



Research Article

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Exploring the Status of Life and Earth Sciences to Other School Subjects in Middle School: Effect of Gender and Grades Obtained

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Abstract

This study examines the status that students attribute to the school subject of Life and Earth Sciences (LES) in terms of importance and preference compared to other school subjects. The study questionnaire was administered to a sample of 970 students (15±1,04 years) in the third year of middle school in the Provincial Directorate of the Ministry of Education in Taza (Morocco). The data collected are analyzed quantitatively. The results show that the LES school subject occupies an intermediate position in terms of importance and a late place in terms of preference compared to other school subjects. Furthermore, the gender difference in the importance of this school subject is not significant, whereas in terms of preference, the difference is significant in favor of females ($p < 0,05$, negligible effect size). According to the grades obtained in LES, the differences are significant in terms of importance ($p < 0,05$, small effect size) and preference ($p < 0,001$, medium effect size) favoring the students with the highest grades in this school subject. To improve the status of LES, the study suggests showing students the importance of this school subject in their daily lives and their academic and career paths, reinforcing experiences that bring them more emotional gain, and adopting innovative and engaging approaches that facilitate their learning.

Keywords: Life and Earth Sciences (LES), School subjects, Importance of LES, Preference of LES, Middle school

1. Introduction

The middle school years are of great importance in a student's school life. During this period, students acquire knowledge and skills in a variety of school subjects that provide a balanced foundation for making informed decisions about their academic future and achieving success in their personal and professional lives. Each school subject has its educational challenges and content to

impart. In recent decades, the relationship between students to school subjects, and in particular science, has been the subject of research in many reviews, which have treated it from the perspective of interest, attitude, and motivation (Krapp & Prenzel, 2011; Christidou, 2011; Osborne & al., 2003; Potvin & Hasni, 2014; Venturini, 2004). These studies show, among other things, that student's interest in science generally decreases as their level of education increases. In justifying this decline, Krapp & Prenzel (2011) assumed that it is due to the type and quality of teaching or that adolescent students have other developmental and identity priorities rather than investing all their energy in learning. Moreover, these studies point to differences in students' interest in certain school subjects and variations in interest associated with personal (age, gender, etc.) and contextual (teaching methods, teacher, etc.) factors. In the opinion of Hasni & Potvin (2015), student's interest and engagement in school subjects or particular topics will increase or decrease as the nature and relative importance of the influencing factors change.

To better understand students' interest in science, Krapp & Prenzel (2011) suggest examining it alongside other school subjects. This approach seems interesting because it provides an overview of the status of school subjects and reveals the tensions that exist between them in terms of interest or attitude. Osborne & al. (2003) also point out that some measures of attitudes towards science can be obtained by asking students to rank their preferences for school subjects. In Colley & Comber's (2003) study, Year 7 students and Year 11 students are asked to rank their preferences for various school subjects. The results show that practical subjects rank higher among the younger students, while a combination of academic and practical subject preferences is found among the older students. Science appears to occupy an intermediate position, with a slight increase in ranking for older students. More recently, Hasni & al. (2017) investigated the relative interest in science and technology (S&T) while examining the status students attribute to this subject to other school subjects in terms of importance, preference, and ease. Their results indicate that S&T occupies an intermediate position compared to other school subjects.

In this context, the lack of research in this area in Morocco leads to a need for studies that examine students' relationships with school subjects in a holistic way. The Moroccan middle school curriculum covers a wide range of school subjects, taught separately from each other. It should be noted that the teaching of science, particularly Life and Earth Sciences (LES) in middle school, continues to face challenges and is often underperforming. This is reflected in the results of Moroccan students in the National Programme for the Assessment of Prior Learning of students (PNEA, 2019) showing that they have gaps in the basic knowledge and skills prescribed by the program of study for this school subject (INE-CSEFRS, 2021). It is therefore crucial to question the relative interest of this subject by exploring its status to other school subjects. Our study, therefore, attempts to answer the following questions: (1) What status, in terms of dimensions of importance and preference, do students attribute to LES to other school subjects? (2) Are there differences for each dimension according to gender and grades obtained in LES? (3) What are the reasons for their degree of preference and their beliefs in the importance of LES?

2. Methodology

2.1 Research design

The present study was limited to two dimensions, namely importance and preference, to determine the status that students attribute to Life and Earth Sciences subject compared to other school subjects. It uses a questionnaire as a data collection tool. The first part of the questionnaire is reserved for students' personal information as independent variables (e.g., age, gender, grades obtained in LES, etc.). However, the second part is composed of two separate sections. In the first section, students are asked to give their opinion, on a 6-point Likert-type scale, about the importance of the following 11 school subjects: Arabic language, French language, English language, Physical education and sports, Islamic education, Physical sciences and chemistry, Life and earth sciences,

Mathematics, Social studies (History, geography and civic education), Computer science and Technology.

Degree of importance of school subjects	Strongly not important	Moderately not important	Slightly not important	Slightly important	Moderately important	Strongly important
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Figure 1: Structure of the Likert-type scale for evaluating the importance of school subjects.

The second section deals with students' preferences for the same school subjects. In addition, for each section, students are asked to give reasons for their perception of the LES school subject. This questionnaire was distributed in a paper format, and students are given 10 to 15 minutes to complete it. Scores 1, 2, 3, 4, 5 and 6 are used to evaluate student responses on a 6-point Likert scale, from (1) strongly not important to (6) strongly important and from (1) strongly not preferred to (6) strongly preferred.

2.2 Participants

In this study, participants are selected from a total population of 8101 students in the third-year of middle school in the Provincial Directorate of the Ministry of Education in Taza, Morocco. We randomly selected 17 different schools. Thus, the questionnaire is administered to a sample of 970 students, far exceeding the minimum size recommended by Krejcie and Morgan (1970). The average age of the students is $15 \pm 1,04$ years, while 512 (52,78%) are females and 458 (47,22%) are males.

2.3 Data analysis

We used SPSS 26.00 software to enter and analyse the data collected from the students. Descriptive analyses (percentages and means) provide a general overview of relative preference and relative importance towards LES. However, parametric tests (t-test, ANOVA, Fisher's post hoc test under LSD, eta squared η^2) are used to highlight differences according to gender and the grades obtained in LES, as well as the effect size. According to Cohen (1998), a η^2 value between $[0,01;0,06[$ indicates a small effect, a η^2 value between $[0,06;0,14[$ indicates a medium effect, and a η^2 value $\geq 0,14$ indicates a large effect. Students' responses to open-ended questions about the reasons for their perceived importance and preference for LES are coded and analyzed quantitatively.

3. Results

The results of the study below present students' perceptions of the importance and preference of LES compared with other school subjects, as well as differences according to independent variables linked to gender and grades obtained in LES.

3.1 Status of Life and Earth Sciences to other school subjects

We note that the means values of perceived importance and preference are subdivided into six intervals (table 1). A value of 3,50 is the threshold, for example, between the perceived importance and non-importance of a school subject.

Table 1. Levels of importance, and preference given to LES according to average value intervals.

Levels of Importance	Levels of Preference	Intervals
Strongly not Important	Strongly not Preferred	$[1;1,83[$
Moderately not Important	Moderately not Preferred	$[1,83;2,67[$

Slightly not Important	Slightly not Preferred	[2,67:3,50]
Slightly Important	Slightly Preferred	[3,50:4,33]
Moderately Important	Moderately Preferred	[4,33:5,17]
Strongly Important	Strongly Preferred	[5,17:6,00]

The means of importance and preference given by students to school subjects are calculated and presented in Tables 2 and 3. It should be noted that more than half of the students have not studied the Technology subject, which is therefore excluded from the analysis.

3.1.1 Degree of Importance of Life and Earth Sciences with other school subjects

In terms of importance, all school subjects scored above the mean value 3,50 on the 6-level scale. In general, these subjects are all perceived as important but at varying levels. French language, Mathematics, Physical sciences and chemistry, Islamic education, and Arabic language are perceived as strongly important subjects, while Computer science and Social studies are the least important subjects (Table 2).

Table 2. Degree of importance for school subjects.

School subjects		Ar	PC	Eng	SS	LES	IE	Fr	Math	PES	CS
Importance	M	5,18	5,23	4,94	4,63	4,89	5,20	5,28	5,23	4,80	4,48
	R	5	2	6	9	7	4	1	2	8	10

M: Mean; R: Rank; Ar: Arabic language; PC: Physical sciences and chemistry; Eng: English language; SS: Social studies; LES: Life and earth sciences; IE: Islamic education; Fr: French language; Math: Mathematics; PES: Physical education and sports; CS: Computer science.

The LES subject is of moderate importance (4,89). It occupies an intermediate position (7th place) compared to other school subjects. Moreover, 135 students (13,92%) consider it as not important, while 434 students (44,74%) give it high importance.

3.1.2 Degree of Preference for Life and Earth Sciences to other school subjects

Table 3 shows that all school subjects score above the mean value 3,50 in terms of preference. Students rank Physical education and sports first, followed by Islamic education as a strongly preferred subjects, while Mathematics and LES are the least preferred (at about the same level).

Table 3. Degree of preference for school subjects.

School subjects		Ar	PC	Eng	SS	LES	IE	Fr	Math	PES	CS
Preference	M	5,05	4,83	4,88	4,71	4,51	5,27	4,81	4,48	5,53	4,72
	R	3	5	4	8	9	2	6	10	1	7

M: Mean; R: Rank

The LES subject is moderately preferred (4,51). It occupies a late position (9th place) in the preference ranking of school subjects. It is not preferred by 186 students (19,18%), and only 285 students (29,38%) strongly prefer it.

3.2 Variations in Life and Earth Sciences status according to gender

Females' and males' mean scores for importance and preference of LES are calculated, and the influence of gender is explored (Tables 4 and 5).

3.2.1 Importance of Life and Earth Sciences by gender

Table 4. Results of t-test: Effect of gender on the importance of LES

	M(f)	R	M(m)	R	ΔM	t-value	Sign.
Importance of LES	4,94	7	4,83	7	0,11	1,190	0,234

M(f): Mean (females); M(m): Mean (males); R: Rank; ΔM: Difference in means between sexes; Sig.: signification; ES: Effect size

Table 4 shows that both females and males attribute moderate importance to LES (4,94 and 4,83 respectively), giving it an intermediate ranking (7th place) compared to other school subjects. Although the difference is slightly in favor of females, it is not statistically significant.

3.2.2 Preference for Life and Earth Sciences by gender

Table 5. Results of t test: Effect of gender on the preference of LES

	M(f)	R	M(m)	R	ΔM	t-value	Sign.	ES (η ²)
Preference of LES	4,63	9	4,39	10	0,24	2,537	0,011	0,008

M(f): Mean (females); M(m): Mean (males); R: Rank; ΔM: Difference in means between sexes; Sig.: signification; ES: Effect size

We observe that LES is moderately preferred by both females (4,63) and males (4,39). Both ranked it lower than other school subjects. The difference is statistically significant in favor of females (ΔM=0,24; p<0,05; η²=0,008), but the effect size is considered negligible.

3.3 Variations in Life and Earth Sciences status according to grades obtained

Based on students' grades in the LES school subject, students are divided into three groups as follows: Group 1 (252 students with grades between 14 and 20), Group 2 (485 students with grades between 10 and 14, except 14), and Group 3 (233 students with grades below 10). Importance and preference means are calculated for each group of students, and the significance of differences is explored (see Tables 6, 7, 8, and 9).

3.3.1 Importance of Life and Earth Sciences by grades obtained

The three groups of students obtained moderate scores for the importance attributed to the LES. For group 1, the students assigned an intermediate rank to LES (6th place), while groups 2 and 3 gave it 7th and 8th place respectively. It should be noted that students with higher grades attached more importance to this subject than their peers with lower grades. Thus, to examine the significance of the differences in importance between the three groups, we performed the ANOVA test and calculated the effect size.

Table 6. Results of ANOVA test: Effect of grades obtained on the importance of LES

	M(Gr1)	R	M(Gr2)	R	M(Gr3)	R	F	Sign.	ES (η ²)
Importance of LES	5,07	6	4,89	7	4,70	8	4,465	0,012	0,010

M(Gr1): Mean (group1); M(Gr2): Mean (group1); M(Gr3): Mean (group3); R: Rank; ΔM: Difference in means between groupss; Sig.: signification; ES: Effect size

Table 6 shows that the difference in the importance of LES according to the grades obtained is

statistically significant, with a small effect size ($F=4,465$, $p<0,05$, $\eta^2=0,010$). However, to identify the significance of the differences between each pair of student groups, we performed a Fisher post-hoc analysis under LSD.

Table 7. Results of Fisher's post-hoc analysis: Effect of grades obtained on the importance of LES

Importance of LES	Difference in means		Sig.
	ΔM (Gr1-Gr3)	0,37	0,003
	ΔM (Gr1-Gr2)	0,18	0,090
	ΔM (Gr2-Gr3)	0,19	0,080

ΔM (Gr1-Gr3): Difference in means between group1 and group3; Sig.: signification

We note that that the only significant difference is between group 3 and group 1 ($\Delta M=0,37$; $p<0,01$). This indicates that the students with the highest LES grades differed significantly from their counterparts with the lowest grades in terms of the importance attributed to LES.

3.3.2 Preference of Life and Earth Sciences by grades obtained

We observe that group 3 students give a high preference to LES (5,29), ranking it ahead of other subjects (2nd place). However, group 2 students gave it a moderate preference (4,44), with a delayed ranking (9th place), while group 1 students gave it a low preference (3,84) and a delayed ranking (10th place). These observations indicate that, as grades decline, preference for this subject decreases considerably. To check the significance of these differences, we performed an ANOVA test and calculated the effect size.

Table 8. Results of ANOVA test: Effect of grades obtained on the preference of LES

	M(Gr1)	R	M(Gr2)	R	M(Gr3)	R	F	Sign.	ES (η^2)
Preference of LES	5,29	2	4,44	9	3,84	10	70,696	0,000	0,128

$M(Gr1)$: Mean (group1); $M(Gr2)$: Mean (group1); $M(Gr3)$: Mean (group3); R: Rank; ΔM : Difference in means between groups; Sig.: signification; ES: Effect size

The ANOVA test strongly suggests a significant difference in students' preference for LES according to grades obtained ($F=70,696$; $p<0,001$; $\eta^2=0,128$) and a medium effect size. Thus, we performed Fisher's post-hoc analysis under LSD to determine the significance of existing differences between each pair of student groups.

Table 9. Results of Fisher's post-hoc analysis: Effect of marks obtained on the preference of LES

Preference of LES	Difference in means		Sig.
	ΔM (Gr1-Gr3)	1,45	ΔM (Gr1-Gr3)
	ΔM (Gr1-Gr2)	0,85	ΔM (Gr1-Gr2)
	ΔM (Gr2-Gr3)	0,60	ΔM (Gr2-Gr3)

ΔM (Gr1-Gr3): Difference in means between Gr1 and Gr3; Sig.: signification

Table 9 shows that the largest difference in preference is between group 3 and group 1 (1,45), followed by that between group 3 and group 2 (0,85), and between group 2 and group 1 (0,60). Furthermore, the differences in preference for LES between each pair of student groups are statistically highly significant ($p<0,001$), with a clear preference for students with the highest grades in LES. We can, therefore, confirm that student performance in LES has a highly significant influence on students' preference for this subject.

4. Discussion

According to Cosnefroy (2007a), the status granted to a school subject is at the origin of a possible path for the development of interest. In this study, we examined the status (importance and preference) that students attribute to the LES school subject to other school subjects. In addition, we explored the influence of gender and grades obtained in LES, as well as the reasons underlying their perceptions of the importance and preference of these school subjects. However, analysis of the data collected from 970 Moroccan students in the third year of middle school reveals important findings and observations related to our research questions. The results of the present study show that the school subject of LES occupies an intermediate position in terms of importance and a lagging position in terms of preference compared to other subjects of the school curriculum.

4.1 Observations on the perceived Importance of the LES school subject

Not all school subjects are equivalent in their perceived importance. Each school subject has a set of specific characteristics, some of which are more valued by the student according to his (or her) personality, needs, and history (Cosnefroy, 2007b). The study by Stables & Wikeley (1997) highlighted that the most important subjects are core subjects such as Mathematics and Science, due to their perceived usefulness and link to careers. The study by Hasni & al. (2017) revealed that Mathematics and French language are the most important subjects and that Science and technology occupy an intermediate position with other school subjects. In the present study, the school subject of LES is perceived as moderately important (4,89). It ranks seventh place in terms of importance compared to other school subjects. However, the most important subjects are French language, Mathematics, Physical sciences and chemistry, Arabic language, and Islamic education (roughly the same level of importance). It seems that the latter are the subjects that are given more time in the student's timetable, that have higher coefficients that influence the student's academic success, and/or that are more valued since primary education, as well as in society. With regard to the variation in the importance of LES according to gender and the grades obtained in LES, the following observations can be cited:

- Both females and males gave to LES an intermediate place (7th place) in terms of importance. The gender difference is in favor of females, but it is not significant ($p > 0,05$; $\Delta M = 0,11$). In other studies, females also accord more importance to biology (Uitto, 2014; Zeidan, 2010).
- According to the grades obtained in LES, this subject occupies an intermediate position for the students with the highest grades (6th place) and a late ranking for those with the lowest grades (8th place). Moreover, the difference in the perceived importance of this subject is statistically significant between the highest and lowest-performing students.

It is also important to note that 47,32% of students responded to the open-ended question on the reasons for their perception of the importance of LES. When we examine the most frequently cited reasons for considering LES an important school subject, the students mention in order: (1) the link between the lessons studied in LES and their daily and future lives, (2) the usefulness of this subject for their future studies (3) its link with their career aspirations, then (4) its contribution to improving their knowledge (body, health, nature, etc.) and (5) its effect on their personal development (personality, self-confidence, etc.). On the other hand, students who found this subject not important justified this mainly by (1) the lack of connection between their career aspirations and the content taught, (2) their ambitions to pursue literary studies, (3) the overload and complexity of the courses (long courses, diversified topics, etc.), (4) the lack of interest in the topics taught and (5) the negative attitude of the teacher (poor explanation, poor class management, etc.). Pearson (2017) points out that acquiring scientific knowledge and being exposed to it daily can have a direct impact on attitudes towards science. Thus, to reinforce the belief in the importance of the LES school

subject, it is necessary to raise awareness of the issues involved in teaching it, to show its usefulness in everyday life, and to present various career opportunities in related fields. In addition, it is important to support and encourage teachers to use innovative teaching methods as Potvin & Hasni (2014) point out, such as anchoring teaching in extracurricular activities, problem-based learning, project-based learning, and contextual learning.

4.2 Observations on the perceived Preference for LES school subject

In terms of preference, the LES school subject is moderately preferred (4,51), about the same level as Mathematics. It occupies a late position (9th place) in the ranking of school subjects. However, the most preferred subjects are Physical education and sports, and Islamic education. Many factors can influence students' preferences for different school subjects. For example, the valorization of Islamic education in society and the escape from the academic demands and entertainment moments that characterize Physical education are reasons for valuing them more than other subjects. In the study by Hasni & al. (2017), Physical education is also a preferred subject for the whole sample studied, and Science and technology occupy an intermediate place in terms of preference. Moreover, in Jenkin & Nelson's (2005) study, science is less appreciated than other school subjects. Looking at changes in preference for LES by gender and grades obtained in LES, the following observations are cited:

- LES school subject ranks last in terms of preference for both females (9th place) and males (10th place). The difference in average between the two sexes is in favor of females, but the effect size is negligible ($p < 0,05$). Many studies report that females are more attracted (more positive attitudes) to Biology than males (Badri & al., 2016; Baram-Tsabari & Yarden, 2008; Prokop & al., 2007; Trumper, 2006; Uitto & al., 2006; Uitto, 2014; Zeidan, 2010).
- LES school subject occupies an advanced ranking (2nd place) in terms of preference for students with high grades in LES (14 to 20) and a delayed ranking for those with moderate and low grades. The differences in preference are more pronounced and statistically significant in favor of students with high grades in LES. According to Bandura (1997), people prefer activities in which they feel competent and confident to those in which they feel less competent. In general, it can be said that the success of the LES school subject is a reason to prefer it more.

It should be noted that a proportion of 59,38% of students responded to our open-ended question on reasons linked to their perceived preference for LES. The reasons most cited, by students for their preference for this school subject include, in order, (1) the link between the knowledge studied and their daily lives, (2) the contribution of the subject to improving their knowledge, and (3) the teaching style of the teacher (good explanation, animation, fun, etc.), followed by (4) the relationship of the subject to their future study, (5) its link with their career aspirations (doctor, nurse, etc.), (6) their ability to understand the content taught easily and (7) its contribution to their personal development. However, students with a negative perception (non-preference) highlighted (1) their difficulties in learning and understanding the lessons, (2) the overload and complexity of the lessons, (3) the negative attitude of the teacher, (4) the lack of connection between their career aspirations and the subject and (5) the demanding nature of the subject at a cognitive level (memorization, comprehension, analysis, revision, etc.). In lower secondary school (middle school), science is becoming increasingly cognitively demanding (Barmby & al., 2008). The study by Ainley & Ainley (2011) showed that relevance and personal meaning are important factors in students' appreciation, interest, and engagement with science content. Furthermore, when students are convinced of the potential benefits of the subject for their future careers, this translates into a positive attitude toward the subject (Kubiatko & al., 2017). Thus, it is important to note that teachers have a crucial role to play in developing students' affective connections and positive attitudes toward LES. This includes showing interest in their students, presenting lessons in a fun and engaging way, using interactive tools, encouraging classroom discussion, and showing the links between the content

taught and the associated career opportunities. In addition, the student's engagement in the classroom, regular work outside school, and the support of parents are highly beneficial in overcoming difficulties and reinforcing positive feelings and preference for this school subject.

5. Conclusion

This study examines the status that students attribute to the LES school subject compared to other school subjects in the Moroccan middle school curriculum in terms of importance and preference dimensions. The results show that the LES school subject occupies an intermediate position in terms of importance and a lagging position in terms of preference compared to other school subjects. They reveal that the differences in preference for LES are statistically significant between the sexes and according to the grades obtained in this subject, favoring females and students with high grades. Also, the difference in the importance of LES according to the grades obtained is significant, in favor of students with high grades. In addition, the students justified their positive or negative perception of the importance and preference of this subject by citing several reasons, in particular, related to the teaching program, the learning environment, the usefulness of this subject, and their characteristics. Further research involving, for example, interviews with students and their teachers may shed more light on our findings. Moreover, classroom interventions can help identify best practices to improve students' belief in the importance and preference of LES school subject.

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