content at the undergraduate level for the following SLO …
      - provide 10 example learning activities at the sophomore college level for the following topic …
      - provide 5 example assessment tasks that challenge university juniors in the practical application of …
   b. With ChatGPT you can specify things like how many and at what level, and then briefly iterate your queries until it produces some content that gets you 80-90% to where you want to be.
   c. If you come up with highly useful ChatGPT prompts, please share them with me – I will do the same.