# Pre-service teachers' attitudes in planning and scheduling geofield trips at secondary school level.
# Attitudine dei futuri insegnanti nella pianificazione e organizzazione delle uscite didattiche nella scuola secondaria.

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ABSTRACT

Fieldwork and field trips have been recognized as having a crucial role in learning Geoscience. Nevertheless, planning and technical difficulties accompany the realization of field activities; among these are the teachers' attitudes to approaching Geoscience in the field. Here we present the results of a research carried out in the frame of the TFA 2nd cycle (University of Milan). The main goals were to teach participants how and when to plan field trips in Earth Science secondary level year schedule and to investigate their teaching approach in the field. The results show that a traditional teachers-centered approach to field didactics dominates the data set and that their ability in field trip planning seems to depend on their previous experience as students. The sites selection confirms the great potential that the Italian territory expresses in terms of field trip variety and feasibility.

RIASSUNTO

Le attività didattiche in campo e gli itinerari didattici sul terreno hanno un ruolo cruciale nell'apprendimento delle Geoscienze e per la contestualizzazione nel territorio dei concetti fondanti delle Scienze della Terra. Ciò nonostante, difficoltà organizzative e tecniche spesso limitano, in ambito scolastico, la realizzazione di attività didattiche sul terreno. Le esperienze sul territorio sono condizionate anche dalla propensione e dall'attitudine degli insegnanti a svolgere attività al di fuori dell'aula. Nel presente lavoro vengono presentati i risultati di una ricerca condotta nell'ambito del percorso di formazione degli insegnanti (TFA secondo ciclo, Università degli Studi di Milano) relativo alle classi di insegnamento A060-A054. Gli obiettivi erano principalmente quelli di affrontare le tematiche relative alla progettazione delle uscite sul terreno, dalla scelta del luogo e del percorso alla formulazione degli obiettivi e delle strategie di insegnamento, e di valutare l'attitudine dei futuri insegnanti verso l'organizzazione delle attività didattiche sul terreno, in particolare il tipo di approccio proposto: a completa conduzione da parte degli insegnanti, volto a favorire la formulazione di domande e la soluzione di problemi, misto. Sono state quindi analizzate le schede compilate dai tirocinanti, che prevedevano l'inserimento di informazioni quali numero di classi, insegnanti e guide coinvolte, tipo di scuola a cui veniva rivolto l'itinerario didattico, caratteristiche del percorso, costi, elementi organizzativi e descrizioni dei risultati attesi in termini di incremento delle conoscenze e delle abilità, di collocazione temporale nel piano didattico, attività in preparazione, strategie didattiche adottate e definizione delle attività degli studenti e dei docenti. I risultati evidenziano la prevalenza di un approccio tradizionale, centrato sulla figura del docente e influenzato dalle esperienze pregresse.

KEY WORDS
Geoscience, field trip, education, teaching approach, teachers' training, landscape

PAROLE CHIAVE
Geoscienze, escursioni sul terreno, strategie didattiche, formazione degli insegnanti, territorio.

## INTRODUCTION

### *1.1 Field trip and geoscience education*

*"Students could view slides of a dune and investigate quartz grains in the laboratory, but it is only by climbing the steep front slope of a sand dune that a student could receive a direct sensory-motor experience of learning about the structure of a dune"* (Orion, 2003).

Field trips are widely considered a powerful method to learn all about Natural Science and Geography but it is in the domain of Earth Science learning where they play a central, if not unavoidable, role. This is because fieldwork allows students to experience directly "*concrete phenomena and materials*" (Orion, 1993).

Since a field trip (FT) represents a way to insert a classroom in the real world, the benefits from field activities are various, moving from a deepest comprehension of knowledge to the acquisition of specific skills and abilities. Many authors (e.g. King, 2008) point out these goals:

- FT promotes a better understanding of Geoscience's fundamental concepts (among others Elkins & Elkins, 2007; Tretinjak & Riggs, 2008).
- FT is a perfect occasion to contextualize all the '*what*', '*how*' and '*when*' questions that have emerged in the classroom (from Orion, 1989).
- The interplay between observation and testing of ideas is a crucial point in scientific thinking; FT plays a key role in developing this habit of mind. In particular, FT enhances specific spatial-temporal skills as it allows students to familiarize themselves with Earth processes, to understand concepts on the spatial and temporal scales, integrating information and discussing the observed data.
- FT allows a systemic approach to matters and promotes an integrated vision of different disciplines (e.g. Assaraf & Orion, 2005).

- Since FTs provide students with a real world experience, they are a natural opportunity to employ the best practice of discovery-based and inquiry-based learning techniques, enhancing critical thinking and problem solving skills (King, 2008).

Out of the geoscience context, we can find many papers on field trips in the general sense of outdoor activities for students, in wild and natural environments, focusing on different types of benefits, which relate to the learner at both the individual and collective level. The first concerns the psychomotor, cognitive and affective development of the individuals, the second the social integration process and the development of knowledgeable active citizens (among others Dillon et al., 2006). In general, such literature evidences how direct experiences of the natural environment can have significant mental and physical health benefits and can enhance self-esteem and self-confidence. Researches regarding more specifically Earth Science education in the field have been also published (e.g. Bollati et al., 2013; Pelfini et al., 2016).

*1.2 Field trip and Earth Science teacher training*

"*Since field education and geoscience education are so inextricably linked, we should make the most of each in promoting the other"* (King, 2008)

Despite what was envisaged by King, recent papers denounce a general decline of field activities in primary and secondary Earth Science courses (Tretinyac & Riggs, 2008). Increasing costs, logistics, strong safety protocol, and legal implications in case of accidents are some of the factors that demotivate teachers to plan field activities. Some authors pointed out that another limiting factor depends on "the unfamiliarity with conducting field trips and the lack of curriculum materials relevant to field trip" (Elkins & Elkins, 2007). In addition, Earth Science student textbooks rarely include sections dedicated to field activities. Lewis (2008), in a paper on historical studies about Earth Science teacher training in the 20th century in the USA, shows that for a long time training programs "*focused more on enriching teachers' geoscience content knowledge*" than on didactic geoscience specific methodologies; he lets us deduce how fieldwork training represents a crucial step in pre-service primary/secondary teaching of Earth Science programs. Fieldwork has represented also the most common educational approach outside the classroom in teachers' training in England (Kendall et al., 2008). However, if there are a good number of studies citing the benefits of these kind of programs in promoting teachers' geoscience content knowledge (among others Hemler & Repine, 2006; Tretinyac & Riggs, 2008), only a few focus on the attitude of pre-service teachers towards fields activities (e.g. Moseley et al., 2002). In the Italian context, some authors have tried to fill this gap with manuals targeted at novice teachers, including chapters dedicated to field activities in the Earth Science domain.

Some works try to measure the effectiveness of the training program on novice teachers' "attitude toward science, confidence in teaching science, and inquiry understanding and skills" (Nugent et al., 2008). Nevertheless, there is no information about the impact of such programs on trainees' skills and abilities in scheduling FT.

The main aim of this research is to investigate, in a sample of Italian pre-service teachers attending the TFA (Active Formative Apprenticeship - Tirocinio Formativo attivo - for acquiring the license for teaching Science in the secondary school), both the role of their prerequisites and previous attitudes towards planning field trips activities and the effectiveness of the course program in enhancing this specific didactic ability. The course where the research has been carried out is a module of the main course on Education in Earth Science, dedicated to the teaching of laboratorial activities indoors and outdoors.

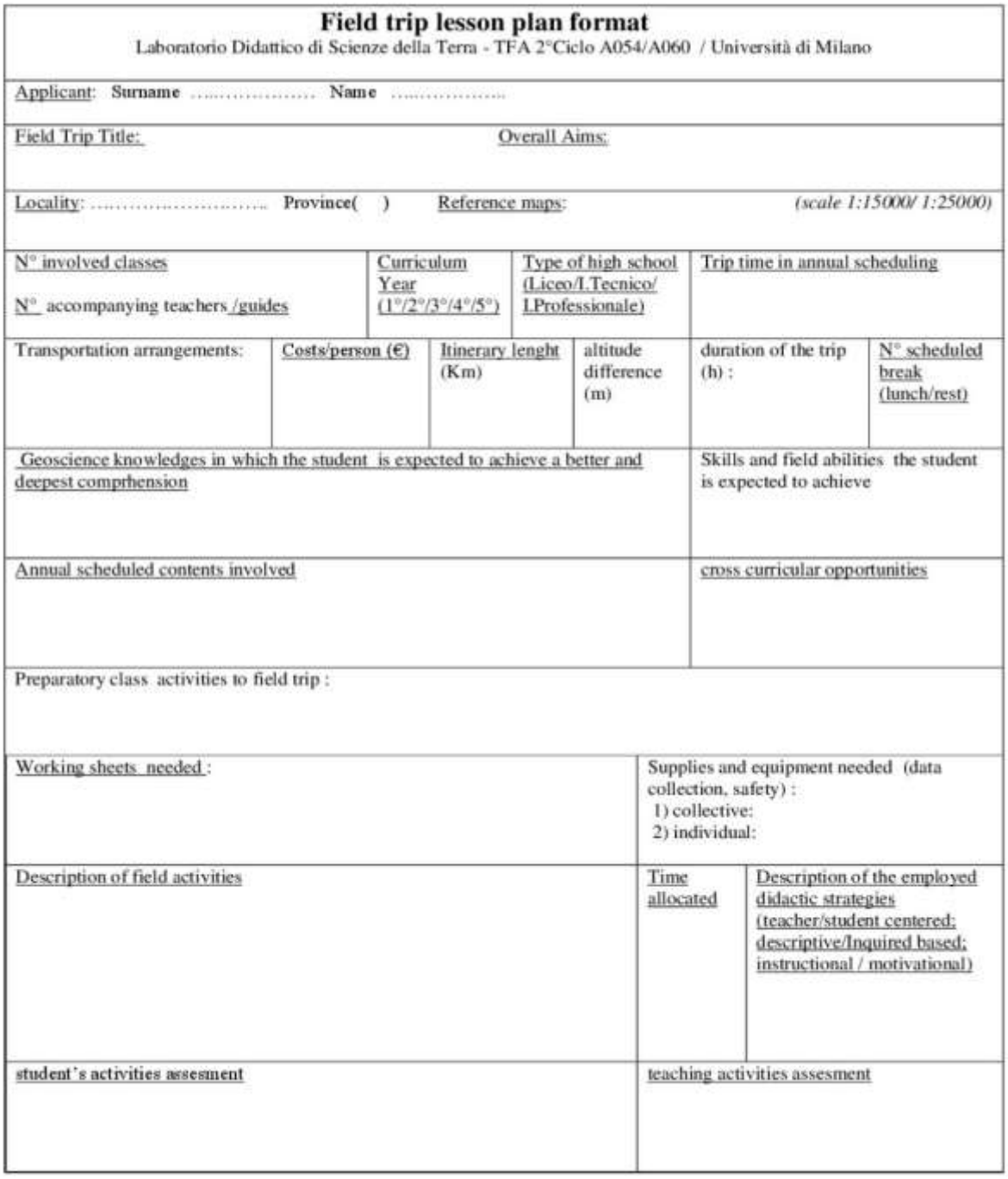
More in detail, we want to analyze if: 1) there is any correlation between pre-service teachers' academic backgrounds and their exam scores in the analyzed sample; 2) there is any correlation between pre-service teachers' experience as students and their attitudes in planning FT; 3) we can indirectly have information about the educational potential that the Italian territory can provide.

## METHODS

During the course, educational strategies about Earth Science teaching and the key role that fieldwork provides to overcome the main cognitive obstacles imposed by the discipline were discussed with a class composed of seventy pre-service Science teachers. Participants faced exercises and examples of teaching leading techniques during FT. The Italian National Curriculum indications for all High Schools were also analyzed, in order to identify where and when to schedule field activities and FT. This assumes that FT, to be didactically effective, needs to be a part of the annual program and not a sporadic and isolated event (Orion, 1993). An urban geological trip, in the center of Milan, was also organized in order to put into practice some of the inquired approaches.

The future teachers were asked to produce a FT lesson plan for a high school class, for their exam, by using a defined format. Location, duration, school typology and all educational strategies were freely definable.

The ways used by trainees to organize their final projects were also considered to check their attitude towards FT. The seventy formats constitute the analyzed dataset. For the evaluation, three primary indicators were considered: general feasibility (logistics, safety, costs, time scheduling, location, potentiality); educational coherence (between FT educational goals and annual scheduling); didactic feasibility (coherence between educational goals of trips and planned didactic strategies) (Fig. 1).



**Field trip lesson plan format**

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| | | | | | |
|---|---|---|---|---|---|
| Applicant: Surname ..... Name ..... | | | | | |
| Field Trip Title: | | | Overall Aims: | | |
| Locality: ..... Province( ) | | | Reference maps: | | *(scale 1:15000/ 1:25000)* |
| N° involved classes<br>N° accompanying teachers /guides | | Curriculum Year (1°/2°/3°/4°/5°) | Type of high school (Liceo/I.Tecnico/ I.Professionale) | Trip time in annual scheduling | |
| Transportation arrangements: | Costs/person (€) | Itinerary lenght (Km) | altitude difference (m) | duration of the trip (h) : | N° scheduled break (lunch/rest) |
| Geoscience knowledges in which the student is expected to achieve a better and deepest comprhension | | | | Skills and field abilities the student is expected to achieve | |
| Annual scheduled contents involved | | | | cross curricular opportunities | |
| Preparatory class activities to field trip : | | | | | |
| Working sheets needed : | | | Supplies and equipment needed (data collection, safety) :<br>1) collective:<br>2) individual: | | |
| Description of field activities | | | Time allocated | Description of the employed didactic strategies (teacher/student centered; descriptive/Inquired based; instructional / motivational) | |
| student's activities assesment | | | teaching activities assesment | | |

Fig. 1 The Field Trip lesson plan format
Fig. 1 Scheda di progettazione per l'uscita sul campo

For statistically testing the presence and the strength of a correlation between the obtained test grade and previous experiences, we formulated two different regression models.

Previous experiences consider both academic courses and non-academic field activities as possibly influencing the planning and the organization of FT. The non-academic experiences were pointed out during conversations and common discussions.

In the first model we decided to use as the explicative variable relative to the exam evaluations (score) a dummy (a binary variable) to which was assigned the value 1 (one) for trainees with a clear previous academic experience in FT (participation and/or organization) and the value 0 (zero) for trainees without any FT experience (dummy ABE = Academic Background Experience). Moreover, a constant has been associated with this variable (CONST).

In order to consider different FT experiences we built a second regression model in which we assigned value 1 (one) to the dummy also for trainees communicating to have had good experiences in FT participation and organization, even if non-academic (related to sport activities, landscape frequentation thanks to parents' nature passion, association activities, etc.). (New dummy, APBE = Academic or Practical Background Experience).

## RESULTS

*Evaluation of trainees*

Most of the TFA candidates' results are to graduate in Natural Science *sensu latu* (Biology, Chemistry, Biochemistry, etc.), degree courses, mainly without specific activities and/or courses concerning the Earth Science domain, so they have no previous geographical or geological field experience. The remaining trainees took their master degrees in natural, environmental, forestry, geological science, etc., academic courses that include field activities. In view of that, we first analyzed final exam data in order to find an eventual correlation between scores and previous backgrounds (values are expressed in thirtieths).
Trainees were grouped in four categories in relation to their academic degrees. The results show an average score of 25/30 for Chemistry graduates, who represent 10% of the trainees' sample. The same score, 25,05/30, was reached by Biotechnology graduates (25,71%). Biology graduates gained a little better score of 25,33/30 (38,57%), while 26,27/30 is the better average score reached by the category which aggregates Environmental Science and Geology graduates (25,71%). This category also shows the maximum number (5) of top scores (30/30. 30/30 *cum laude*).
For what concerns the first regression model, results are reported in Fig. 2.
They show the presence of a positive and statistically significant correlation between the score and the previous academic FT experience. The low square R value, adjusted for degrees of freedom, is due to the shortage of observations with ABE value = 1.
In this way we can affirm that candidates with clear previous academic experiences, of what concerns planning and realization of FT, have a high probability to obtain a final score better than the average (25/30) of the remaining candidates, which ranges in the order of +/- 3.24/30.

| Dependent variable : SCORE | coefficient | t-test value | p-value | Adjusted R-squared = 0.08 | N° of obs = 70 |
|---|---|---|---|---|---|
| Predictor: ABE | 3.24 | 2.70 | 0.009 | | |
| Constant: CONST | 25.07 | 61.89 | 0.000 | | |

a

| Dependent variable : SCORE | coefficient | t-test value | p-value | Adjusted R-squared = 0.59 | N° of obs = 70 |
|---|---|---|---|---|---|
| Predictor: APBE | 5.14 | 10.18 | 0.000 | | |
| Constant: CONST | 22.94 | 65.15 | 0.000 | | |

b

Fig. 2 a) Results from the first model; b) Results from the second model
Fig. 2 a) Risultati ottenuti con il primo modello; b) Risultati ottenuti con il secondo modello

For what concerns the second regression model, results are shown in Fig. 2b. Results appear encouraging. They strengthen the previous hypothesis; moreover, the results evidence a considerable increase in the evaluation general level of statistical significance.
Evaluations carried out with the second model evidence how candidates (the future teachers in the examined sample) with previous experience in Geoscience FT, both academic and non-academic, have a higher probability to obtain a final score greater than the average one (22.94/30) variable in a range of +/- 5,14/30.

*The choice of field educational strategies.*

Referring to the educational strategies planned by trainees, the results show that only in a few cases would they gain outdoor activities in a discovery/motivational way (2/70). Generally, a guided inquiry with focus generated from trainees' field experience covers 30% of plans, while in most of the cases, over 60%, plans were dominated by an instructional/descriptive teachers' leading style (Fig. 3a).

*The educational potential of Italian territory*

The sites selection shows a dominance of Lombardy's and Piedmont's locations. This is obvious as the TFA was run in the University of Milan and most of the participants live in north-western Italy. This would explain why mountainous environments are prevalent in the FT projects. Anyway, ten Italian regions, along the entire peninsula, were involved with FT, covering seven different geographical and geomorphological environments. These

main environments were defined by their predominant physiographic elements (Fig. 3b).

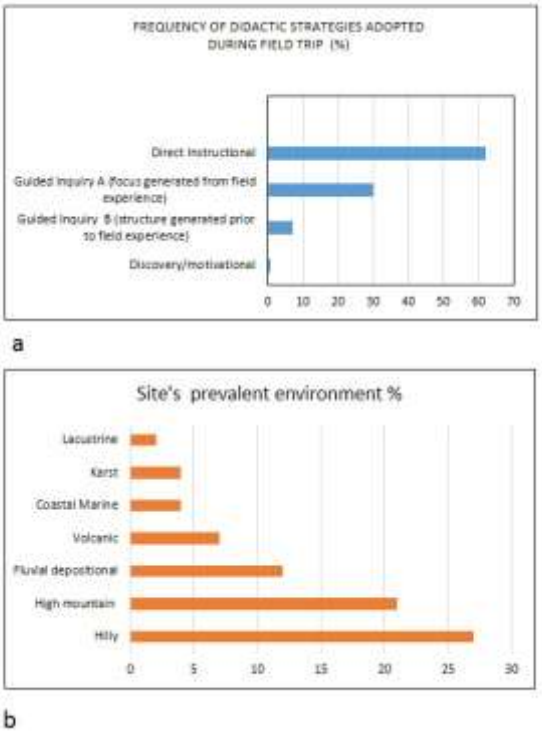


Fig. 3 a) Educational strategies proposed by trainees for FT. b) Different geographical and geomorphological environment linked with trainees' projects.
Fig. 3 a) Strategie didattiche per l'attività di campo proposte dai tirocinanti. b) I diversi ambienti geografici e geomorfologici trattati nei progetti.

Due to the peculiar character of each site, various topics were covered during the proposed FTs. Different Earth Science topics have been proposed as considered relevant for the curricula (in a decreasing order of FT proposal abundance: Alpine geomorphology, lithology, fluvial geomorphology, volcanism, structural geology, karst geomorphology, hydrology, coastal geomorphology, paleontology/paleoecology, stratigraphy, mining, pedology). Ecology, History, Art and Architecture have also been explored, with significance as cross-curricula opportunities.

## DISCUSSION

*Evaluation of trainees*

The very low variability between the test results at first glance seems to denote an absence of correlation between apprentices' degrees and scores, in the examined sample. Specific skills and abilities achieved during tertiary education apparently seem not to influence the prospect of organizing FT and fieldwork in high school. Nevertheless, the two statistical models, which consider respectively the fieldwork linked with the academic formation and also this latter joined with the personal field experiences, even if experimented outside the formation period, let us suppose that the greater the previous field experience, the greater the possibility to get a score higher than the average for each group. Obviously, considering the sample is small and the assessment of previous experience was deduced after discussions, the result can be only referred to the examined trainee's sample. Anyway, the results are encouraging and suggest continuing the research.
The brainstorming allowed also us to deduce how teaching was not the first job choice for someone; somebody probably hoped, or hopes, to spend his competence in different working domains. Graduates in Environmental Sciences (in a broad sense) who show a higher frequency of top scores (30/30 and 30/30 *cum laude*) seem to be more flexible to achieve the didactic skills requested by the teacher's profile.

*The choice of field educational strategies.*

If we compare trainees' results, especially if we consider their proposals in terms of educational feasibility (Fig. 2a), it appears clear that the experiential learning approach is not instinctive. In the majority of cases (60%) the planned outdoor activities are led by teachers in an instructional/descriptive style; only in one third of plans do trainees present an inquiry approach and only in very few cases are the FT proposed in a discovery/motivational way. This reflects the Italian educational practice at secondary level, which is traditionally teacher-centered and poorly participative: "Active didactics, group work, cooperative learning are forms that are beginning to be more frequent in nursery and primary school, while they are still rare experiences in the secondary school" (MIUR 2003).
Even if, during the training course, the student-centered approach was underlined, the future teachers seemed to replicate their previous experiences as students.
Nugent et al. (2008) remark that the majority of undergraduate science courses in the American colleges are rich in contents but poor in engaging students in active investigation, with a clear impact on future science educators: "*It is difficult for our future teachers to create effective and engaging science courses for their students without exposure to such experiences*" (Tretinjac & Riggs, 2008). Moreover, as observed by Tretinjac & Riggs (2008), if we don't let pre-service teachers gain field experiences they will remain unaware of the educational potential the outdoor environment can provide.

*Italy's landscape variety*

The location of the proposed FTs shows how rich and versatile the Italian territory is for outdoor educational approaches. Topics relevant for High School science curricula are in almost all cases touched either as primary subjects or as secondary ones. Anyway, the learning goals of such a versatile territory are not limited to the Earth Science ones since they could be extended to those of Geography, Economy and Citizenship education etc., as mentioned in the plan of apprentices.

## CONCLUSIONS

The present research, even if limited to a small sample, allows us to deduce some conclusions:
- Even if fieldwork and FT are considered very important in Geoscience education, the interviewed future Italian teachers seem to have poor experience of them, and FTs appear difficult to plan, considering, other than traditional strategies, active and inquiry approaches.
- Results confirm the literature for what concerns the importance of inserting FT as a part of the annual program and not as a sporadic event, in order to be didactically effective. Moreover, also cities and towns represent an opportunity for FT as experimented by the sample TFA apprentices.
- The future teachers' backgrounds, their motivation in choosing teaching as their job, the rich literature on problems concerning the teaching of Science, and our results suggest that a more designed path for science teachers at the academic level could be advantageous. This is even more necessary for what concerns Earth Science as evidenced during the most recent cultural events and congresses, including a thematic session dedicated to geoscience education.
- Finally, results outline how the proposed FT rarely considers a motivational approach. This is a crucial point as a plan of action based on motivation induces interest in students and represents an incentive for studying Geoscience. Probably a motivational and discovery approach belongs more to a constructivist belief about teaching which is uncommon in Italian secondary schools. Interdisciplinary and cross-disciplinary FT planning could help to develop a systemic sight of the characteristics of their territory.

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