AEDLi Framework

Coding manual

Part 3 of 3: Guiding Examples for the Individual Ratings

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Based on Project titled 'Developing Primary Science Teachers' Language Awareness to Enhance the Teaching of Disciplinary Literacy: A Study of Teachers' Lesson Enactments through the Lens of Adaptive Expertise' [OER 18/19 SLH] led by *Dr Seah Lay Hoon* and *Dr Sun Baoqi*

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List of tables of indicators

Reading the tables

1. This row indicates the criteria (if any) for the indicator to be used.

2. This row shows the indicator and its abbreviation.

4. For indicators with initial binary ratings, these rows show the unit of analysis and the examples for the initial ratings. For indicators without initial binary ratings, these rows do not exist (See Note 5).

5. For indicators with initial binary ratings, these rows show the unit of analysis and the general description (in bold) for the overall rating. For indicators without initial binary ratings, these rows show the unit of analysis, with the general description and example together for the rating.

3. These rows describe the lesson context of the example that would apply to all ratings. Typically, these would include the Agenda Setting and Activity Design, unless the Activity Design is the object of analysis (see for e.g., AD.Ad.2).

6. The colour scheme of the table (seen in the cell colour of the 'Ratings' row and the font colour of the general descriptions reflect the dimension measured by the indicator. **Blue** is used for Flexibility, **orange** for Deliberate Practice, and **green** for Deep Understanding.

This indicator is used only if there is metalanguage used in the materials.	
Indicator (AD.Ac.1)	**Accuracy** of metalanguage use in materials
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why a bulb does not light up in a circuit, with the help of metalanguage terms such as 'feature', 'process', and 'effect' to structure such explanations
	Materials/Activities: (1) T's PPT slides with explanation of the 3 metalanguage terms and how they can be used to structure the explanations, and (2) explanation writing tasks for Ss at class and individual levels
Example of metalanguage chosen for lesson	'feature', 'process', and 'effect' selected as key components of explanations for why bulbs do not light up in a circuit
Unit of analysis	Instance of metalanguage use in materials
Ratings	Criteria [With examples below]
Accurate	E.g., 'Process' is used to refer to the flow of electricity in the circuit.
Inaccurate	E.g., 'Effect' is used to refer to the types of circuit instead of the observation of the bulb in the circuit.
Unit of analysis	Whole lesson
Ratings	Criteria [With examples below]
Rating 3	Metalanguage use in materials is mostly (about 90%) accurate.
Rating 2	Metalanguage use in materials is moderately (about 50% to 80%) accurate.
Rating 1	Metalanguage use in materials is rarely to occasionally (about 10% to 40%) accurate.
Rating 0	Metalanguage use in materials is always inaccurate.

Note: While the examples for the indicators were inspired by empirical data (actual lesson transcripts), they were refined according to the criteria set for the indicators. In addition, the examples were inspired by actual lessons observed across different grade levels, including Grade 4, 5, 7 and 9. Hence, there is a need for users to adapt the examples provided to F-lit objectives, tasks and content accordingly to the grade level of the lesson being examined.

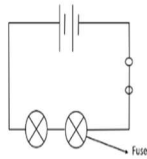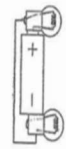## Guiding Examples for the Individual Ratings

Agenda Setting

Table 1. Examples for ratings of indicator AS.Al.1

This indicator is used only if there is a F-Lit objective (either communicated or inferred) in the lesson.	
Indicator (AS.Al.1)	**Alignment** of F-Lit objective to relevant materials/activities and discursive support
Context of examples	
Lesson component: Agenda Setting	**F-Lit objective:** To increase awareness of pronoun use and construct clearer written responses by avoiding indiscriminate use of pronouns
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**F-Lit objective is fully aligned to materials/activities and discursive support.** E.g., Both PPT slides and activity sheet reflect F-Lit objective: the PPT slides are used to introduce what pronouns are and provide examples for class-level discussion while the activity sheet is used to give Ss practice in pronoun replacement through pair work (*Cf. Adequacy of coverage of F-Lit objective*). T reminds Ss of F-Lit objective before activities and constantly directs Ss to think about pronoun use and whether certain pronoun replacements would make the meaning of the sentence clearer.
Rating 2	**F-Lit objective is partially aligned to materials/activities and discursive support.** E.g., Lesson begins with whole-class discussion of the need for pronoun replacement using the PPT slides, but, but the practice questions that follow the discussion focus on error correction of sentences not related to pronoun replacement. As a result, while T's discursive support during the whole-class discussion is aligned to the F-Lit objective, her discursive support during the practice questions is not.
Rating 1	**F-Lit objective is poorly aligned to materials/activities and discursive support.** E.g., Lesson begins with whole-class discussion of the need for pronoun replacement using the PPT slides, but only very briefly, before going on to focus on other aspects of error correction not related to noun-pronoun replacement. The practice questions also focus on error correction of sentences not related to pronoun replacement. As a result, T's discursive support during the lesson is hardly focused on the F-Lit objective.
Rating 0	**F-Lit objective is not aligned to materials/activities and discursive support.** E.g., Materials/activities and T's discursive support fully focus on error correction of sentences not related to pronoun replacement.

Table 2. Examples for ratings of indicator AS.Ex.1

This indicator is used only if there is a F-Lit objective (either communicated or inferred) in the lesson.	
Indicator (AS.Ex.1)	**Explicitness** and **strategic** presentation of F-Lit objective in materials/activities and discursive support
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why a bulb does not light up in a circuit, with the help of metalanguage terms such as 'feature', 'process', and 'effect' to structure such explanations
	Materials/Activities: (1) T's PPT slides contain explanation of the 3 metalanguage terms and how they can be used to structure the explanations, and (2) explanation writing tasks for Ss at class and individual levels
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Presentation of F-Lit objective in the materials/activities and discursive support is explicit and strategic.** *Explicit:* E.g., F-Lit objective is prominently presented on PPT slide and also discursively introduced at the same time. T explains that the 3 metalanguage terms are the components of the explanation. *Strategic:* E.g., T introduces F-Lit objective at the beginning of the lesson. She also introduces both writing tasks (one at class level, followed by one at individual level) by explaining to class that they will have the opportunity to write explanations with the help of the 3 metalanguage terms. In her discursive support with Ss, T repeatedly reminds them about the F-Lit objective to think about the metalanguage terms in their construction of the explanations.
Rating 2	**Presentation of F-Lit objective in the materials/activities and discursive support is explicit and somewhat strategic.** E.g., Presentation of the F-Lit objective is explicit as in Rating 3, but not as strategic: *Strategic:* T introduce only the class-level writing task by explaining that there will be the opportunity to write explanations with the 3 metalanguage terms. She does not do the same for the individual writing activity. In her discursive support with Ss, T does not remind Ss about the F-Lit objective to use the 3 metalanguage terms to construct explanations for why the bulb does not light up.
Rating 1	**Presentation of F-Lit objective in the materials/activities and discursive support is somewhat explicit but incidental.** *Explicit:* E.g., F-Lit objective is presented only once discursively, with T very briefly making reference to the 3 metalanguage terms as the components of the explanations. *Strategic:* E.g., T does not make any reference to the F-Lit objective when introducing any of the writing tasks.
Rating 0	**Presentation of F-Lit objective in the materials/activities and discursive support is not explicit and not strategic.** E.g., F-Lit objective is not presented in any of T's materials or T's discursive support, but can be inferred from T's discursive support.

Table 3. Examples for ratings of indicator AS.Ad.1

This indicator is used only if there is a F-Lit objective (either communicated or inferred) in the lesson.	
Indicator (AS.Ad.1)	**Adequacy** of coverage of F-Lit objective in materials/activities
Context of examples	
Lesson component: Agenda Setting	**F-Lit objective:** To construct written explanations for why a bulb does not light up in a circuit, with the help of metalanguage terms such as 'feature', 'process', and 'effect' to structure such explanations
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**F-Lit objective is adequately fulfilled by cumulative effect of T's design and use of materials/activities, such that Ss are likely to achieve the F-Lit objective comprehensively.** E.g., Materials/activities contain adequate information and learning opportunities for Ss to achieve the F-Lit objective fully. The PPT slides explain what the 3 metalanguage terms cover and how they are used in construction of the explanations:

Electrical circuits – Associated metalanguage

Feature of circuit	Meaning	Process (involving electric current)	Effect on light bulb/s
Closed circuit	The circuit has no gaps in it.	electric current can flow through	All light bulbs can light up.
Open circuit	The circuit has one or more gaps in it.	electric current cannot flow through	No light bulb can light up.
Series circuit	The bulbs in the circuit are arranged/connected to form a single path for electric current.	electric current cannot flow through when one bulb is not working.	No light bulb can light up when one bulb is not working.
Parallel circuit	The bulbs in the circuit are arranged/connected to form two or more paths for electric current.	electric current can flow through the other path when one bulb is not working.	The light bulb in the other path/s can light up when one bulb is not working.

Metalanguage in purple

The PPT slides also contains scaffolded examples that T works through with the class (image below, on the left) and items that require Ss to construct their own explanations (image on the right):

Explain why the bulb in the circuit did not light up.

Feature (of circuit)	
Process (electrical current)	
Effect (on light bulb)	

Ans: The circuit is an open circuit as one of the light bulb is fuse and electric current cannot flow through the circuit causing the bulb to not light up.

Explain why the bulbs in the circuit did not light up.

Feature (of circuit)	
Process (electrical current)	
Effect (on light bulb)	

Ans:

	The scaffolded examples and writing tasks for Ss cover the three situations where the bulb would not light up: 1) Open circuit due to fusing of bulb 2) Open circuit due to presence of electrical insulator in circuit 3) Same terminals (i.e., positive-positive or negative-negative) of battery connected
Rating 2	**F-Lit objective is somewhat fulfilled by cumulative effect of T's design and use of materials/activities, such that Ss are likely to achieve the F-Lit objective partially.** E.g., Materials/activities contain somewhat adequate information and learning opportunities for students to achieve the F-lit objective fully, but with one or two aspects not attended to. For e.g., with reference to Rating 3, the materials miss out writing task for one of the situations causing the bulb to not light up.
Rating 1	**F-Lit objective is poorly fulfilled by cumulative effect of T's design and use of materials/activities, such that Ss are likely to achieve the F-Lit objective in a limited manner.** E.g., Materials/activities contain incomplete information and limited learning opportunities with many aspects not attended to, which do not allow for students to achieve the F-lit objective fully. For e.g., with reference to Rating 3, the materials do not have any or have very few writing tasks, or may focus on only 1 situation causing the bulb to not light up.
Rating 0	**F-Lit objective is not fulfilled by cumulative effect of T's design and use of materials/activities, such that Ss are not likely to achieve the F-Lit objective.** E.g., Materials/activities contain inadequate or non-existent information and learning opportunities for students to achieve the F-lit objective fully, with almost all aspects not attended to. For e.g., with reference to Rating 3, the materials very briefly cover only 1 situation causing the bulb to not light up with no writing task.

Table 4. Examples for ratings of indicator AS.Fl.1

This indicator is used only if there is a S language need that requires a change in the F-Lit objective.	
Indicator (AS.Fl.1)	**Flexibility** of T's adaptation of planned F-Lit objective mid-lesson in addressing S language needs
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations using comparatives and superlatives for the choice of material for different purposes
	Materials/Activities: Activity sheet requiring Ss to make comparisons between materials and write explanations for why one material is better/best for certain purposes.
Example of S language need arising	T notices Ss facing multiple difficulties of a similar nature, which makes fulfilling the original F-Lit objective for most Ss challenging. For e.g., T notices S difficulty with making relevant comparisons from the following observations of Ss: 1) merely describing materials separately without making comparisons, 2) struggling with forming comparisons using comparatives and/or superlatives, 3) making unclear comparisons (e.g., "Material A is stronger" without mentioning the other object compared to) or comparisons involving different qualities (e.g., "Material A is strong, but Material B is flexible").
Unit of analysis	Instance of S language need arising that requires T's adaptation of planned F-Lit objective
Ratings	**Criteria** [With examples below]
Rating "Flexible"	**T's changes to the planned F-Lit objective in response to class's language needs are flexible, i.e., her changes target S language needs effectively.** E.g., T changes F-Lit objective to focus on constructing simple statements with comparatives and superlatives before returning to her original F-Lit objective (possibly in a subsequent lesson).
Rating "Inflexible"	**T changes the planned F-Lit objective to address S language needs, but her changes are not flexible to such needs, i.e., her changes do not target such needs, or she does not make any changes at all.** E.g., T changes F-Lit objective to focus on sentence structure elements not related to comparisons, e.g., noun-verb collocations.

Activity Design

Table 5. Examples for ratings of indicator AD.Ac.1

This indicator is used only if there is metalanguage used in the materials.	
Indicator (AD.Ac.1)	**Accuracy** of metalanguage use in materials
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why a bulb does not light up in a circuit, with the help of metalanguage terms such as 'feature', 'process', and 'effect' to structure such explanations
	Materials/Activities: (1) T's PPT slides with explanation of the 3 metalanguage terms and how they can be used to structure the explanations, and (2) explanation writing tasks for Ss at class and individual levels
Example of metalanguage chosen for lesson	'feature', 'process', and 'effect' selected as key components of explanations for why bulbs do not light up in a circuit
Unit of analysis	Instance of metalanguage use in materials
Ratings	**Criteria** [With examples below]
Accurate	E.g., 'Process' is used to refer to the flow of electricity in the circuit.
Inaccurate	E.g., 'Effect' is used to refer to the types of circuit instead of the observation of the bulb in the circuit.
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Metalanguage use in materials is mostly (about 90%) accurate.**
Rating 2	**Metalanguage use in materials is moderately (about 50% to 80%) accurate.**
Rating 1	**Metalanguage use in materials is rarely to occasionally (about 10% to 40%) accurate.**
Rating 0	**Metalanguage use in materials is always inaccurate.**

Table 6. Examples for ratings of indicator AD.Ex.1

This indicator is used only if there is a F-Lit objective (either communicated or inferred) in the lesson and there is metalanguage used in the materials.	
Indicator (AD.Ex.1)	**Explicitness** and **strategic** use of T's metalanguage in materials in fulfilling F-Lit objective
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why certain food is (un)suitable for fictitious aliens with particular dietary restrictions
	Materials/Activities: 1) a classified glossary, 2) a handout with explanation components, and 3) an activity sheet for Ss to construct explanations
Example of metalanguage chosen for lesson	'part', 'food substance', 'product', and 'function' selected as key components of explanations for why certain food is (un)suitable for fictitious aliens with particular dietary restrictions
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Metalanguage used in materials is explicit and strategic in fulfilling F-Lit objective.** *Explicitness:* E.g., Metalanguage is used prominently (repeatedly, consistently, and its appearance contributes to the fulfilment of the F-Lit objective) in all materials: as 1) classified glossary headings, 2) components for explanations, and 3) scaffolding words in activity sheet. *Strategic use:* E.g., Selection of metalanguage is judicious: 1) the set selected ('part', 'type of enzyme', 'food substance', 'product', and 'function') is accessible and manageable for Ss, and 2) the different metalanguage terms are able to make explicit the language demands and structures of the explanations required of Ss. Metalanguage is also used for various purposes, e.g., as a/n 1) information organiser in a classified glossary, 2) components of explanation in a separate handout, and 3) scaffolding tool in activity sheet to direct Ss to relevant portions of classified glossary and/or handout.
Rating 2	**Metalanguage used in materials is explicit and somewhat strategic in fulfilling F-Lit objective.** E.g., T's metalanguage use is prominent as in Rating 3, but not as strategic: *Strategic use:* Selection of metalanguage is somewhat judicious: though the set of metalanguage ('part', 'type of enzyme', 'food substance', and 'function') selected is accessible and manageable for Ss, the metalanguage 'product' should also have been included as it is needed in the construction of the full explanation.

	Metalanguage is used for only 1-2 purposes, e.g., as 1) an information organiser in a classified glossary, and 2) components of explanation in a separate handout.
Rating 1	**Metalanguage used in materials is somewhat explicit but incidental in fulfilling F-Lit objective.** E.g., *Explicitness:* Metalanguage is not always used consistently (e.g., "purpose" is sometimes used in place of the metalanguage term "function"). Its appearance may not always contribute to the fulfilment of the F-Lit objective. *Strategic use:* As in Rating 2, selection of metalanguage is somewhat judicious but metalanguage is used for only 1 minor purpose, e.g., T merely labels words with the metalanguage but does not explicate what the metalanguage is used for. Several missed opportunities to use the metalanguage in the lesson are also observed.
Rating 0	**Metalanguage used in materials is not explicit and not strategic in fulfilling F-Lit objective.** *Explicitness:* E.g., Metalanguage is used inconsistently (e.g., different synonyms like "use" or "purpose" sometimes used in place of "function") and its appearance does not contribute to the fulfilment of the F-Lit objective. *Strategic Use:* E.g., Selection of metalanguage is not judicious: most of the metalanguage needed for explanation construction to fulfil the F-Lit objective not selected, e.g., only 'part' is selected). Metalanguage use is not strategic at all with no clear purpose.

Note: metalanguage use is best evaluated across lessons on the same topic.

Table 7. Examples for ratings of indicator AD.Ad.1

This indicator is used only if there is a F-Lit objective (either communicated or inferred) in the lesson.	
Indicator (AD.Ad.1)	**Adequacy** of materials/activities in integrating F-Lit and content objectives
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To increase awareness of pronoun use and construct clearer written responses by avoiding indiscriminate use of pronouns
	Materials/Activities: PPT slides to unpack what pronouns are and to show items for class-level discussions on replacing pronouns; activity sheet with items requiring Ss to identify non-specific pronouns and replace them in pair discussion and writing
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Content and F-Lit objectives are adequately integrated throughout all materials/activities.** Integration of content and F-Lit objectives seen in all materials/activities: *PPT:* E.g., Slides unpack what pronouns are, with i) definition, ii) common examples used in science, e.g., 'it' and 'they'/'them', and iii) characteristics of pronouns which make the indiscriminate use of them problematic, especially in science writing where the referent (the noun referred to by the pronoun) is linked to scientific concepts. For class-level discussion, slides also include sentences containing pronouns and ambiguous referents – Ss to identify and replace the pronouns with the correct referents, e.g., A) When the hot water and the metal lid come in contact, *it* gains heat and expands (more than 1 potential referent) B) When the surrounding air comes in contact with the cooler surface of the metal lid, *it* loses heat and condenses into tiny water droplets (more than 1 referent, and actual referent not found in sentence). Replacement of pronouns with the correct referents require knowledge of content (science concepts) as well as language. *Activity sheet:* E.g., The activity sheet contains items that require Ss to study sentences containing ambiguous pronouns, identify and replace the pronouns with the correct referents by applying their science knowledge.
Rating 2	**Content and F-Lit objectives are somewhat integrated throughout all materials/activities.** E.g., Integration of content and language objectives adequately present only in some materials. For e.g., with reference to Rating 3, T does not use science examples in her slides, but does so in the writing activity.

Rating 1	**Content and F-Lit objectives are poorly integrated throughout all materials/activities, with either content or language being the main focus.** E.g., Integration of content and language objectives is poor in all materials. For e.g., with reference to Rating 3, T does not talk about how the use of pronouns can result in ambiguous referents (which in turn can affect the scientific meaning of the sentence), while the activity sheet consists of items with only one potential referent in the sentence, e.g., "Bulb C will light up because it is in a parallel circuit." As a result, language becomes the focus because Ss are only required to identify and match the only referent to the pronoun.
Rating 0	**Content and F-Lit objectives are not integrated throughout all materials/activities.** E.g., Integration of content and language objectives absent in all materials. For e.g., with reference to Rating 3, T does not talk about how the use of pronouns can result in ambiguous referents (which in turn can affect the scientific meaning of the sentence), while the activity sheet consists of items that require Ss to replace pronouns in generic, non-science sentences that do not require the application of any science knowledge.

Table 8. Examples for ratings of indicator AD.Ad.2

Indicator (AD.Ad.2)	**Adequacy** of written scaffolding provided in materials or by T in fulfilling F-Lit objective
Context of examples	
Lesson component: Agenda Setting	**F-Lit objective:** To construct written explanations for why certain food is (un)suitable for some aliens with particular dietary restrictions
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Cumulative effect of the scaffolding provided across materials is adequate; apart for content-related issues, no additional scaffolding from T is necessary.** E.g., Materials used include 1) a classified glossary, 2) a handout with explanation components, and 3) activity sheet for Ss to construct explanations. Scaffolding in materials is provided adequately (e.g., at the word/phrase/text/task levels) such that 1) Ss can reasonably fulfill the task, and 2) without being excessive. Apart from content-related support, no additional support from T is needed. Example of possible support at the different levels: <u>At word/phrase level</u>, a classified glossary list provides organization of vocabulary such that Ss can easily locate the vocabulary needed to construct the explanation. <u>At text level</u>, a complementary handout to support explanation construction can show 1) components of explanation (e.g., digestive part → enzyme produced → function of enzyme (food substance digested, and products obtained). Handout also shows scaffolding for the opposite: when a certain body part is missing (e.g., missing part → inability to produce certain enzymes → function of missing enzyme → inability for food substance to be digested → recommendation for diet as a result) and 2) grammatical resources (e.g., prepositions and connectors) needed for explanation construction. Finally, <u>at task level</u>, for an activity that requires Ss to provide separate explanations with a similar explanation structure, progressive reduction in scaffolding can be provided. For example, the first explanation expected of Ss can start with single-word gap-fills. Longer gap-fills (requiring Ss to fill in phrases) are then used in the subsequent explanations, with the last item requiring Ss to construct the entire explanation.
Rating 2	**Cumulative effect of the scaffolding provided across materials is somewhat adequate; apart for content-related issues, some additional scaffolding from T is necessary.** E.g., Materials used include 1) a classified glossary, and 2) activity sheet for Ss to construct explanations. Scaffolding in materials is provided adequately such that apart from content-related support, some additional minimal level of support from T is needed.

Rating 1	**Cumulative effect of the scaffolding provided across materials is limited; apart for content-related issues, much additional scaffolding from T is necessary.** E.g., Materials used include activity sheet for Ss to construct explanations. Limited scaffolding in activity sheet is provided, substantial additional support from T is still required apart from content-related support.
Rating 0	**Cumulative effect of the scaffolding provided is not adequate or non-existent; apart for content-related issues, substantial additional scaffolding from T is necessary.** E.g., The only material used is an activity sheet for Ss to construct explanations. Hence, Ss are expected to produce full explanations with no scaffolding at all levels.

Table 9. Examples for ratings of indicator AD.Ad.3

Indicator (AD.Ad.3)	**Adequacy** of materials/activities for S language production, in quantity and quality, in sufficiently fulfilling F-Lit objective
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To describe verbally and in writing the changes of states in the water cycle in the correct sequence
	Materials/Activities: individual-level writing task to describe the water cycle with helping prompts
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Cumulative effect of the materials/activities provides adequate opportunity for Ss to practice producing language, in both quantity and quality, in fulfilling F-Lit objective.** Opportunities amply provided for written language production, in the following e.g.: Activity sheet requires Ss to individually describe in writing the water cycle in a narrative prose.
Rating 2	**Cumulative effect of the materials/activities provides somewhat adequate opportunity for Ss to practice producing language, in both quantity and quality, in fulfilling F-Lit objective.** E.g., Materials/activities require Ss to produce some extended written language, e.g., in isolated sentences not connected together in prose.
Rating 1	**Cumulative effect of the materials/activities provides limited opportunity for Ss to practice producing language, in both quantity and quality, in fulfilling F-Lit objective.** E.g., Materials/activities require Ss to only produce single words or short phrases in writing. For e.g., with reference to Rating 3, the activity consists of gap-fills with no opportunities for extended written language production.
Rating 0	**Cumulative effect of the materials/activities provides no opportunity for Ss to practice producing language in fulfilling F-Lit objective.** E.g., Materials/activities are entirely T-centred and require no independent S language production. For e.g., with reference to Rating 3, the activity consists of a handout with a written description of the water cycle without any writing opportunities for Ss.

Table 10. Examples for ratings of indicator AD.Fl.1

This indicator is used only if there is a S language need requiring a change to the materials/activities.	
Indicator (AD.Fl.1)	**Flexibility** of T's change to the planned lesson materials/activities in addressing S language needs according to F-Lit objective
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To describe verbally and in writing the changes of states in the water cycle in the correct sequence
	Materials/Activities: Activity sheet 1) a class-level verbal construction of the water cycle with accompanying whiteboard annotations and word cards, followed by Activity sheet 2) an individual-level writing task to describe the water cycle with helping prompts
Unit of analysis	Instance of spontaneous S language need arising that requires T's change to planned lesson materials/activities
Ratings	**Criteria** [With examples below]
Rating "Flexible"	**T's changes to lesson materials/activities in response to class's language needs are flexible i.e., her changes target S language needs effectively.** E.g., T responds to spontaneous S language need in the following scenarios with targeted adaptations of the lesson materials/activities: *Scenario 1, leading to addition of content:* Ss observed to be still unclear about how to name the different states of water and the changes of states (e.g., condense, evaporate) learnt in previous lesson. Upon realizing this, T creates and brainstorms with the class to populate a classified glossary table on the whiteboard for Ss to copy onto their science journals. Classified glossary contains 1) the states of water (e.g., "solid", "liquid" and "gas"), 2) examples of each state of water (including those needed in the activity sheet, e.g., 'water vapour', 'cloud', 'rain'), and 3) the changes each state of water undergoes. Example of a classified glossary list: {table below} *Scenario 2, leading to removal of content:* Ss observed to struggle with Activity 1 (class-level verbal construction of water cycle). Upon realizing this, T uses the rest of the lesson time to help class with verbal construction of the water cycle. She does not rush the lesson in order to be able to start/complete Activity 2 (written construction of water cycle), and does not do Activity 2 (she may plan for it to be covered in a subsequent lesson after she thinks Ss are reasonably able to do so).

Category	Glossary
States of water	Ice, water, steam
Changes to water (when temperature increases)	melting, evaporation
Changes to water (when temperature decreases)	freezing, condensation

	Scenario 3, leading to adjustment of content: Ss observed to require more scaffolding with the writing task in Activity 2. Upon realizing this, T changes the design of the writing task such that Ss write sentences for each stage of the water cycle first. After this, she creates another activity where Ss brainstorm connectors to join the sentences together and remove unnecessary words to form a paragraph describing the water cycle.
Rating "Inflexible"	**T's changes to lesson materials/activities in response to class's language needs, but her changes are not flexible to such needs, i.e., her changes do not target such needs, or she does not make any changes at all.** E.g., T responds to S spontaneous language needs in the following scenarios, but her adaptations of the lesson materials/activities are not targeted: *Scenario 1, leading to addition of content:* Ss observed to be still unclear about the different states of water and the changes of states (e.g., condense, evaporate) during Activity 1 (verbal construction of water cycle). T, however, misunderstands the need and only gets Ss to learn to spell the process words correctly before continuing with Activity 2. *Scenario 2, leading to removal of content:* Ss observed to struggle with Activity 2. T skips the activity entirely without offering further support. *Scenario 3, leading to adjustment of content:* Ss observed to require more scaffolding with the writing task in Activity 2, specifically in sentence construction. T, however, misunderstands the need and only gets Ss to learn to spell the process words correctly.

Discursive Support

Table 11. Examples for ratings of indicator DS.Ac.1

This indicator is used only if there is discursive metalanguage used by T.	
Indicator (DS.Ac.1)	**Accuracy** of T's discursive metalanguage
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To increase awareness of pronoun use and construct clearer written responses by avoiding indiscriminate use of pronouns
	Materials/Activities: PPT slides to unpack what pronouns are and to show items for class-level discussions on replacing pronouns; activity sheet with items requiring Ss to identify non-specific pronouns and replace them in pair discussion and writing
Metalanguage chosen for lesson	'Noun' and 'pronoun' used to refer to specific grammar items in sentence construction.
Unit of analysis	Instance of metalanguage use in T's discursive support
Ratings	**Criteria** [With examples below]
Accurate	T uses 'pronoun' accurately to label 'it'.
Inaccurate	T uses 'noun' inaccurately to label 'it'.
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive metalanguage use is mostly (about 90%) accurate.**
Rating 2	**T's discursive metalanguage use is moderately (about 50% to 80%) accurate.**
Rating 1	**T's discursive metalanguage use is rarely to occasionally (about 10% to 40%) accurate.**
Rating 0	**T's discursive metalanguage use is always inaccurate.**

Table 12. Examples for ratings of indicator DS.Ex.1

This indicator is used only if there is discursive metalanguage used by T.	
Indicator (DS.Ex.1)	**Explicitness and strategic** use of T's discursive metalanguage in fulfilling F-Lit objective
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why a bulb does not light up in a circuit, with the help of metalanguage terms such as 'feature', 'process', and 'effect' to structure such explanations
	Materials/Activities: 1) PPT slides to unpack how the 3 metalanguage terms 'feature', 'process', and 'effect' form the components of explanations to explain why bulbs do not light up in a circuit, and scaffolded examples; (2) activity sheet with items similar to the scaffolded examples for pair-discussion and writing of explanations, and open-ended items with no scaffolding for Ss to construct their explanations.
Example of metalanguage chosen for lesson	'Feature', 'process', and 'effect' used in the lesson to identify the nature of the components that constitute the explanations
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive metalanguage use is explicit and strategic in fulfilling F-Lit objective.** *Explicitness:* E.g., 'Feature', 'process', and 'effect' are prominently (repeatedly, consistently, and its appearance contributes to the fulfilment of the F-Lit objective) used in T's talk. T avoids using other synonyms (e.g., 'observation') or prompts (e.g., "What can you see?") in place of 'effect' after ensuring that Ss understand the meaning of the metalanguage. [Note: When metalanguage is not used consistently, (i.e., replaced with synonyms or prompts with no reference to the metalanguage they replace), it may lose its potency as a (1) mental heuristic tool for better memory retention of the language scaffolds, (2) tool to talk about relevant language features that are applicable across lessons and different science topics, e.g., 'function' and 'structure' can often be used as explanatory components across different biological topics.] *Strategic use:* E.g., Choice of 'feature', 'process', and 'effect' as the discursive metalanguage in use is consistent with that used in the materials. The metalanguage terms also complement each other in unpacking the language demands of the explanations to fulfil the F-Lit objective, and are used for various pedagogical purposes in T's discursive support, examples: (1) to explain the language demands needed to fulfil the F-Lit objective, (2) to scaffold Ss' spoken and written responses, and (3) to provide feedback to Ss' spoken and written responses.
Rating 2	**T's discursive metalanguage use is explicit and somewhat strategic in fulfilling F-Lit objective.** E.g., T's discursive metalanguage use is prominent as in Rating 3, but not as strategic: *Strategic use:*

	E.g., with reference to Rating 3, the three metalanguage terms 'feature', 'process' and 'effect', are used only for the pedagogical purpose of explaining the language demands required to fulfil the F-Lit objective.
Rating 1	**T's discursive metalanguage use is somewhat explicit but incidental in fulfilling F-Lit objective.** *Explicitness:* E.g., with reference to Rating 3, the 3 metalanguage terms ('feature', 'process', and 'effect') are not always used consistently (e.g., synonyms such as 'observation' and prompts such as 'What do you see?' are used in place of 'effect' even after the meaning and usage of the latter has been established). T may also use other metalanguage discursively without explaining how they play a role in fulfilling the F-Lit objective. *Strategic use:* T may use other metalanguage terms such as "function" to label a component of the explanation with no link made to 'feature', 'process', or 'effect'. Metalanguage may also be used when T discusses the scaffolded examples in the PPT slides, but at times misses opportunities to do so.
Rating 0	**T's discursive metalanguage use is not explicit and not strategic in fulfilling F-Lit objective.** *Explicitness:* E.g., Metalanguage is used inconsistently and its appearance does not contribute to the fulfilment of the F-Lit objective. *Strategic Use:* E.g., Selection of metalanguage is not judicious: most of the metalanguage needed for explanation construction not selected (e.g., only 'effect' is used).

Table 13. Examples for ratings of indicator DS.Ad.1

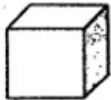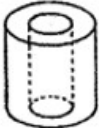| Indicator (DS.Ad.1)	**Adequacy** of T's discursive scaffolding in addressing all S language needs
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct coherent and precise explanations to items on transport in plants
	Materials/Activities: (1) PPT slides for class-level discussion on sample responses that require editing to make them coherent and precise, and (2) 2 activity sheets – one for group work and one for pair work, for Ss to practice constructing coherent and precise sentences to items
Unit of analysis	Instance
Ratings	**Criteria** [With examples below]
Adequate	E.g., Across all activities, T engages in extensive scaffolding targeted at different aspects of constructing coherent sentences in science in the course of fulfilling the F-Lit objective, as in the following examples: *Dealing with lengthy sentences* In the first activity where Ss are to discuss and correct language issues in sample explanations, T guides Ss in removing unnecessary words and breaking up long sentences, while retaining the writer's original intent. *Connecting ideas* T guides Ss in using appropriate connectors to join discrete ideas that Ss have identified from breaking up long sentences. *Using correct word pairings (e.g., noun-verb, noun-adjective)* T elicits or explains the correct word pairings in Ss' responses. For e.g., when S writes, "The roots transport water to all parts of the plant," T highlights the pairing of "roots" and "transport" and engages in questioning and/or explanation to show that "roots" (noun) do not "transport" (verb) materials to the plant. She then elicits the correct noun ("water-carrying tubes") that goes with "transport". Through T targeting these different aspects when the need arises, the Ss were able to fulfil the F-Lit objective.
Inadequate	E.g., Besides content-related scaffolding, T does not provide any discursive scaffolding related to language.
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive scaffolding is adequate all or most of the time.**
Rating 2	**T's discursive scaffolding is adequate half the time.**
Rating 1	**T's discursive scaffolding is adequate occasionally.**
Rating 0	**T's discursive scaffolding is not adequate all the time or non-existent.**

Table 14. Examples for ratings of indicator DS.Ad.2

Indicator (DS.Ad.2)	**Adequacy** of T's discursive scaffolding for S language production in quantity and quality
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written descriptions for the processes involved in transpiration in plants
	Materials/Activities: activity sheet with 1) item requiring Ss to annotate the movement of water and the processes involved in transpiration on a diagram showing a transverse section of a leaf
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**Cumulative effect of T's discursive scaffolding provides adequate opportunity for Ss to practice producing language, in both quantity and quality.** E.g., T's scaffolding is used to elicit mainly extended responses from Ss. In her scaffolding, she uses open-ended questions (e.g., 'How do I make this into a comparison?', 'Why do you say it is light and not heavy?', 'What do you observe?', 'What do you think?') most of the time, to elicit extended responses from Ss. Close-ended questions such as "Is this true for every plant?" and "What are you comparing against?" and T's explanations without eliciting responses from Ss are used only when appropriate and very sparingly.
Rating 2	**Cumulative effect of T's discursive scaffolding provides somewhat adequate opportunity for Ss to practice producing language, in both quantity and quality.** E.g., with reference to Rating 3, T tends to use a mix of open- and close-ended questions.
Rating 1	**Cumulative effect of T's discursive scaffolding provides limited opportunity for Ss to practice producing language, in both quantity and quality.** E.g., with reference to Rating 3, T tends to use mainly close-ended questions.
Rating 0	**Cumulative effect of T's discursive support provides no opportunity for Ss to practice producing language, in both quantity and quality.** T's discursive support is entirely T-centred, i.e., T explains with no attempt to elicit any response from Ss.

Table 15. Examples for ratings of indicator DS.Ad.3

Indicator (DS.Ad.3)	**Adequacy** of T's discursive feedback in addressing all S language needs
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why certain food is (un)suitable for fictitious aliens with particular dietary restrictions
	Materials/Activities: activity sheets for Ss to construct explanations related to F-lit objective
Example of S language need arising	T notices S writes "protease" instead of "protein" in response to question asking for the appropriate nutrient (need is identified by T).
Unit of analysis	Instance of S language need arising that requires T's discursive feedback
Ratings	**Criteria** [With examples below]
Adequate	E.g., T identifies that S has used the enzyme instead of the nutrient (perhaps because the spelling of both words are similar). She first evaluates the accuracy of S's response by commenting that the word "protease" used is wrong, and then comments on S language use, e.g., by saying that "protease" is an enzyme rather than a nutrient, elaborating that the names of enzymes tend to end with the suffix '-ase'.
Inadequate	E.g., T merely tells S that the correct answer is "protein" and not "protease".
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive feedback is adequate all or most of the time.**
Rating 2	**T's discursive feedback is adequate half the time.**
Rating 1	**T's discursive feedback is adequate occasionally.**
Rating 0	**T's discursive feedback is not adequate all the time or non-existent.**

Table 16. Examples for ratings of indicator DS.Fl.1

Indicator (DS.Fl.1)	**Flexibility** of T's discursive scaffolding in addressing all S language needs
	Context of examples
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To increase awareness of pronoun use and construct clearer written responses by avoiding indiscriminate use of pronouns
	Materials/Activities: PPT slides to unpack what pronouns are and to show items for class-level discussions on replacing pronouns; activity sheet with items requiring Ss to identify non-specific pronouns and replace them in pair discussion and writing
Example of S language need arising	In the following item which compares the temperature difference of 2 bowls of dessert – one with hollow cylindrical ice and the other with normal ice cubes, the response to the item is given and Ss are required to identify non-specific pronouns in the response and replace them with specific nouns. S asks T what the first 'it' refers to in the given response expressing doubt if "it" refers to "ice" or "the hollow cylindrical ice": *Image: Task from activity sheet*
Unit of analysis	Instance of S language need arising that requires T's discursive scaffolding
Ratings	**Criteria** [With examples below]
Flexible	**T's discursive scaffolding is flexible, i.e., her scaffolding target S language needs effectively.**

	Example of targeted use of scaffolding: E.g., T first helps S to see that "the hollow cylindrical ice" is a more complete description of the "ice" and should be referred to as such especially when there are 2 distinct types of ice in the question. Having identified that S's difficulty is with matching 'it' to the correct referent (given that there are more than one referent), T then points out that in the clause containing "it", "the hollow cylindrical ice" performs the action of "cooling down" something else, which would mean "it" cannot also be the hollow cylindrical ice. T then elicits from the students what "it" is. When S continues to look perplexed, T follows up with 'What else besides the ice is placed into plastic containers A & B?'. S replies 'dessert' to which T asks if the ice can be used to cool the dessert down.
Inflexible	**T's discursive scaffolding is inflexible, i.e., her scaffolding does not target S language needs effectively.** E.g., with reference to Rating "Flexible", T explains instead what "cylindrical" mean, without elaborating further. Her scaffolding, while language-focused, does not target S language need of understanding what the pronoun "it" refers to. Or, despite S language need arising that requires T's discursive scaffolding, T does not provide the scaffolding.
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive scaffolding is flexible all or almost all the time.**
Rating 2	**T's discursive scaffolding is flexible half the time.**
Rating 1	**T's discursive scaffolding is flexible occasionally.**
Rating 0	**T's discursive scaffolding is rarely or is not flexible**

Table 17. Examples for ratings of indicator DS.Fl.2

Indicator (DS.Fl.2)	**Flexibility** of T's discursive feedback in addressing all S language needs
Context of examples	
Lesson components: Agenda Setting and Activity Design	**F-Lit objective:** To construct written explanations for why certain food is (un)suitable for fictitious aliens with particular dietary restrictions
	Materials/Activities: activity sheets for Ss to construct explanations related to F-lit objective
Example of S language need arising	T notices S writes the following in responds to question asking for the appropriate nutrient (need is identified by T): "There should not be protease in the diet because the alien cannot ate protease."
Unit of analysis	Instance of S language need arising that requires T's feedback
Ratings	**Criteria** [With examples below]
Flexible	**T's discursive feedback is flexible, i.e., her feedback target S language needs effectively.** E.g., T identifies that S has used the enzyme instead of the nutrient (perhaps because the spelling of both words are similar), and hence does any (or combination) of the following: 1) T recasts with "protein", 2) T evaluates the accuracy of S's response by commenting that the word "protease" used is wrong, 3) T comments on S language use, e.g., by saying that "protease" is an enzyme rather than a nutrient, elaborating that the names of enzymes tend to end with the suffix '-ase'
Inflexible	**T's discursive feedback is inflexible, i.e., her feedback does not target S language needs effectively.** E.g., T points out that "ate" is the wrong tense. Her feedback, while language-focused, does not contribute to a change to the scientific meaning of S's response. Or, despite S language need arising that requires T's discursive feedback, T does not provide the feedback.
Unit of analysis	Whole lesson
Ratings	**Criteria** [With examples below]
Rating 3	**T's discursive feedback to S response is flexible all or almost all the time.**
Rating 2	**T's discursive feedback to S response is flexible half the time.**
Rating 1	**T's discursive feedback to S response is flexible occasionally.**
Rating 0	**T's discursive feedback to S response is rarely or not flexible**

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