Matrix with assessment rubrics of interdisciplinary learning goals & competencies.

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2020

Below, we describe a general rubric for interdisciplinary education. This rubric is the result of the integration of several rubrics which have been used in some programs at Utrecht University. The rubric includes seven categories which we consider as the most important for interdisciplinary learning: (1) Disciplinary grounding, (2) Perspective taking , (3) Common ground & Integration (4) Critical Reflection (5) Collaboration, (6) Communication, (7) Adaptability and creativity. The first three are typical learning goals in interdisciplinary learning, while the last four are competencies or general academic skills that are however vital for interdisciplinary work.

The rubric can be used to assess interdisciplinary competencies regardless the 'product' of the learning activity. Which of the seven categories are used for assessing an assignment or learning activity, depend on the main learning objectives of the assignment. The weight of the used categories does also depend on the learning objectives of the specific assignment used in a course.

First we describe the seven general interdisciplinary categories (Table 1), next these are transformed into a rubric (Table 2), and lastly we provide two example rubrics for specific assignments: an oral assignment ('the fictitious dialogue') and a writing assignment for an interdisciplinary paper.

Acknowledgement:
The development of this assessment matrix of interdisciplinary competencies (sept.2020) has been supported by an USO-grant ("Interdisciplinaire assessment, struikelblok of innovatiekans?") and by a Comenius grant for Senior Fellows ("Ontwikkeling en implementatie van een leerlijn interdisciplinariteit; interdisciplinair leren denken en werken voor biologen").

TABLE 1: Seven interdisciplinary categories

CATEGORIES	DESCRIPTION	ASSESSMENT CRITERIA
1 Disciplinary grounding	Disciplinary grounding involves having a basic knowledge and understanding of the involved disciplines as well as ways in which their knowledge is constructed, validated and communicated. This implies knowing which phenomena are being studied in the disciplines (basic disciplinary concepts, theories, assumptions), understanding the basic assumptions of these disciplines, the epistemology, its methods and ways of validation, and genres of communication (e.g. a research paper, a review, a law, a historical narrative).	▪ Justification of the need for an interdisciplinary approach. ▪ Justification of the choice of contributing disciplines: which disciplines are relevant regarding the problem, which are chosen to be used, and which are left out, and why? ▪ Critical overview of the 'state of art' of the relevant disciplines regarding the problem. ▪ Insights are presented in a coherent way and relevant terms are explained.
2 Perspective taking	Perspective taking involves analyzing the problem from the position of each interested discipline and identifying their commonalities and differences. It also encompasses an attitude of disciplinary humility and open mindedness to- and valuing of different perspectives, and the willingness to reflect on of one's own biases and assumptions	▪ Open mindedness: appreciation of and genuine interest in different (personal and disciplinary) perspectives; ▪ Disciplinary humility: awareness of his/her own biases and assumptions and of the limitations of his/her own discipline. ▪ Valuing of other (non-) disciplinary perspectives as a part in the problem-solving process.

3 Common ground & Integration	**Common ground** is the shared basis between conflicting disciplinary insights or theories. This is a creative process that involves modifying or reinterpreting disciplinary elements that conflict. It also incorporates the identification of how terms are used differently in different disciplines and defining problems explicitly in neutral terms. **Integrating perspectives** involves generating a new understanding that would not have been possible using a single discipline. It includes being able to use integration techniques (e.g. models, metaphors) to find new holistic understanding	▪ Clear and critical analysis of (methodological and theoretical) strengths and weaknesses of each disciplinary insight; ▪ Clear analysis of similarities and differences between disciplinary insights related to the research question(s). ▪ Common ground has been found. ▪ Key concepts are defined in neutral terms. ▪ Disciplinary insights are integrated into a new understanding of the problem to answer the research question.
4 Critical reflection	Reflection is a purposeful activity in which experiences are analyzed, in order to learn and improve. Evaluating an interdisciplinary project and its value and difficulties makes students aware of the intricacies of interdisciplinary work, and considering how to do it better next time helps consolidate the learning experience. A broader awareness is reflected in how the proposed solution may impact society (who/what will be affected in terms of e.g. health, politics, economics, social structures, etc.). In addition, the potential limitations of the proposed solution are addressed.	▪ The reflection provides valuable insight in the phases process, the challenges faced, and the learning gain. ▪ The reflection shows implications for future learning. ▪ The reflection addresses a broader awareness by explaining the impact of the proposed solution and by addressing its potential limitations (and possibly strategies to overcome these limitations).
5 Collaboration	Interdisciplinary collaboration requires more of students' collaboration skills than disciplinary teamwork does. First, the need to explain and discuss perspectives to each other clearly and build on each other's ideas is more challenging in interdisciplinary teamwork for students than when collaborating with peers from the same discipline, where they speak the same language and do not need to explain and discuss everything extensively. Due to the lack of experience students have in each other's disciplines where it is not always possible to critically examine the works of others, they also need to learn to trust and respect one another. Team and task regulation is needed in all teamwork, although in interdisciplinary collaboration this more effort from students because they need each other's contributions and feedback in all parts of the project and are not able to divide tasks as they normally do. Further, the complexity of interdisciplinary projects requires compromising in order to keep the project manageable.	▪ Listening with an open mind to other personal and/or disciplinary perspectives; ▪ Explaining in layman's words of one's own disciplinary perspective; ▪ Trusting and respecting the expertise of teammembers; ▪ Providing constructive feedback and shows openness to feedback from others; ▪ Clearly exchanging goals, priorities and values, and making concessions to formulate a common goal; ▪ Awareness of and sensitivity towards the position of other team members and see how disagreements can occur before they did.
6 Communication	Communication in interdisciplinary teamwork includes being open minded and non-judgmental in listening to and trying to understand other's perspectives. Explaining clearly is important as peers from other disciplines do not share the same background as is the awareness of the diversity of disciplinary language, differences in understandings of concepts and terms	▪ Is aware of the level of knowledge of the audience he/she is addressing Can patiently explain disciplinary knowledge to others without using disciplinary jargon. ▪ Listens to others, is open minded and non-judgmental. ▪ Is able to effectively communicate his/her findings regardless of the medium used (writing, oral presentation, etc.)
7 Adaptability and creativity	Interdisciplinary work is creative and innovative, with unknown outcomes and a risk of failure. Thus, in disciplinary education, students have to cope with the fact that teachers do not have all the answers. This requires a tolerance for ambiguity, the courage to venture in unfamiliar space, to grapple with periods of insecurity, and to make mistakes.	▪ Thinks creatively in situations that are unfamiliar and doesn't give up easily. ▪ Thinks out of the box and takes risks because he/she realizes risk aversion stands in the way of originality. ▪ Sees challenges as an opportunity to develop and, if mistakes are made, sees them as a learning opportunity. ▪ Is aware that interdisciplinarity problems often do not have a right or wrong answer and that more solutions are possible.

TABLE 2 Rubric interdisciplinary competencies

CATEGORIES	INSUFFICIENT (NOVICE)	SUFFICIENT-GOOD (INTERMEDIATE)	GOOD-EXCELLENT (MASTERY)
Disciplinary grounding	▪ The complexity of the problem is not well indicated and the need for an interdisciplinary approach is not justified. ▪ Key disciplinary insights are described too superficially, and/or some key concepts missing. ▪ The selection of one or more disciplines is questionable and/or important disciplines related to the problem are lacking. ▪ Insights are not presented in a coherent and balanced way, and definitions on key concepts are missing.	▪ The problem is well introduced, but the relevance could be more elaborate. ▪ It is explained why the involved disciplines are required, and why others are left out. ▪ Nice elaboration on some of the disciplinary insights but not all insights could be approached more in depth. ▪ The presentation of the insights could be more coherent and balanced, not all relevant terms are clearly explained.	▪ The problem is challenging, well anchored in literature review, and its societal relevance is made clear. ▪ Shows thorough understanding of the (disciplinary) insights, assumptions, and context. ▪ Relevant terms and concepts are explained clearly. ▪ A clear justification is given why the complexity of the problem exceeds the boundaries between disciplines. ▪ The most relevant disciplines that relate to the problem are covered and well justified, as well as the ones left out.
Perspective taking	▪ Shows no real open mindedness towards other ideas and beliefs. ▪ Does not question his/her own (disciplinary) biases and assumptions. ▪ Has difficulties including other viewpoints as part of the problem solving process.	▪ Shows interest in other viewpoints although superficially. ▪ Is reluctant to temporarily set aside his/her own viewpoints and beliefs. ▪ Values other (non-) disciplinary perspectives as a valuable addition, rather not quite as equally important.	▪ Open mindedness: appreciation of and genuine interest in different (personal and disciplinary) perspectives; ▪ Awareness on of his /her own biases and assumptions and of the limitations of his/her own discipline. ▪ Values other (non-) disciplinary perspectives as a part in the problem-solving process.
Common ground & Integration	▪ Strengths and weaknesses of each disciplinary insight are quite superficial and based on preferences rather than critical analysis. ▪ Similarities and differences of disciplinary insights are there, but analysis and structure are lacking. ▪ Key concepts are not clearly defined. ▪ As a result the disciplinary insights are presented next to each other rather than in a connected and integrated way.	▪ Clear analysis of strengths & weaknesses of most disciplinary insights, but not all aspects are elaborated on. ▪ The differences and similarities are analyzed, though somewhat superficially. ▪ Some key concepts are defined. ▪ An endeavor to find common ground is shown by trying to reconcile or connect disciplinary insights.	▪ Clear and critical analysis of strengths and weaknesses of each disciplinary insight, with respect to theories, methods and assumptions. ▪ Clear analysis of similarities and differences between disciplinary insights related to the research question(s). ▪ Key concepts are defined in neutral terms. ▪ Common ground has been found and is clearly explained. ▪ Integration of the disciplinary insights resulted in a new or reconciled understanding. The new insights are applied to the problem or case, providing new directions for solutions or answers.
Critical reflection & Broader awareness	▪ The reflection does not move beyond a description of the learning experience. ▪ The reflection hardly describes societal impacts nor explains what/who will be affected by the proposed solution. ▪ Potential limitations of the proposed solution are not or hardly addressed.	▪ The reflection provides some insights in the process of integration and learning gain, but the value of the learning to the student is vague and/or unclear. ▪ The reflection includes an indication of some societal impacts and moderately explains what/who will be affected by the proposed solution. ▪ Potential limitations of the proposed solution are addressed as well as some strategies to overcome them.	▪ The reflection provides valuable insight in the phases process, the challenges faced, and the learning gain. ▪ The reflection shows implications for future learning. ▪ The reflection clearly addresses societal impacts of the proposed solution and explains what/who will be affected. ▪ Potential limitations of the proposed solution are clearly described as well as solutions to overcome them.

Collaboration	▪ Is often too submissive or dominant in the collaboration process. ▪ Has difficulty in explaining his/her insights to peers. ▪ Respects and trusts the expertise of some of the team-members; ▪ Is willing to providing feedback but is not very open to feedback from others; ▪ Participates in exchanging priorities but does not take initiative. Has difficulties with compromising. ▪ Can be rude to peers.	▪ Listens to others but does not acknowledge whether he/she understands the other. ▪ Tries to explain his/her insights but shows some difficulty in doing so. ▪ Respects and trusts the expertise of most of the team-members; ▪ Is willing to providing feedback and is mostly open to feedback from others; ▪ Participates in exchanging priorities but does not take initiative. Is willing to compromise. ▪ Is aware of and sensitive towards the position of other team members.	▪ Listens with an open mind to other's personal and/or disciplinary perspectives. ▪ Explains in layman's words of one's own disciplinary perspective; ▪ Trusts and respects the expertise of team-members; ▪ Provides constructive feedback and shows openness to feedback from others; ▪ Clearly exchanges goals, priorities and values, and does concessions to formulate a common goal; ▪ Aware of and sensitive towards the position of other team members and sees how disagreements can occur.
Communication	▪ Has a hard time explaining disciplinary knowledge to a layman's audience, finds it difficult to avoid jargon. ▪ Listens to others, but rather judgmental. ▪ Is not always clear in communicating his/her findings.	▪ Is aware of the level of knowledge of the audience he/she is addressing, but finds it difficult to avoid jargon. ▪ Listens to others, is open minded and non-judgmental. ▪ Is not always clear in communicating his/her findings.	▪ Is aware of the level of knowledge of the audience he/she is addressing Can patiently explain disciplinary knowledge to others without using disciplinary jargon. ▪ Listens to others, is open minded and non-judgmental. ▪ Is able to effectively communicate his/her findings regardless of the medium used (writing, oral presentation, etc.)
Adaptability and creativity	▪ Isn't able to apply learned knowledge to new and unfamiliar situations or outside the familiar disciplinary setting. ▪ Stays within his/her comfort zone not daring to try something new or unfamiliar or gives up easily in trying new situations. ▪ Has a hard time in complex and unstructured situations. ▪ Discards ideas too soon or focusses on one idea from the start without thinking of other possibilities.	▪ Tries to apply disciplinary knowledge in new and unfamiliar settings but gives up too easily or resort to familiar ground if he/she doesn't reach a preferred result. ▪ Starts to venture outside one's comfort zone and explores new and/or creative ways to solve a problem. ▪ Takes risk but falls back on known patterns and working methods if things get hard. This limits the student's creative opportunities. ▪ Can come up with multiple ideas but finds it hard to determine which ideas will be useful in the end.	▪ Thinks creatively in situations that are unfamiliar and doesn't give up easily. ▪ Thinks out of the box and takes risks because he/she realizes risk aversion stands in the way of originality. ▪ Sees challenges as an opportunity to develop and, if mistakes are made, sees them as a learning opportunity. ▪ Is aware that interdisciplinarity problems often do not have a right or wrong answer.

Two examples

Depending on the specific student assignment, one or more categories addressing interdisciplinary learning goals or competencies could be chosen from the rubric, and added to the 'regular' criteria for that assignment. Below, we provide two examples of specific assignments in which interdisciplinary and regular academic skills are combined: one for an oral assignment (the fictitious dialogue), and one for a paper assignment.

EXAMPLE 1:
Oral assignment

Assignment:
The fictitious dialogue[1]

In this assignment, student teams of 4 are asked to write and perform a dialogue about an issue relevant to the course. For the dialogue, two 'thinkers' are chosen, for example Plato, Marx, Mill, Darwin, and students are asked to imagine that they are this person and invent a dialogue between the two. In groups of 4, two students prepare one side of the dialogue, and the other two the other person. The four of them put the dialogue together, and two students perform it in class. The personalized arrangement and speaking in the 'I'-form intensify the experience.

Learning objectives: This learning activity is designed to stimulate perspective-taking and to take an effort to truly engage with different perspectives.

How to use the rubric for this assignment
Since the learning outcomes of this group assignment focus on perspective taking, the interdisciplinary assessment criteria could be in this case dome of the criteria belonging to disciplinary grounding and perspective taking. Collaboration can be added to the criteria because students have to work together to prepare the dialogue and communication could also be added because students have to speak up during the debate.

The Rubric of this assignment can be found on the next page.

EXAMPLE 2:
Writing assignment

In most paper assignments, the first four interdisciplinary categories are used, completed with some regular writing criteria (such as defining an objective, formulating a conclusion and aspects such as structure & writing style). In this example, reflection is added since reflection assignments help students explicate the learning gain (and encourage them to reflect on the (societal) impact of the proposed solution). In addition, these reflections help teachers to learn where students faced difficulties.

The Rubric of this assignment can be found on page 89 & 90

1 This assignment is designed by Dr. Chiara Robbiano (UCU, Utrecht University).

Rubric Fictitious Dialogue (Example 1)

CATEGORIES	INSUFFICIENT (NOVICE)	SUFFICIENT-GOOD (INTERMEDIATE)	GOOD-EXCELLENT (MASTERY)
Disciplinary grounding	▪ Key disciplinary insights are described too superficially, and/or some key concepts missing. ▪ Insights are not presented in a coherent and balanced way, and definitions on key concepts are missing.	▪ Nice elaboration on some of the disciplinary insights but not all insights could be approached more in depth. ▪ The presentation of the insights could be more coherent and balanced, not all relevant terms are clearly explained.	▪ Shows thorough understanding of the (disciplinary) insights, assumptions, and context. ▪ Relevant terms and concepts are explained clearly.
Perspective taking	▪ Shows no real open mindedness towards other ideas and beliefs. ▪ Does not question his/her own (disciplinary) biases and assumptions. ▪ Has difficulties including other viewpoints as part of the problem solving process.	▪ Shows interest in other viewpoints although superficially. ▪ Is reluctant to temporarily set aside his/her own viewpoints and beliefs. ▪ Values other (non-) disciplinary perspectives as a valuable addition, rather not quite as equally important.	▪ Open mindedness: appreciation of and genuine interest in different (personal and disciplinary) perspectives; ▪ Awareness on of his /her own biases and assumptions and of the limitations of his/her own discipline. ▪ Values other (non-) disciplinary perspectives as a part in the problem-solving process.
Collaboration	▪ Is often too submissive or dominant in the collaboration process. ▪ Has difficulty in explaining his/her insights to peers.. ▪ Respects and trusts the expertise of some of the team-members; ▪ Is willing to providing feedback but is not very open to feedback from others; ▪ Participates in exchanging priorities but does not take initiative. Has difficulties with compromising. ▪ Can be rude to peers.	▪ Listens to others but does not acknowledge whether he/she understands the other. ▪ Tries to explain his/her insights but shows some difficulty in doing so. ▪ Respects and trusts the expertise of most of the team-members; ▪ Is willing to providing feedback and is mostly open to feedback from others; ▪ Participates in exchanging priorities but does not take initiative. Is willing to compromise. ▪ Is aware of and sensitive towards the position of other team members.	▪ Listens with an open mind to other's personal and/or disciplinary perspectives. ▪ Explains in layman's words of one's own disciplinary perspective; ▪ Trusts and respects the expertise of team-members; ▪ Provides constructive feedback and shows openness to feedback from others; ▪ Clearly exchanges goals, priorities and values, and does concessions to formulate a common goal; ▪ Aware of and sensitive towards the position of other team members and sees how disagreements can occur.

Rubric Writing Assignment (Example 2)

RUBRIC INTERDISCIPLINARY PAPER			
CATEGORIES	INSUFFICIENT (F/D) (NOVICE)	SUFFICIENT/GOOD (C/B) (INTERMEDIATE)	VERY GOOD/EXCELLENT (A) (MASTERY)
Objective: Problem statement & Justification of interdisciplinary approach	▪ The problem and its relevance are not explained very clearly. ▪ The research question is too broad, or too narrow for an interdisciplinary approach. ▪ The complexity of the problem is not well indicated and the need for an interdisciplinary approach is not justified. ▪ The selection of one or more disciplines is questionable and/or important disciplines related to the problem are lacking.	▪ The problem is well introduced, but the relevance could be more elaborate. ▪ The research question could be more focused and remains a bit broad and imprecise. ▪ The complexity of the problem is indicated, and an interdisciplinary approach is justified. ▪ It is explained why the involved disciplines are required, and why others are left out.	▪ The problem is challenging, well anchored in literature review, and its societal relevance is made clear. ▪ The research question is clearly stated and is researchable (specific and narrowed down). ▪ A clear justification is given why the complexity of the problem exceeds the boundaries between disciplines. ▪ The most relevant disciplines that relate to the research question are covered and well justified, as well as the ones left out.
Disciplinary grounding	▪ Key disciplinary insights are described too superficially, and/or some key concepts missing. ▪ Insights are not presented in a coherent and balanced way, and definitions on key concepts are missing. ▪ Over-reliance on one or two sources and/or sources are not (fully) relevant.	▪ Nice elaboration on some of the disciplinary insights but not all insights could be approached more in depth. ▪ The presentation of the insights could be more coherent and balanced, not all relevant terms are clearly explained. ▪ There is some variety in sources, but not all are relevant or up-to-date.	▪ State of the art of the various disciplinary insights is presented. ▪ Insights of each discipline are coherently presented and relevant terms are clearly explained. ▪ A variety of relevant sources is used, including recent and primary sources.
Common ground & Integration	▪ Strengths and weaknesses of each disciplinary insight are lacking or quite superficial and based on preferences rather than critical analysis. ▪ Similarities and differences of disciplinary insights are there, but analysis and structure are lacking. ▪ An attempt to find common ground and connecting insights is lacking or, when it is made, it is not very structured.	▪ Clear analysis of strengths & weaknesses of most disciplinary insights, but not all aspects are elaborated on. ▪ The differences and similarities are analyzed, though somewhat superficially. The presentation of the analysis could have been better structured/visualized and/or supported by more relevant examples. ▪ An endeavor to find common ground is shown by trying to reconcile or connect disciplinary insights. An attempt to integrate different perspectives is clarified.	▪ Strengths & weaknesses as well as similarities and differences are critically analyzed, with respect to theories, methods and assumptions. ▪ Analysis is presented in a clear way (preferably) by using tables or other visualization. ▪ Common ground is found using (or extending) one of Repko & Szostak's methods, and integration of the disciplinary insights resulted in a new or reconciled understanding. The new insights are applied to the problem or case, providing new directions for solutions or answers.
Conclusion	▪ The main question remains mainly unanswered, or the conclusions are not based on the results that are presented.	▪ Conclusions are given. Part of the research question(s) remain unanswered and/or part of the conclusion is not fully based on the results that are described. Discusses impact of researched material on problem.	▪ The conclusions are clearly described and provide answers to the research question(s). Insightful discussion of impact of the researched material on problem. Further research steps are indicated

Structure and writing style	▪ Structure needs improvement (use of headings, chapters and sections could be more consistent; ordering of information is not always logical. The title is unimaginative. ▪ Writing style is insufficient (e.g. parts are plagiarized; message remains unclear, student's own voice is lacking). ▪ Sources are not correctly cited, and/or reference list is missing or incomplete. ▪ The use of jargon makes the paper unsuitable for a multidisciplinary audience.	▪ Structure could be more optimal (more consistency in use of headings; some parts are ordered in an illogical way; better balance between the various parts). The title is attractive and clarifies the interdisciplinary topic/approach. ▪ Some parts are written in clear language, but other parts remain a bit vague. The student' own voice is recognizable in some or most parts. ▪ Citations are mostly consistently used, and reference list is nearly complete. ▪ The use of jargon in some parts makes the paper less easy readable for a multidisciplinary audience.	▪ The paper is well structured, in a logical order, well-reasoned, and headings and sub-headings are effective. The title is effective and draws the attention of a broad audience. ▪ The paper is written in colorful language, clear and understandable, and in the student's own words. ▪ Correct use of citations, and all information is well documented in the reference list. ▪ The paper reads easily, lacks jargon, attracts the attention and is understandable for a multidisciplinary audience.
Reflection	▪ The reflection on the added value of the interdisciplinary approach is lacking or does not move beyond a description of the learning experience. ▪ A broader awareness is missing: the societal impacts and/or potential limitations of the proposed solutions are not or hardly discussed.	▪ The reflection provides some insights in the process of integration and learning gain. The added value of the interdisciplinary approach is described (but perhaps a bit vague or unclear). ▪ The reflection discusses the societal impacts and/or potential limitations of the proposed solutions.	▪ The reflection provides valuable insight in the learning process, the challenges faced, and the learning gain of the interdisciplinary approach. ▪ The reflection shows implications for future learning. ▪ The reflection shows a broader awareness by addressing the societal impacts of the proposed solution, and discussing potential limitations as well as solutions to overcome them.