GUIDELINES FOR ASSESSING ESKOM EXPO FOR YOUNG SCIENTISTS' RESEARCH PROJECTS

Eskom Expo for Young Scientists (Expo) welcomes and thanks you for volunteering to be an Expo judge. You join the ranks of many other volunteers who are making a difference in our children's lives through STEM education.

At Expo, while learners are usually recognised and rewarded for their research efforts through awards, it is also an ideal opportunity to give suggestions, advice or ideas for improving the research further. Hence the judging process is more about developing and assessing the research projects rather than being 'judgemental' or hypercritical. It is also important as a judge to acknowledge the work done by the learner, without inflating the comments or praises. Equally so, a judge should never be negative towards the learner, dismiss the learner or say anything demotivating, derogatory or offensive. Most importantly, assess the project and not the learner! You must be objective at all times. Impressionable learners look up to judges as experts and knowledgeable adults, making you an important part of their journey as young scientists. Ideally every project should be assessed by a minimum of two (2) Judges. The Expo Assessment Forms have been designed to help judges by providing more guidance for judging, as well as to guide learners on how to do research and what is expected of them.

Types of Research Projects

At Eskom Expo for Young Scientists, research projects have been categorised into four (4) types. Hence there are four (4) Project Assessment Forms:

1. Scientific Investigations
2. Engineering Type and Computer Science
3. Mathematics and Theoretical projects
4. Social Sciences

Learners enter projects in one of 13 Categories covering the four types listed above or sometimes as multi-disciplinary across Categories. To deciding on the Category of the project, ask: In which area has the actual research been done? Where is the focus? It is not about where or how the research can be applied but about the research done. Sometimes, the learners' write-ups can be confusing and only after reading the entire project, will you be able to categorise the project correctly. If a project is placed in the wrong Category, do not alarm the learner but explain that the project will be best assessed by a Judge from the correct Category. A project in an incorrect Category must not be marked down.

Structure of the Assessment Form and Scoring

The Assessment Forms have sufficient detail to guide you. When in doubt, always consult your Convener or Chief Judge. If required, we depend on Judges to use their discretion and always give the learner the benefit of the doubt. A judge should not be interpreting what is meant in the Assessment Form. All Judges should have the same understanding of the Form so get clarity at the Judges training. Assess the Research project by reading the Research Report and the Poster, and interviewing the learner.

Completing the Project Assessment Form

All Assessment Forms are divided into six (6) Sections: Introduction; Method; Results & Discussion; Limitations, Further Research & Conclusion; Originality, Creativity & Value; Presentation

All sections, except the Interview can be assessed during pre-judging. Make notes on any questions you have and during the interview you can get clarity, probe the learner's understanding, and establish whether it is the learner's own work. After the interview, add the scores and record it as an 'Initial Score' on the Assessment Form. The project should be assessed **independently** by at least two (2) Judges. Do not average the scores from different judges. Only after discussion with the other Judges and your Convener, should you record the

score under 'Final Score after Discussion'. However, if there is no pre-judging session then all six (6) Sections must be completed during and after the Interview.

Scoring
Use 0 or 1 or 2 to score each item, where:

0 = Not done/no evidence/incorrect
1 = Average or 50% correct or partially achieved
2 = Very good or well done

Agree on a score and write this clearly in the block "Final Score after Discussion". If an item in the learner's Project Report/Poster is listed under the wrong section e.g. the variables are listed under the Introduction Section and not in the Method Section, the learner should not be penalised. However, sequencing is important, for example, the Hypothesis must be stated before the Results.

The common areas of all four (4) Assessment Forms are explained below:

1. Introduction (10 marks)

- Establish whether the learner has done sufficient reading/background research. The literature review must be relevant, and sufficient for the research study. The learner must use credible sources, such as books, verified on-line articles, Journal articles etc.
- As a Judge you need to determine whether the literature review is adequate for that particular study e.g. for a well-known, broad and well researched topic, the learner may have a range of literature to choose from to explain concepts and cite many research sources. If the learner is researching an area which is unknown or where there is very little research done and written about, then a short paragraph with the available information is considered adequate for that project.
- The learner must state the problem/issue/phenomenon/need that will be addressed.
- The Aim or goal of the study, as well as the Hypothesis/Research Question/Engineering/Design Goals must be linked to the problem, and must be clear and correct.
- There does not have to a heading called "Introduction".

2. Method:

- Did the learner use the appropriate method/data collection for the study e.g. you cannot do surveys only for an Engineering project.
- The materials are listed or evident in the Methods section. Does the learner list all the materials used? Are the appropriate measurements used e.g. 250g Sulphur?
- A logical step-by-step procedure/process/algorithm must be given.
- The method must be clear enough so it can be easily followed and replicated by anyone.
- The number of trials/repetitions/testing or prototypes (2 or more) tested must be sufficient (Reliability)
- The procedure/sampling/data collection instruments etc. have to be accurate for Validity. Was the data collected correctly?

3. Results and Discussion

- This should be the bulk of the write-up.
- The results have to be correctly and appropriately represented e.g. by a Graph.
- The learner has to show that the results have been sufficiently analysed and discussed.
- The Discussion links the Problem/Need, Aim, Hypothesis/Research Question and Results.
- What do the Results mean? Are patterns, trends, outliers in the data discussed?
- Does the learner make claims that cannot be made from the data collected?
- Learner mentions what other studies have found/not found and how this study fills the gap in the field or improves on what has been done. Of what value is this research?
- Discussion must be coherent and logical.

- The learner states whether the Design Criteria have been met/Hypothesis accepted/rejected or correct/incorrect? Has the Research Question been answered?

4. Limitations and Conclusion

- This Section looks at whether the learner has identified the shortcomings of the research and has thought about how to improve on this.
- The Hypothesis must be accepted/rejected.
- The Conclusion must summarise the findings.

5. Originality

- Is there any evidence of Plagiarism e.g. texts, pictures, ideas copied verbatim or the idea is copied and not acknowledged? If yes, then communicate this to your Convener and Chief Judge, for a decision by the Ethics Committee. In addition, report any serious ethical issues that were not picked up by the Project Approval team e.g. testing on humans. The Project Approval team looks at ethics at face value and checks the projects for Expo compliance.
- Is the research valuable e.g. new knowledge/product/methods or cost effective solution/green solution?
- Does the learner's knowledge extend beyond the school curriculum, for the age of the learner?
- Is this research innovative, novel, new? Is it ground-breaking?
- Does it show creativity e.g. a unique approach, a different angle, recycled or alternative materials used?

Does the project have the *potential* to be innovative if upgraded with appropriate guidance? If yes then you cannot give the project marks for this on this Assessment Form but you must indicate how it can be upgraded/improved at the end of the Form.

6. Presentation

Written:

- Does the learner have the required documents e.g. Research Plan (written in the future tense and signed by the teacher), Journal (notes, data), Abstract (a summary of the Project Report in the past tense)
- Project Report must have all the required headings.
- Is the Project Report well written and coherent?
- Is there a list of references?
- Are the Tables, Graphs, Diagrams clear, correctly labelled and illustrations/photos acknowledged?
- The assistance received is listed in the Acknowledgements.
- The Judge cannot be influenced by the aesthetics and art work of Project File and Poster. While the efforts of the learner should be appreciated, it is not part of the judging criteria. In addition, not all learners are artistic or have access to decorative materials.
- The Poster must be a summary of the Report. It must be easy to follow and understand. Does the Poster have the required headings including Acknowledgements? The Poster does not need to have References.

Interview

- The interview must focus on the learner's understanding of the research. It should not focus on how a learner speaks or the nuances of speech e.g. tone of voice, pitch or voice projection. A learner who speaks softly but audibly should not be marked down.
- There are no criteria in the Assessment Forms for personality, confidence, body language and enthusiasm etc. These are subjective and they are not related to the research. It is the research that needs to be assessed and not the learner's personality.
- The learner must be able to communicate the findings logically and accurately, using correct scientific language i.e. must be able to explain the research.
- During pre-judging decide what additional questions you will ask. This could also be used to test whether it is the learner's own work.

- The learner may not discuss all the items on the Interview Section of the Assessment Form during the interview. In order for you to assess each item on the Form, you will need to ask the relevant questions. For example:
    - What problem/issue/phenomenon are you addressing in this research?
    - Briefly explain your results.
    - Do you know of other research studies in the same area?
    - How will your research be used …. or used to ….
- Did all group members contribute equally or according to their strengths/knowledge? Group work is about collaboration and bringing different abilities/strengths together, not only sharing the workload.

Complete all additional questions at the end of the Form. Use another sheet of paper if necessary – write the learner's name, Project Number etc. and attach to the Assessment Form.

The distinguishing features typical to each of the four (4) Forms are explained below.

1. Scientific Investigation Projects

Scientific Investigations use specific methods to acquire knowledge. There are many adaptations of the scientific investigation method. Scientific investigations can be Descriptive (used to draw a conclusion), Comparative (used to determine relationships), and Experimental (for testing cause and effect). The most common type of investigation is experimentation and involves the following processes: making an observation and/or identifying a problem/issue; doing background research/literature review; articulating the Aim/Purpose of the research, formulating a Hypothesis/Research Question, determining Variables, testing the Hypothesis through a procedure/method, collecting and analysing data, discussing the results, accepting or rejecting the Hypothesis, and drawing a Conclusion. The learner has to follow the scientific investigation method correctly. Variables are very important in this type of scientific inquiry.

2. Engineering Type/ Computer Science Projects

Engineering and Computer Science Projects involve applications. The emphasis is on design-test-redesign-retest. This refers to the *iteration* of the procedure i.e. repeating the steps/sequence until the goals and design criteria are achieved. Often learners neglect the literature review and/or the actual engineering process/program but focus only on how well the model/output works, making no reference to the 'science'.

The learner must show how the prototype/product/solution fulfilled the need(s) or addressed the problem that was stated. The Engineering Goals/Processes and the Design Criteria have to be correct and applicable for the aim of the study and have to be met. Examples of Design Criteria for Engineering are: cost effectiveness (materials, labour); inputs such as energy or fuel consumption; whether the prototype is easy to manufacture e.g. components are available; is it user friendly; is it reliable; long lasting and durable; and other physical characteristics such as shape, size, weight, speed, waterproof, colour, transparency, reflective surface, strong, can be used in specific terrains, photosensitive etc.

Examples of Design Criteria for Computer Science projects are: capacity; outputs (power, desirable effects); acoustic requirements; performance characteristics (accuracy, speed, strength, permeability, and resolution); environmental requirements (operating temperature range, storing temperature range, water resistance, resistant to corrosion); compatibility with other systems; meets regulations.

Displaying a model/prototype/product/solution can demonstrate/support explanations, however it is not compulsory to display them at the science fair, especially if they are too large and are a safety hazard. In these cases, photographs and videos are equally acceptable. It is the testing/trials of the prototype or solutions that is important. There must be a minimum of two (2) prototypes.

3. Mathematics/ Theoretical Projects

Mathematics and Theoretical research projects are expository and not experimental. Defining characteristics of these projects, are its logical arguments, reasoning and distinct methods/proofs. The write-up must be coherent, easily understandable and free of errors. For these types of projects determine if the research question is answerable and whether it has been answered through the research. All graphics, diagrams and notations must be clear, accurate and correct. All claims/deductions made must be supported by proofs/data. Is the learner's reasoning/argument logical?

4. Social Sciences Projects

The Social Sciences includes the study of human life, human behaviour, social groups and social institutions. Social Sciences research can be: Pure, Applied, Exploratory, Descriptive, Diagnostic, Evaluations, and Action Research. It is important to determine the type of research because this will influence the method and instruments used. Social Sciences use Quantitative or Qualitative or both (mixed methods). Depending on the problem/need/phenomena being researched, the correct method(s) must be used i.e. is the research Quantitative (cause/effect experiments, measuring, quantifying, and testing) or Qualitative (Observations, Interviews, questionnaires)? Only the cause-effect projects usually have variables. Statistics are often used to analyse the data. The learner must understand what the statistical analyses mean.

Important for Social Science research are whether the method is appropriate, the instruments are well-constructed and reliable, the sample size is adequate and selected correctly, and whether the research is objective and unbiased. Ethics, issues of consent and confidentiality are equally important.

Reliability, Validity, Triangulation and Sampling

A good research study is reliable and valid. Learners may not use these exact terms in their reporting.

Reliability is about consistency. The learner tests-retests and does several replicates/trials to get more or less the same answer. If the study is done again by someone else, then they will get the same results.

Validity is about accuracy. Was the design accurate? Were the measurements correct? Was there a control to compare results against? Were the instruments tested and trialled? Did the learners measure what they set out to measure? Are the results accurate and truthful?

Triangulation is about using several sources for the data e.g. participants completed a Questionnaire but the learner also interviewed them to confirm/verify the results. This makes the data credible.

Sampling: Consider how they have sampled and why they have sampled that way. Was the sampling random or deliberate? Was this the best way to sample? Is the sample size adequate? Can deductions be made from the sample used? Is the sample representative of the whole population or was the study only concerned with a specific group? Sampling can also be convenient e.g. only the river next to the school was studied. Can the results be generalised to all other rivers in the country?

Some points to consider for the Interview

During the interview you should do the following:

- Introduce yourself to the learner
- Be pleasant and approachable
- Do not talk down to the learner, make negative and personal remarks, dismiss the learner in any way, be aggressive or intimidate the learner
- Judge the project, not the learner. You must be objective. Do not be biased in any way. Do not make judgements based on the personal circumstances of the learner e.g. the learner is from a private/rural

school, learner is female, the learner could not be capable of such work because …the learner is from a rich/poor community ….. etc.

- All Expo projects are done in English, however if there is a language barrier, bring it to the attention of your convener
- Respect cultural and language differences
- Do not access your cellphone or be distracted in any way
- Make notes and maintain eye contact, to show that you are listening to the learner
- Ask questions. Often when Judges do not ask questions, the learner interprets this as disinterest
- Ask the learner for a summary of the project. If the learner digresses, recites a speech or is giving too much detail, guide the learner by asking questions
- Be sensitive to the allocated time for the project, however do not rush through the interview. Learners feel aggrieved if they do not get their allotted time for the interview
- Establish whether all members of group projects worked on the project and participate in the interview. Does each member know what the others did? Did one member do all the work?
- Be professional and dress appropriately
- Do not under any circumstances discuss scores with persons or other Judges not involved in the project, teachers, parents or the learner
- Do not leave Assessment Forms lying around
- Do not ask questions or make deliberate statements that indicate that you do not know anything about the subject area
- Do not make negative statements such as: "your work is not good enough" or praise the learner in any way that creates expectations e.g. "your work is brilliant; your work is of university level"
- Make positive suggestions e.g. perhaps you should consider…. Have you thought of…..I would recommend the following upgrade etc.
- Thank the learner for sharing the research and wish them best for their future endeavours

A good judge is:

- a volunteer who is committed to the entire judging process
- professional
- a good team worker who values the opinion of his/her fellow Judges
- qualified to judge in a particular category either academically or vocationally
- is able to assess the learner in a way that is appropriate for his or her development age and not have unrealistic expectations
- interested in children and their view of the world
- sensitive, empathetic, understands children
- is a good listener and is even willing to learn from a child
- non-judgmental and unbiased/fair/impartial/objective rather than subjective
- good at communicating both verbally and non-verbally
- aware of the impact of the judging process especially the interview on the participant(s)
- able to find something good about every project even if it has been done many times before
- non-confrontational in his/her relationship with the learners and co-Judges
- is able to make the interview experience a positive one for every participant, fulfilling the aim of Expo which is to develop young scientists, inspire and instil a love of science