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Dear Mr. Su,

My co-authors and I thank the reviewers for their careful evaluation of our manuscript and for their valuable and stimulating comments. We have now revised the manuscript accordingly using track-changes. We reproduced the reviewers' comments below and provided a point-by-point response.

Best wishes,

**Reviewer 1:**

1. The research seems up-to-date and interesting in terms of its subject. Although the research title is not too long, it is suitable for the purpose. It was also bad that the abstract of this research was not in the structured abstract form. In other words, it would not be good not to write a summary including the purpose, method, data collection tool and results in the summary. However, the research findings should be briefly mentioned in the abstract and the term "we" should not be used. Third language is used in research articles.

**Authors' Response:** We thank the reviewer for this comment, and the abstract has been revised accordingly. Our original submission included the purpose and method and it has now been expanded to include the tools used for data collection to be used by students, as well as the associated results of the research. With respect, we feel that the use of first or third person language in scientific research articles is simply down to a matter of preferences rather than convention. Third-person text is certainly not a mandate in the Education Sciences editorial guidelines. However, we have taken the reviewer's suggestion and changed the abstract to read in the third-person.

2. The introduction of the research is appropriate in terms of literature, but it is not sufficient. The introductory part of the research is also not sufficient in terms of subject area. The research is related to STEM, but the concept of STEM has not been adequately addressed. For example, the study "Tezer, M. (2019). The Role of Mathematical Modeling in STEM Integration and Education. In Theorizing STEM education in the 21st century. IntechOpen") in the field of STEM and its theory and similar research could be included. The bibliographies used are up-to-date. Therefore, the use of new bibliography in the introduction and discussion sections of the research has enriched the research.

**Authors' Response:** We have now addressed the insufficient background information surrounding STEM education on pages 2 lines 71-77). We also added references concerning this information (28-30 and 46). Additional text and references were also added to the experimental design and overview section (page 4, lines 167-187).

3. Purpose and sub-objectives were written in line with the findings. The research method is not well written. Experimental research method was used in the research. But in the research, it would be better to write the experimental research design for this experimental study.

**Authors' Response:** The experimental design and overview section has now been amended to include a more detailed explanation of the framework of the study. These additions can be found on page 4 between lines 167-187.

4. The research could be used in STEM education, but it could also have an educational aspect. It would be better if the research included students' opinions and the validity-reliability of the data collection tool was also included. In other words, the educational dimension of the research is lacking. My recommendation is to add students' views to the research through qualitative methods. Thus, it will make the research more powerful. Care was taken to write the tables used in the research in the form of APA6 standard. Writing the results of the research in the form of frequencies, excluding parametric or non-parametric tests, calls into question the reliability of the research. Discussion, conclusion and suggestions section were written in the research. It would be more meaningful to have student opinions and suggestions written accordingly to the research results.

**Authors' Response:** The goals of this research is the design of a judicious experiment for implementation into a laboratory setting. The inclusion of student opinions would represent the publication of human subject data, which would require a IRB review and approval *before* implementing the experiment in a classroom setting and obtain students' opinion and suggestions. The experiment would have to be implemented in future semesters. As such, this would not be achievable within the requisite time frame and would not be possible during the 10 day revision period. Such a study is planned for a future study. As for the table format (see SI), we are reporting the results of our analytical tests (TLC): in the scientific method, multiple trials (at least three) are carried out to obtain a statistically significant mean value and associated uncertainty as required. Repeated trials would allow for minimizing the impact of both systematic and random error, that is, errors arising from limitation of the technique/instrument or operator. Such trials are reported in the tables in the SI.

## Reviewer 2:

In this work, the authors present a laboratory experiment for undergraduate chemistry students with basic knowledge of general chemistry. It will provide the students with the opportunity of practicing concepts related to solvent extraction, chromatography and spectroscopic analysis and their application in understanding the UV protective molecular filters present in sunscreens. This Reviewer considers that the proposal is highly interesting for teaching purposes and the manuscript is well written. Therefore, I recommend publication of the work. Nevertheless, in order to improve the clarity of some parts, I suggest the authors to address the following points:

- On page 3, at the beginning, revise the grammar of the sentence "In this manuscript, we add the study of the photostability of the prepared of sunscreen samples by means of steady state

irradiation with UV excitation light, in tandem with UV/vis spectroscopy as probing technique”.

**Authors’ Response:** we thank the reviewer for this comment. We have now revised this sentence.

- At the beginning of Section “Pedagogical Aims and Learning Outcomes”, the authors of this work try to describe the structure of the courses and the academic context of the proposed laboratory experiment. I find this explanation too short and not very general. They should contextualize a bit more at which point of the education of the undergraduate student this experiment should be included. This explanation should not be particular for the undergraduate chemistry curriculum at UL Lafayette but for a general undergraduate chemistry curriculum.

**Authors’ Response:** We agree with the reviewer. We have added additional text and information to this section to describe typical a General Chemistry course in undergraduate curricula and provided more content on how this experiment aligns with the General Chemistry Lab course objectives.

- On page 3, at the end, it is written “(see aim 2)”, but the reader cannot see a list with “Aim 1” and “Aim 2”. I suggest to transform those two paragraphs into a numbered list.

**Authors’ Response:** We have corrected this section by numbering the aims and slightly rephrasing for more clarity.

- It would be useful for the reader to remind the definition of SPF by means of a footnote.

**Authors’ Response:** We agree with the reviewer. The acronym had been already defined in the text (page 3, line 126), but we specified it once more in Table 1 (v. caption).

- It would increase the quality of the work if the authors briefly summarize the mechanism of photostability (as suggested in the literature) for each of the compounds shown in Fig. 1.

**Authors’ Response:** A concise statement regarding the mechanisms of photostability can be found in page 2, line 60. We extended this sentence to specify which mechanisms apply to the specific molecules in Figure 1.

- The use of a light source with a wavelength at 315 nm should be better motivated. Might the use of a higher-energy UV source enhance the differences between the sunscreens?

**Authors’ Response:** We thank the reviewer for this comment. Our available set of LED light sources provide wavelenths as short as ~260 nm. However, this study features longer wavelength UV excitation (315 nm) because all the UV filters in the sunscreen lotions absorb light in this region (see Figure 3), while solvent and other organic compounds typically absorb much shorter wavelengths (< 300 nm). This insures that any photoinduced process is primarily attributed to excitation of the UV filters (as opposed to other chemical species). We clarified this point on page 7, line 288-294.

Potentially higher photon energy or higher intensity could have some influence on the excited state decay mechanisms and on extent to which the ground state is recovered. However, we feel that

exploring this further would not fall within the scope of this project; wavelength dependence was therefore not explored in this study

- Regarding the Supporting Information, the reader might miss the fitting procedure of the absorbance signals.

**Authors' Response:** The Supporting information reports primarily the experimental procedure to be followed to complete the laboratory experiment and the results obtained from the TLC. The fitting procedure is described in the main text and is simply based on summing the individual UV absorption spectra of the sunscreens to reproduce the ones recorded for the samples (page 9, lines 380-392)